The purpose of this manual is to provide the design professional and Construction Manager with a general listing of design criteria from a technical, facilities perspective specifically to Broward College. The manual is divided into chapters (00-33), which reflect the Construction Specification Institute (CSI) 2014 Master Format. Chapters not applicable to construction design at the College have been omitted. It is not the intent of this manual to direct design or insist upon any proprietary products, but merely to serve as a basis of quality and standardization needs for the College. The design professional and Construction Manager are responsible for ensuring the items listed herein are incorporated into the project. Variances from the items listed herein should be coordinated with the BC Facilities Construction Project Manager and confirmed in writing.

The Conformance Statement shall be signed by the Architect / Engineer of record and provided with the construction document submittal to the Broward College Facilities Construction Project Manager. Any comments, suggestions for improvements in the content of this manual are encouraged and always appreciated. We hope this guide will be of assistance to you and your staff and look forward to a successful project to improve the quality of education at Broward College.

The Broward College Facilities Construction Project Manager (BCPM) is the designated single point of contact for administering a project and is considered the Owner’s Representative. All contact and direction to the Architect/Engineer Firm should be through this representative.

*Design contracts awarded after July 2015 shall comply with this document.*
COMFORMANCE STATEMENT

PROJECT NAME: ________________________________________________________________

BC PROJECT NUMBER: _________________________________________________________

I do hereby certify that I am the Architect / Engineer of record for the above indicated project and I have reviewed the Broward College design and construction guidelines and have incorporated the requirements of those guidelines into the construction documents unless indicated otherwise below.

Architectural / Engineering Firm: ________________________________________________

Architect / Engineer of Record: _________________________________________________

Design Deliverable Description ___________________________ Submittal Date ___________

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00 10 00  Solicitation

1. Broward College holds Architects/Engineers and Construction Managers continuing services agreements for construction projects from $0 - $2,000,000. These contracts are usually for a period of 3 years. Project specific solicitations will be issued for Architects/Engineers and Construction Managers for projects over $2,000,000.

2. Architects/Engineers are engaged in the projects once the projects are approved by the college and an initial program is prepared by Broward College Facilities Budget and Planning Department.

3. A preconstruction agreement may be issued to the CM @ Risk to participate during the plan review process and assist with estimating efforts.

4. Once plans have been reviewed and approved by the Building Official, the CM @ Risk will be able to solicit bids. Refer to Appendix 00 01 for purchasing bid limits.

5. The advertisement shall be submitted to the BCPM. The BCPM will submit the draft to the College Procurement Department for review and approval.

6. Any project with an estimated construction cost of $300,000 or more must be advertised for at least three weeks. Projects with an estimated construction cost of less than $300,000 can be advertised for one week.

7. The CM @ Risk is responsible to prepare bid packages, advertise, receive the bid package, evaluate the bids and submit a GMP based on the lowest most qualified and responsive bids. In the event the lowest bid is not the most qualified, the CM @ Risk must submit a justification.

8. The typical GMP submittal package shall include the following documents:
   a. Cover Page
   b. Proposal Letter
   c. Table of Contents
   d. Schedule of Values
   e. Scope of Work, assumptions and clarifications as required
   f. Bid tabulation, scope sheet comparisons along with copies of bids
   g. Evidence of competitive bidding for Self-performed work (copies of bids or letter of refusal)
   h. Advertisement for Bid (newspaper ad, electronic solicitation ad, etc.)
   i. Index of contract documents
   j. Project Schedule
   k. Construction Manager Insurance. Refer to Appendix 00 02 for insurance requirements.
   l. Subcontractors SDBE log
   m. Performance and Payment Bond letter of intent
9. The agreed upon list of subcontractors listed on the GMP shall not be changed without BCPM approval. List shall include contractor name, address, phone number and state license number.

10. Insurance requirements if vendor will be putting work in place on college property:
   
   a. Broward College must be named as an additional insured and Certificate Holder.

   b. The college address to be use in the certificate of insurance is:
      Broward College
      6400 NW 6 Way, 2nd Floor
      Fort Lauderdale, Florida 33309

   c. Coverage must be at least $1,000,000/$2,000,000 in regards to General Commercial Liability and $1,000,000 of Automobile Liability, including Workers Compensation pursuant to FL Statutory Limits.

11. No retainage is held on Preconstruction Purchase Order payments. A separate GMP Purchase Order will be issued to the CM @ Risk. No work shall begin without an executed agreement and Notice to Proceed letter. Refer to Appendix 00 02 for a Notice to Proceed sample letter.

12. BCPM must be invited to attend Bid Openings.
01 00 00 General Requirements for Design

1. Typical General Requirements may vary with the size and complexity of any given project. Coordinate items of inclusion with the BCPM.

2. All design and construction drawings shall be 24” x 36”. The architect shall produce a reduced set of construction drawings for use in the field scaled to half size. All details shall be clearly shown and accurately referenced on the construction drawings.

3. At the completion of the construction document phase, the design professional shall provide CAD drawing (.DWG format and .PDF) files to the Owner. All deliverable document sets are to be transmitted via .pdf files. Utilize .pdf software plug-into export from CAD software, such as Bluebeam Revu or similar to create searchable files. The file naming protocol is as follow:
   a. Broward College Project Number first (ie. 0000-C15-00.0)
   b. Project Description (Room number if applicable)
   c. Type of Asbuilt (Discipline and progress phase)
   d. Date
   e. Example: 1032-C15-0.2 Rm 234 Mechanical Asbuilt - Final 04-10-2015

4. A list of all codes referenced on the project shall be included on the drawings. Contact Authority Having Jurisdiction (AHJ) to confirm appropriate version is used for permitting.

5. Any projects over $300,000 will be submitted to FDOE for review and approval. The A/E, with assistance from the BCPM, will prepare the following forms: OEF 111B, 208A, 209, and 564. Refer to Appendix 01 08 for plan submittal requirements from the Florida Department of Education.

6. Each project shall include a site plan or at least partial site plan showing relative locations of existing buildings.

7. Field verify all topographic features, elevations, landscaping at project perimeter to ensure seamless tie-ins.

8. When designing a new building, the following shall be considered:
   a. Main building entrances shall be readily identifiable.
   b. Whenever possible, building orientation shall conserve energy and allow for natural light and ventilation.
   c. Provide identification and preservation of natural site feature.
   d. Vegetation buffers and areas to remain unclear shall be clearly noted on the drawing. The Contractor is required to protect these areas during construction.
   e. Provide an exterior building perimeter 2’ wide, 4” thick, sloped concrete landscape skirting around the building.
9. Broward College endorses and supports the Integrated Project Delivery (IPD) method and expects all design team members and construction team members to actively participate and work towards maintaining a positive relationship among all team members throughout the project duration.

10. Coordinate with the BCPM when developing design for the following systems: Security & Access Control (refer to Appendix 01 01), Audio Visual systems (refer to Appendix 01 02 and 01 09), Doors and Hardware (refer to Division 8).

11. The structural plans shall clearly show all floor drain locations and the extent/limits that the concrete slab requires pitching towards the drain (i.e. emergency showers, mechanical rooms, etc.). Coordinate drains locations to avoid conflict with doors or other possible tripping hazards.

12. All exterior walls shall be continuous to the underside of the roof deck assembly. Do not design soffits venting into an attic space above interior spaces. Above ceiling spaces shall be designed air tight to prevent outside air from entering ceiling space. Roof insulation shall be designed in the roof deck assembly and not placed on ceiling assemblies.

13. Parapet walls shall have roofing membrane installed as a complete system including coping. The coping shall be stainless steel or as required by roofing system.

14. All buildings shall have a roof building identification number. Refer to Appendix 01 03.

15. Metal roof systems or roofs that drain over the perimeter face of the building shall be designed with gutters and discharge into underground storm collection system, where applicable. Discuss and decide on a direction pertaining to this item with the BCPM.

16. EFIS wall systems shall not be specified for any building or structure.

17. The architect shall state in the contract documents all permits (i.e., Florida Building Code Permit, Water Management District, Site, utility, Right of Way Access, etc.) that are applicable to the project. All demolition projects require a demolition permit. All low voltage projects will also require a separate low voltage permit. Architect shall create and maintain a permit matrix for the project.

18. Post all permits in conspicuous location. The contractor shall coordinate all inspections required during construction. CM to send invite to BCPM for inspections. Invite to be sent via MS Outlook or similar digital calendar tool.
19. A/E to specify equipment based on the following:

   a. “Owner Furnished/CM Installed” - the Owner will provide the equipment. The CM will be responsible for relocating/receiving, installation, startup, testing and inspecting.

   b. “Owner Furnished/Owner Installed” - the Owner will provide and be responsible for relocating/receiving, installation, startup, testing and inspecting. CM shall coordinate any additional requirements needed to accommodate the equipment.

20. A building dedication plaque is required on new construction and major redevelopment projects. The top of sign shall be at 60” AFF. Refer to Appendix 01 04 for details.

21. All room numbering will be done by BC Planning and Capital Budget Department. If a project requires existing rooms to be re-numbered, the changes will need to be reflected on the electrical panels, fire alarm panel, intercom, energy management, security, local law enforcement, fire department, F.I.S.H., etc. and coordinated through the BC EMS group.

22. Designer to check and review the most recent Comprehensive Safety Inspection Report, Environmental Reports, Asbestos Reports, and ADA Survey for inclusion in project design.

23. New construction and renovation designs shall include a storage room for attic stock storage. Room shall be 120 NSF.

24. Provide Key Management System to include lockable key cabinet or cabinets on new facility construction and on major renovation projects. Provide space for every door and key tags. Coordinate with BCPM.

25. Identify all appliances required and include as part of the contract documents. Coordinate manufacturers/model numbers with BCPM.

26. Assure door openings and passageways are sufficient for replacement or moving of appliances and/or equipment.

27. Submittals - Provide at least three (3) product options for each item or approved equal. Products identified in this manual shall take precedence. Refer to Appendix 01 10 for digital submittal process guidelines.

28. Verify that all products that require Florida Product Approval are so approved before specifying and the NOA is listed.

29. An Equipment Information Form is to be completed on all equipment in the project. The form shall specify any equipment installed that will require scheduled service and maintenance. Refer to Appendix 01 05.
01 50 00  General Requirements for Construction

1. The contractor is expected to work in a safe manner. The utmost consideration to safety should be given while working around students and staff.

2. Barricades should be maintained where required while construction is occurring and checked regularly. Contractor is required to submit a safety barrier plan and/or maintenance of traffic plan when affecting pedestrians and/or traffic, to the BCPM and to the BC Building Department if required. A chain link fence 6 feet in height with windscreen will be required around all work sites.

3. Access to and from the construction area needs to be planned and agreed upon by all involved.

4. Subcontractors shall be required to attend a pre-construction meeting with the project management team before beginning their work. Refer to Appendix 01 06 for proposed agenda.

5. It is the CM’s responsibility to locate all private and public utilities prior to beginning of construction. Existing utilities damaged during construction will be the CM’s sole responsibility to repair.

6. Clean construction site and construction debris daily.

7. Interaction with students and staff without BCPM presence is prohibited.

8. The CM shall submit a comprehensive company safety plan with provisions specific to the project. The contractor, subcontractors and workers shall abide by the Broward College security procedures while on site.

9. The Architect shall require the CM to submit Material Safety Data Sheets (MSDS) for all hazardous products and make them available at the job site.
01 70 00  Close Out Requirements

1. CM Asbuilt site drawings to be submitted to the Owner shall be certified by a professional land surveyor and clearly show all as-built conditions, elevations and utilities. The final survey must be incorporated into the BC Master Plan. CM to coordinate with BCPM for surveyor vendor selection.

2. Architect to provide to CM updated record CAD drawings inclusive of all revisions to each sheet for the CM to prepare asbuilts. The contractor shall be required to submit a complete set of as-built drawings in Auto CAD (.DWG and .PDF format) in addition to the hard copy.

3. Broward College (BC) requires surveys to be performed from time to time to support the design of improvements at the colleges various campuses.

4. The surveyor must meet with BC Staff to determine the site limits, scope of work, and insight into the purpose of the survey. Field work, in most cases, will take place during normal operational hours, so consideration must be made to not disturb the students or faculty. The surveyor should consult with staff to coordinate access and gain any security clearances that may be needed, before scheduling field work.

5. All survey work shall meet the Florida Rules 5J-17.050 - Minimum Technical Standards for Surveying and Mapping, as well as the specifications set forth herein. Refer to Appendix 01 07 for survey requirements.
02 00 Existing Conditions

1. Architect / Engineer shall conduct an existing conditions survey/observation including above ceiling and applicable mechanical and electrical rooms. The survey shall be coordinated through the BCPM.

2. Architect & CM shall reference Owner's environmental reports prior to beginning of design/demolition activities. If hazardous materials are encountered during demolition, notify the BCPM immediately.

3. Where remediation procedures are required, contractor shall provide landfill records indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

4. The Design Professional shall invite BCPM to inspect existing inventory of equipment and components within area of work, and prepare a list of items to be removed, discarded, sold, relocated or stored. Broward College maintains right of first refusal.

5. Existing utilities indicated to remain in service shall be maintained and protected against damage during demolition or selective demolition operations. Allow for a timeframe (72 hours minimum) for notification prior to shut-downs or excavations that may affect existing infrastructure or operations.

6. Any areas damaged during demolition or selective demolition shall be repaired immediately using approved methods and materials. Restore to match prior existing conditions.

7. Contractor shall comply with governing EPA notification regulations before beginning demolition and with hauling and disposal regulations of authorities having jurisdiction.

02 40 00 Demolition

1. A pre-demolition conference shall be scheduled by the contractor 2 weeks prior to demolition activities.

2. Contractor shall provide to the BCPM a building demolition schedule for approval prior to the start of demolition.

3. Contractor shall submit pre-demolition photographs and/or video documenting all existing conditions before the work begins including roadway routes trucks will be utilizing.

4. When required by the College, contractor shall submit a logistics plan indicating areas to be protected during demolition.

5. Building demolition shall be conducted so that operations of adjacent occupied spaces will not be disrupted.

6. Confirm that LEED requirements for Building Reuse for the project have been met.
03 00 00  Concrete

1. A pre installation conference shall be conducted.

2. Mix Designs shall be submitted for each class of concrete or precast concrete by primary supplier. It is highly recommended to have secondary supplier’s mix designs approved in the event the primary supplier can’t accommodate the schedule.

3. The Design Professional shall identify materials and/or assemblies that need to be tested and indicate which testing agency is responsible for the testing. General Contractor shall retain services of independent third-party testing agency. Broward College reserves the right to retain services of testing agency for the project.

4. Testing Agency shall be an independent agency qualified in accordance to ASTM C 1077 and ASTM E 329 for testing indicated and other applicable agencies.

5. Shoring shop drawings and calculations shall be signed and sealed, and prepared by or under the supervision of a professional engineer registered in the state of Florida.

6. Where required, contractor shall provide documentation indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating cost for each product having recycled content for projects pursuing LEED certification.

03 30 00  Cast-in-Place Concrete

1. Steel reinforcing shop drawings shall include placing drawings.

2. Reinforcement fabrication shall be in compliance with CRSI’s Manual of Standard Practice.

3. Formwork shop drawings shall be prepared by or under the supervision of a professional engineer registered in the state of Florida.

4. Informational submittals shall include current welding certificates, material certificates and material test reports.

5. The Design Professional shall provide a floor flatness and levelness schedule based on structure type and finish material.

6. Where required, Contractor shall provide Product Data for liquid floor treatments and curing and sealing compounds documentation including printed statement of VOC content for projects pursuing LEED certification.
Division 03
Concrete

7. Where required, Contractor shall provide Product Data for each concrete mixture containing fly ash and/or slag as replacement for Portland cement or other Portland cement replacements, and for equivalent concrete mixtures that do not contain Portland cement replacements for projects pursuing LEED certification.

8. Design Professional shall indicate control joint pattern for all slabs-on-grade. For exposed concrete applications, joints need to be cleaned and filled with approved joint filler compound for specific application. Location of all expansion/control joints shall be shown on plans.

9. Waterstops shall be provided as follows:
   b. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstop.
   c. Flexible PVC Waterstops: CE CRD-C 572.

10. Provide polyolefin system sheet vapor retarders in compliance with ASTM D 4397, not less than 15 mils with taped joints. Provide complete system from single source. Documents to include all penetration details.

11. Coordinate curing compound with concrete finish requirements for compatibility.

12. Expansion and Isolation Joint Filler Strips shall comply with ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork. Confirm compatibility of sealant with expansion joint filler material. Joint shall be covered with an approved flexible sealant.

03 41 00 Precast Concrete

1. The project specifications and drawings shall include information regarding structural performance of precast structural concrete, including loading criteria and fire resistance rating. It shall also include finish type, profile and reveals.

2. Structural precast shop drawings shall include member locations, plans, elevations, dimensions, sections, openings, support conditions, reinforcement and fabrication and installation of precast structural concrete units, signed and sealed by the professional engineer registered in the state of Florida responsible for their preparation.

3. Delegated structural design calculations for precast structural concrete shall comply with performance requirements and design criteria, including analysis data, signed and sealed by the professional engineer registered in the state of Florida responsible for their preparation.
4. Informational submittals shall include qualification data for installer, fabricator and testing agency, welding certificates, material certificates, material test reports, source quality control reports and field quality control reports.

5. Fabricator qualifications shall require a firm experienced in the type of precast structural concrete in the project. In addition, fabricator's participation in PCI's Plant Certification and Erectors Certification programs will be required.

6. Welding qualifications shall include qualification of procedures and personnel in accordance to AWS D1.1, "Structural Welding Code - Steel" and AWS D1.4, "Structural Welding Code - Reinforcing Steel". The Design Professional shall specify criteria for visually inspected and/or tested welding connections, frequency and type of tests.

7. Comply with the latest and/or adopted edition of ACI and PCI publications.

8. Concrete, admixtures, grout and steel reinforcement shall comply with ASTM standards.

9. Architect/Engineer to specify mock up sample to demonstrate reveals, surface finishes, texture, color and standard workmanship.

03 47 13 Tilt-Up Concrete

1. Tilt-up concrete shop drawings shall include panel locations, plans, elevations, dimensions, shapes, reveals, cross sections, reinforcing, details of steel embedments, MEP embedded items, additional steel reinforcement to resist hoisting and erection stresses, location and details of hoisting points and lifting devices, and fabrication and installation of tilt-up concrete units. It shall also include finish type, profile and reveals.

2. Shop drawings and/or calculations for the lifting, erection and temporary bracing of the panels, signed and sealed by the Professional Engineer registered in the State of Florida responsible for their preparation shall be required.

3. Informational submittals shall include qualification data for installer, manufacturer and testing agency, welding certificates, material certificates, material test reports and field quality control reports.

4. Manufacturer qualifications shall require a firm experienced in the type of tilt-up concrete in the project is required. In addition, confirm that certification according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" is also required.

5. Installer qualifications shall include providing a qualified installer who employs a supervisor on Project who is an ACI-certified Tilt-up Supervisor.

6. Mockups are required and shall include casting and erecting tilt-up concrete panel to demonstrate typical reveals, surface finishes, texture, color and standard workmanship.
03 52 16 Lightweight Insulating Concrete

1. The Design Professional shall indicate Design Mixtures required for each lightweight insulating concrete mix and testing schedule.

2. Provide an average insulation value of R-20 minimum and/ or more as required to meet the project's energy performance goals.

3. Material thickness shall be coordinated with roof drains, curbs and parapets.

4. Material thickness shall be accounted for in the structural design.
04 00 00 Masonry

04 20 00 Unit Masonry

1. Contractor shall submit samples for verification for each type and color of exposed masonry units and colored mortars.

2. Informational submittals shall include material certificates for each type and size of product.

3. Contractor shall provide submittal of design mixes for each type of mortar and for grout.

4. Contractor shall provide building sample panel mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects.

5. Broward College requires blocks to be saw-cut only. Architect/Engineer to indicate in the project's specifications.

6. Do not use defective units (chips, cracks, etc.).

7. Exterior face of CMU cavity walls shall be fully coated with appropriate barrier to prevent moisture and water intrusion. Architect to provide complete specification.

8. Bituminous damp-proofing shall be specified as a troweled, rolled or sprayed-on application. If a sprayed-on application is considered acceptable, it shall be specified to be applied in no less than three separate coats per approved manufacturer’s recommendations and verified to the Owner’s satisfaction. Specify mill thickness in addition to number of coats (tolerances).

9. All exterior brick support angles where the underside of the angle is exposed (i.e., lintels, windows, etc.) shall be specified to be hot dipped galvanized or stainless steel.

10. All control/expansion joints shall be shown on the plans. Architect to show brick joints and engineer to show CMU joints. Engineer to provide all locations for control joints and expansion joints on approved documents.

11. Through-wall flashing systems shall be detailed on the drawings.

12. Split-face block shall be used as veneer only, not solid unit load bearing walls.
04 21 13  Brick Masonry: Face Brick

1. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.
   a. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished. On Drawings, show details of special conditions and special shapes required.
   b. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
   c. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
   d. For consistency, use face of brick. Saw cut is needed. Avoid turning and using end of brick to eliminate color variations (zipper effect).

2. Provide Facing brick complying with ASTM C 216, Grade SW, Type FBX or HBX Subject to the College’s Approval.
   a. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
   b. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated “not effloresced.”
   c. Surface Coating: Brick with colors or textures produced by application of coatings will not be allowed.
   d. Color and Texture: Size and color of Brick shall be coordinated with adjacent buildings and Campus standards. Where shown to “match existing,” provide face brick matching color range, texture, and size of existing adjacent brickwork.
   e. A stand-alone 5’ x 5’ minimum Mock up shall be provided from a mixed sample of bricks.

3. Plastic/vinyl weep with cotton wick and stainless steel insect screen shall be used.

4. Only brick manufacturer’s approved cleaning chemical shall be used. Specify final cleaning to be performed at completion of construction.
05 00 00  Metals

05 00 50  General Metals

1. Pre installation conference shall be conducted for all structural steel and joist framing installations.

2. Contractor shall submit documentation indicating percentages by weight of postconsumer and pre-consumer recycled content for products having recycled content, Include statement indicating cost for each product having recycled content for projects pursuing LEED certification.

05 12 00  Structural Steel Framing

1. Steel members exposed to the exterior and weather shall be specified as receiving hot-dipped galvanized G-90 min. coatings.

2. Contractor shall be responsible for scheduling all weld testing per plans/specs and manufacturer’s recommendations.

05 21 00  Steel Joist Framing

1. Where primer is required, it shall be shop applied. Joists that are permanently exposed to view shall be specified to be painted.

05 40 00  Cold-Formed Metal Framing

1. Cold-formed metal framing shop drawings shall include layout, spacings, sizes, thicknesses and type of cold-formed steel framing; fabrication; fastening and anchorage details, including mechanical fasteners; reinforcing channels; opening framing; strapping, bracing, bridging, splices, accessories, connection details and attachment to adjoining work.

2. Cold-formed metal framing calculations for all exterior applications that are subject to dead, live and/or wind loads, shall be signed and sealed by the Florida registered Professional Engineer responsible for their preparation and following the design criteria indicated in the structural drawings.

3. Contractor shall submit product data for each type of cold-formed steel framing product and accessory required for installation.

4. Informational submittals shall include welding certificates, product test reports, and research reports.
5. Miscellaneous materials shall be in compliance with the following:

   a. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.
   b. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404.
   d. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
   e. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom of exterior track or rim track members.

6. Provide two beads of acoustical sealant under bottom tracks of interior sound partition walls.
06 00 00  Wood, Plastics, Composites

06 00 50  General Material and Finish Standards

1. Low Emitting Materials: As general practice, composite wood and agrifiber products used on the interior of the building (defined as inside of the weatherproofing system) shall contain no added urea-formaldehyde resins and that laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins. Composite wood and agrifiber products include: plywood, panel substrates and door cores.

2. Wood sourcing shall conform to Florida Statute 255.20; Specification of State-produced lumber.

06 10 53  Miscellaneous Rough Carpentry

1. Provide only pressure treated material for all lumber in contact with concrete, masonry, the ground, or water. Verify that the types of treatment that are acceptable for each type of exposure and the retention level of preservative been specified.

2. The Design Professional shall indicate the type and treatment of fasteners in contact with pressure treated lumber.

3. Plywood backing panels shall be installed on all walls in the telephone/communications/data rooms and closets.

4. Backing for accessories shall be solid lumber when applicable.

06 40 23  Interior Architectural Woodwork

1. All interior architectural woodwork to be "Custom" grade in accordance with latest edition of the AWI "Quality Standards", unless higher grade is specifically required by the College. All joints shall be glued under pressure and nailed. Use of staples is not acceptable.

2. Body core members, countertops, backs, drawers and pigeonhole partitions to be exterior grade plywood, minimum 7-ply, conforming to PS 1-83, bearing APA grade mark of A-B or better. The use of MDF is not permitted.

3. Provide Grade 1 hardwood, kiln-dried to minimum of 12% moisture content at fabrication.

4. Drawer's joints to be locked shoulder (dovetail), glued under pressure and nailed.
5. Plastic laminate shall be in compliance with NEMA Standard LD3-1980, in thicknesses as follows:
   a. Exposed exterior vertical: 0.030 inch
   b. Exposed interior surfaces (including backs of doors): 0.020 inch
   c. Toe space base (black): 0.030 inch
   d. Countertop horizontal surfaces and edges: 0.050 inch
   e. Backsplash vertical surfaces and edges: 0.050 inch
   f. Drawer fronts: 0.050 inch

6. Hinges for 3/4-inch thick doors shall be brushed chrome-plated steel, five knuckle 0.088 gage, wraparound type allowing 270 degree swing at end of casework unit mounted with a minimum four (4) plated #8 self-tapping screws per hinge leaf.

7. Surface-mounted type pulls shall be in US26D (satin chrome) finish, by Stanley, EPCO, or equivalent.

8. Door catches to be provided as follows:
   a. For doors up to and including 38-inches, provide one heavy-duty magnetic type catch, slotted for adjustment.
   b. For doors over 38-inches, provide two (2) heavy-duty magnetic type catches.

9. Shelf supports to be provided as follows:
   a. End supported standards, KV #255 Steel, Knape & Vogt or equivalent, secured with No.5 flat-head screws. Where chemicals will be stored, provide aluminum standards.
   b. End support clips, zinc-plated, KV #256ZC, Knape & Vogt or equivalent.

10. Fabrication requirements: Conform to AWI (full overlay design) unless specifically directed otherwise by the College.

11. Base Cabinets: Backs, 1/4-inch thick plywood, plastic laminate finish. Sides, finished exposed end panels to cabinet assemblies in field consisting of an applied 3/4-inch thick end panel with high pressure plastic laminating, finish as follows:
    a. Interior Behind Doors: Plastic laminate
    b. Exposed Exterior End, Front Faces and Interiors: Plastic Laminate
    c. Unexposed Exterior End: Phenolic overlay applied with 200 psi at 200 degrees F or plastic laminate with backing.

12. Omit dust covers.
13. Bases: Provide each base cabinet with its own unit base, factory applied.

14. Countertops, Backsplashes, and End Splashes: Plywood, minimum 3/4-inch thick construction, finished with solid surface material; Corian or equal. Provide 4” min. backsplash and end splashes.

15. Restroom sink countertops: provide sloped removable plastic laminate panels under countertops typical.

16. Open Wall Cabinets: Construction similar to base cabinets, all exposed surfaces finished with plastic laminate. Recessed tops and bottoms are not acceptable.

17. Provide 3/4-inch thick plywood with plastic laminate finish on both faces, swing hinged, full overlap type for both base cabinets and wall cabinets.

18. Installation requirements: Coordinate, locate and install wall structure reinforcement, wood grounds and back bracings in wall construction prior to installation of casework items. Attach countertops securely to base units. Spline and glue joints in countertops. Provide concealed mechanical clamping of joints.

19. Rough-in requirements: Provide holes in casework for plumbing and electrical work using templates furnished by suppliers of plumbing fixtures and electrical devices. Unnecessary oversize cut opening or sloppy opening will not be acceptable. Escutcheon plates shall be used when penetration is exposed to view.
07 00 50 General Standards

1. The following conditions shall be specified to prevent issues due to mold growth in renovation and new construction projects:

   a. New construction and/or renovation: Prevent water intrusion into the building (including dew point/condensation conditions) during construction.

   b. Should water intrusion occur, the contractor shall take steps to immediately remove water, including dehumidification of the atmosphere as required to dry out the building, prevent entrapment of moisture with construction materials, and all other components of construction.

   c. Dehumidification through the use of building HVAC systems require the use of adequate filters to prevent distribution of construction dust, etc., in air handling and duct systems.

   d. If water intrusion occurs, all efforts shall be done to dry out affected material and material shall be removed immediately. Inspections shall be made on a continual basis to ensure no mold growth or conditions for mold growth exists, including, drywall, wall cavities or concealed areas affected by moisture. If mold is observed, the contractor shall be responsible to utilize consultant services to address the process and procedure for removing mold by treatment and/or material removal.

   e. Sequence of construction installations shall be coordinated in such a way that the building is weather tight and acclimated per manufacturer’s requirements for finish products installation.

2. All new, repair, and replacement roofing projects shall have plans and specifications developed by a registered architect. Plans and specifications are subject to BC Facilities Construction Project Manager and Roofing Consultant approval.

3. General: Rooftop MEP Systems are to be minimized to the greatest extent practicable. Where unavoidable, provide code required clearances from surface of roofing system for proper maintenance and drainage of roof. Accommodate MEP systems with prefabricated curbs, carriers, and penetration seals.

   a. Roof Penetrations: Provide factory fabricated roof penetration seals and equipment supports to all roof penetrations.

   b. Pitch pans will not be permitted.

   c. Pre-manufactured boots and sleeves shall be used.

   d. When the placement of MEP equipment on the roof is unavoidable, support with pre-engineered equipment supports or round pipe supports fabricated of aluminum, stainless or hot-dipped galvanized steel (G-90).
4. Product Test Reports shall be required for roof materials, indicating that roof materials comply with Solar Reflectance Index requirement for projects pursuing LEED certification.

5. The following roof drainage requirements shall be met: Provide roof system with a minimum positive slope to drain of 1/4-inch per linear foot. Roof drains are to be positioned at low points in the roofing system (not over columns). For new construction, drains are to be connected to storm drainage leaders located adjacent to perimeter building walls. Drains are to be a minimum 24” away from vertical walls and are to be sumped into roof.

6. Crickets and saddles shall be provided between drains and on the up-slope side of equipment penetrations as per NRCA and FBC.

7. Maintenance access requirements: Provide roof walks at logical access ways to protect roofing system from maintenance traffic. Provide OSHA compliant roof access for maintenance personnel. Whenever possible, a stairwell shall be extended to the roof level and an access door 3’ x 7’ shall be provided. Provide exterior rain guard, overhang and upturned curb threshold support for door weather protection. Provide OSHA compliant signage for fall protection on door.

8. All buildings shall have a roof building identification number. Refer to Appendix 01 03.

9. Provide roofing manufacturers standard heavy duty walking pads to all mechanical equipment.

10. Unless required by Structural Engineer, all supports and penetrations shall be round pipe. Square pipe, angles or unistrut through roofing system is not permitted.

11. Specification of OSHA roof tie downs shall only be used if no other options are available. The College prefers not to install tie downs since they require annual certifications and testing.

07 11 00 Waterproofing

1. Vapor barrier system under all building slab on grade. Minimum 15 mill. Poly membrane with 3” overlap and all taped sealed seams as specified by the manufacturer.

2. Waterproofing shall be required on the soil side at below grade conditions. Where hydrostatic pressure is likely, sheet membrane waterproofing or "Bentonite" or equal shall be employed. Required at all elevator pits.

3. Provide a seamless continuous positively bonded elastomeric waterproof membrane at “between slab” on plaza decks, parking decks, or at planters primarily on concrete and masonry surfaces.

4. Wet walls shall utilize a waterproofing membrane compatible with the finish product to be installed over it. Showers shall utilize a waterproofing membrane on floors and full height of walls. Provide complete system with valves, sleeves and accessories.

5. All waterproofing membrane systems shall include a minimum 10 year warranty.
07 18 00 Traffic Coatings

1. Material compatibility shall be required so that primers; base-, intermediate-, and topcoat; and accessory materials are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience. Indicate sourcing limitations for traffic coatings and pavement markings from single source from single manufacturer respectively or be compatible.

2. Preferred Roofing Systems:
   a. Single Ply Membrane Flexible Sheet Roofing
      1) Twenty (20) year labor / material warranty
      2) Basis of design shall be Fibertite or equal.
   b. Modified Bitumen (SBS) Roofing
      1) Twenty (20) year total roof system NDL warranty inclusive of roofing materials from roof deck to finish membrane shall be provided and will begin after project substantial completion. Provide non-deductible roofing warranty inclusive of all material and labor.
   c. Metal Roofing
      1) Metal roof system shall be installed with no less than 2 and 12 slope, with continuous panel run from ridge to edge installed over a solid deck design with a peel and stick membrane, i.e., Ice and Water Shield or equal.
      2) Twenty (20) year leak free system warranty.
      3) Metal roof panels shall not be roll formed on the job site unless approved by the BCPM. Metal roof panels shall be roll formed in the manufacturer’s permanent factory and transported to the job site.
      4) All roof curbs shall be provided and installed by the roof system manufacturer and be designed for that specific roof system.
      5) All lighting arrestor system parts shall be secured to the metal roofing standing seams with anchor clips acceptable to or provided by the roofing manufacturer. Do not “glue” anchors to the metal roof. Penetrations shall be kept to a minimum.

3. Flashing and Sheet Metal
   a. Aluminum: ASTM b 209-90, Alloy 3003, Tempe H14 AA-C22A41 baked on enamel finish 0.040” thick, at edge detail and 0.050” at coping.
   b. Stainless Steel: ASTM A 167-91 Type 304, soft temper 24 gauge thick, smooth 2B finish if not painted.
   c. Manufacturer’s laminated metal 24-gauge stainless steel for all flashing areas on single ply roofs.
   d. All metal flashing shall meet current SMACKNA guidelines.
   e. Metal decking scheduled to receive light weight concrete shall be designed G90.

4. Coping shall be aluminum, copper or stainless steel and mechanically fastened to the structure.
5. Maintenance/walkway pads shall be specified around all sides of HVAC equipment on single ply and modified bitumen capped asphalt built-up roofs. (Contrasting color suggested).

6. Sprayed on waterproofing for masonry restoration shall be water based only unless prior written approval by BCPM.

7. Provide roof access hatches and ladders to high roof areas, example: auditorium roofs, gymnasium roofs, cafeteria roofs and multistory classroom roofs.

8. The General Contractor shall:
   a. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of traffic-coating work.
   b. Verify that substrates are visibly dry and free of moisture.
   c. Proceed with installation only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

9. Substrates shall be cleaned and prepared according to ASTM C 1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application, before applying traffic coatings. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.

10. Traffic coating shall be applied according to ASTM C 1127 and manufacturer's written instructions.

11. Vehicular pavement-marking paint is to be applied with mechanical equipment to produce markings of dimensions indicated with uniform straight edges.

**07 25 00 Weather Barriers**

1. Ensure a continuous seal is formed by a vapor and air barrier for each building enclosure.

2. Where masonry veneers are used, a water proofing barrier over substrate is required.

4. Roof Hatches:
   a. Fabricate with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counter flashing.
   b. Weld or mechanically fasten and seal corner joints.
   c. Provide continuous weather tight perimeter gasketing and equip with corrosion-resistant.
   d. Provide integral telescoping ladders when a fixed wall mounted ladder can’t be provided. Where a wall mounted fixed ladder is installed, provide a vertical safety post (Bilco ladder up or equal).
   e. Provide aluminum roof hatch units minimum size 36”x36” as manufactured by Bilco Company, "Model S20", or equivalent.
   f. Hatch shall be located over unconditioned space and installed minimum of 15’ away from away from roof edge to avoid code required guard rails. Hatch shall be provided with access control tie in.
07 92 00 Joint Sealants

1. Acceptable manufacturers include Sonobourne, Dow, Tremco or equal.

2. Sealant color, where applicable, shall match color of adjacent surface(s), typical.

3. Urethane sealants with minimum 10 year warranty will be accepted. Silicon sealants with minimum 20 year warranty will be accepted.

4. Field pull test shall be mandatory on all sealants by certified agent.

07 95 00 Expansion Control

1. All exterior sealants shall be adequate for UV exposure.

2. Contract documents to indicate joint type, location, dimensions and sealant to be used. All interior and exterior joints shall receive sealant, including sidewalks.

3. All floor to floor systems shall be recess mounted, mechanically anchored, Class II, clear anodized aluminum metal, heavy duty traffic and/or pedestrian rated as required with dual durometer gaskets with a flat profile, free of ridges/reveals that collect dirt.

4. Coordinate recess block outs for expansion joints and adjacent finishes for a continuous floor surface.
08 00 00  Openings

08 00 50  General Standards

1. All exterior openings shall be provided and installed as a system or assembly and are required to meet or exceed requirements of the Florida Building Code (latest edition), including the high-velocity hurricane zone requirements, for wind and impact resistance of components and cladding. Exterior products shall be designed and tested to be impact-resistant as a system in accordance with the Florida Building Code and provide Product Approval.

2. All exterior entry doors shall be insulated and recessed the width of the door or provided with an exterior overhang for weather protection.

3. Doors to group toilets shall be equipped with ADA operators. Avoid doors in series at restrooms and configure floor plan to avoid sight lines into restrooms.

4. A minimum door leaf size of 3'-0" x 7'-0" shall be specified for both interior and exterior doors. Standard door height is 7'-0" (6'-8" door height is not permitted in new construction projects).

5. Where large furniture, fixtures and equipment are included in the project, or may be required in the future, doors (both exterior and interior) shall be sized to allow for moving the items in and out.

6. At least one main entry door shall have an operator including the proper signage. All doors must comply with ADA/Florida Building Code requirements for size, opening/closing force, time delay on closer-equipped doors, etc.

7. All mechanical, IT, Communications and elevator machine rooms shall have insulated hollow metal doors.

8. All janitor closet doors shall swing out and shall be protected with a non-metallic impact protection panel at bottom 42" of door (interior side).

9. Wall louvers shall be provided in lieu of exterior louvered HM doors whenever possible.

10. Door closings shall have parallel arms. Perpendicular arms shall not be used.
11. Provide door vision panel lites at the following locations and any other regularly occupied space unless indicated otherwise by Broward College:
   a. classrooms
   b. labs
   c. offices
   d. corridors
   e. interior stair access

08 11 13 Hollow Metal Doors and Frames

1. Door openings shall have a drip guard accessory and doors shall have a sealed top cap to prevent water from accumulating in door. Specify full gasketing and threshold install in full bed of sealant. SDI Standard steel doors level 3 – Model 1 (Heavy duty – full flush).

2. Fabrication of hardware reinforcement plates shall be from same material as door face sheets to comply with the following minimum sizes:
   a. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
   b. Closers, and Concealed Holders: Minimum 0.067 inch thick.
   c. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick

3. Provide Standard Steel Frames in compliance with ANSI A250.11, and in accordance with Door and Hardware Institute (DHI) publication “Installation Guide for Doors and Hardware”.
   a. Exterior HM to be at least 14 gauge hot-dipped galvanized, G60 typical. All exterior HM frames shall be grouted.
   b. Interior HM frames to be at least 16 gauge galvanized.

4. All hollow metal doors and frames shall comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish standard steel door and frames after assembly.

5. Field-painted doors and frames shall be shop primed. Shop Primer: Manufacturer's standard, one coat of baked-on rust inhibiting prime paint in accordance with ANSI A 224.1; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.


7. Wrap around frames are required at service area (Maintenance, cafeterias, etc.).

8. Provide continuous sound insulation at the inside of all interior steel doors and frames or foam.
08 14 16  Flush Wood Doors

1. Contractor shall submit chain-of-custody certificates indicating that flush wood doors comply with F.S.C. requirements and further indicate cost for each certified wood product as applicable for projects pursuing LEED certification. Stain color to be confirmed with owner.

2. Contractor shall submit product data for adhesives and composite wood products documentation indicating that product contains no urea formaldehyde for projects pursuing LEED certification.

3. Provide factory finished birch quartered slice, slip matched, Grade A veneered-faced doors with lumber core assemblies with lifetime warranty (for interior use only). Stain color to be confirmed with owner. Particleboard cores are not permitted. Doors to be insulated or meet specified STC values of the room.

4. Fire-Rated Door Frame Assemblies shall comply with NFPA 80 and shall be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

5. Doors and Windows

   a. For aluminum windows, all extrusions shall be 0.125” minimum thickness with stainless steel hardware fasteners. Screens shall be included and specified as aluminum.

   b. Architect shall specify Aluminum storefronts for main entries.

   c. Acceptable Hardware Manufacturers:

      | PRODUCT                                      | ACCEPTABLE MANUFACTURER | ACCEPTABLE SUBSTITUTE |
      |----------------------------------------------|-------------------------|----------------------|
      | Butt Hinges                                  | Stanley                 | Hager                |
      | Locksets, Latch sets                         | Schlage Lock Co.        | None                 |
      | Privacy sets, Deadlocks, Cylinders, Keys, Keying Exit Devices | Von Duprin              | None                 |
      | Door Closers                                 | LCN                     | None                 |
      | Overhead Stops & Holders, Magnetic Holders   | Rixon-Firemark          | Glynn-Johnson        |
      | Push Plates, Pull Plates, Kick plates, Wall Bumpers, Floor Stop & Holders | Rockwood Mfg. Ives     | Quality, Brookline   |
      | Threshold, Weather Strip, Transom Astragal, Sound Seal, Light Seal, Automatic Door Bottoms | Pemko Mfg.             | Zero, Reese, Guard   |
d. Locksets for interior and exterior doors shall be D-series with Primus interchangeable core. Locksets to be coordinated with building access control.

e. Double doors with panic hardware use 99 or 98 series with removable mullion (keyed).

f. All panic hardware use 99 or 98 series

g. Steel doors shall comply with the Steel Door Institute (SDI).

h. Steel door frames shall be 18-gauge interior and 16 gauge galvanized exterior with mitered continuous weld at corners. All door and window frames set in masonry shall have the interior field coated before installation with a brushed applied bituminous coating and grouted solid during installation. Frames set in CMU masonry construction shall have 4” heads. (New work: tie frames to block-work rather than bolting.)

i. Interior door shall be specified as wood veneer, solid staved core conforming to NWMA with a minimum style width of 2”. Closure hardware shall be fastened with through bolts and finish washers. The top and bottom of wood doors shall be coated at the jobsite after hanging with clear varnish to seal the exposed wood. This shall be required even if doors are “Factory Sealed”.

j. Exposed vertical riser bars on doors with panic devices shall be specified as stainless steel with stainless steel vertical rod guards. Aluminum shall not be specified or accepted.

k. Backing for hinges on metal doors should be at least 3/16” steel (continuous hinges acceptable).

l. Door butts shall be stainless steel with non-removable pins, provide ball bearing butts at all doors with closers.

m. Provide stainless steel kick plates on doors minimum 10” x full width of door.
08 31 13 Access Doors and Frames


2. Provide Flush Access Doors and Trimless Frames: Fabricated from steel metallic-coated steel sheet at Gypsum board wall and ceiling surfaces with spring-loaded concealed pin type hinges and screw driver or pinned-hex access operated cam latch. Size as appropriate to meet accessibility requirements of device.

3. Provide stainless steel access doors at bathrooms, custodial closets and finish tiled surfaces.

08 33 23 Overhead Coiling Doors

1. Exterior aluminum Kynar finished overhead coiling doors to withstand design wind load with current NOA without evidencing permanent deformation or disengagement of door components. Large manufacturer sticker not allowed.

2. Provide Fire Rated Stainless-Steel Door Curtain Slats at food service locations: ASTM A 666, Type 304; sheet thickness of 0.025 inch (0.64 mm).

3. Provide Endlocks and Windlocks for Service Doors to have safety switch along bottom of door and gasketing to prevent water intrusion.

08 33 26 Overhead Coiling Grilles

1. Provide Open-Curtain Grilles for open areas that require security. Manual or motorized door operation as confirmed by Broward College.
   a. Aluminum Grille Curtain: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2. Provide bottom bar finished to match grille with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

3. Provide concealed installation of overhead coiling grilles at all interior/occupied spaces.
   a. Where a concealed condition is not possible, provide aluminum hood 0.040-inch-(1.02-mm-) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M).
08 41 13 Aluminum Framed Entrances and Storefronts

1. Provide heavy-duty commercial systems for interior and exterior applications as follows:
   a. Doors/ Entrances: Provide manufacturer’s standard designs. Custom designs permitted only approved by Broward College.
   b. Finish: Provide manufacturer’s standard anodized finish colors for Broward College approval.

2. Sill flashing shall be provided as part of storefront system.

3. Contractor shall submit Product Data for adhesives and sealants used inside of the weatherproofing system, including printed statement of VOC content for projects pursuing LEED certification.

4. Contractor shall submit documentation indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content for projects pursuing LEED certification.

5. Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.

6. Provide Special Finish Warranty: shall be Manufacturer’s standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty Period: 10 years from date of Substantial Completion.

08 44 23 Glazed Aluminum Curtain Walls

1. The structural framing system shall be coordinated with Product Approval (NOA) allowable clear spans to accommodate curtain wall system.

2. All miscellaneous steel connections for curtain wall system shall be coordinated with the building’s structural system.

3. Curtain-wall systems shall maintain an average U-factor of not more than 0.66 Btu/sq. ft. x h x deg F when tested according to AAMA 1503, or as required to meet energy efficiency project requirements.

4. Provide manufacturer’s standard colors of anodized finish system for Broward College approval.
5. Installer Qualifications: shall be capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer. Engineering Responsibility: Preparation of data for structural-sealant-glazed curtain-wall systems including the following:
   a. Shop Drawings, Project-specific preconstruction-testing program development, and comprehensive engineering analysis by a qualified professional engineer.
   b. Quality-control program development and reporting complying with ASTM C 1401 recommendations including, but not limited to, system material qualification procedures, preconstruction sealant-testing program, and procedures and intervals for system fabrication and installation reviews and checks.

6. Qualifying procedures and personnel shall be according to AWS D1.2, "Structural Welding Code-Aluminum."

7. Structural-Sealant Glazing shall be provided in compliance with recommendations in ASTM C 1401, "Guide for Structural Sealant Glazing."

08 62 00 Skylights

1. Skylights are not permitted without prior Owner’s approval. The use of clerestories is preferred.

08 71 00 Finish Hardware

1. Coordinate Finish Hardware requirements for each room with BC PM and BC Locksmith

2. Provide each kind of hardware from one hardware supplier (DHI Certified Architectural Hardware Consultant) to the greatest extent possible.

3. All card reader access door locations shall be coordinated with Broward College Access Control Manager and all applicable frames shall be identified for preparation.

4. Provide hardware that conforms to published templates generally prepared for machine screw installation.

5. Contractor shall provide a covered and dry secure lock-up for all hardware items delivered to the project for storage until installation has been completed. Protect installed hardware through Substantial Completion and issuance of Certificate of Occupancy.

6. Supplementary marking on door: Provide UL label indicating Fire Door to be equipped with fire exit hardware and provide UL label on exit device indicating “Fire Exit Hardware” where panic exit devices are required on fire-rated doors.

7. Overhead door closers shall be warranted in writing by the manufacturer against failure due to defective materials and workmanship for a period of ten (10) years commencing on the Date of Final Completion and Acceptance, and in the event of failure, the manufacture is to promptly repair or replace the defective with no additional cost to the Owner.
8. Acceptable Manufacturers:

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>SPECIFIED MANUFACTURER</th>
<th>ACCEPTABLE SUBSTITUTE</th>
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<tbody>
<tr>
<td>1) Hinges</td>
<td>Ives</td>
<td>Hager, Stanley, Bommer</td>
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<tr>
<td>2) Locks &amp; Latches</td>
<td>Schlage</td>
<td>None or equal with BC Locksmith approval</td>
</tr>
<tr>
<td>3) Cylinders, Keys, Keying</td>
<td>Schlage Primus</td>
<td>None or equal with BC Locksmith approval</td>
</tr>
<tr>
<td>4) Exit Devices</td>
<td>Von Duprin</td>
<td>None or equal with BC Locksmith approval</td>
</tr>
<tr>
<td>5) Door Closers</td>
<td>LCN – installed parallel to door</td>
<td>None or equal with BC Locksmith approval</td>
</tr>
<tr>
<td>6) OH Stops/ Holders</td>
<td>Glynn Johnson</td>
<td>Rixson</td>
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<tr>
<td>7) Magnetic Hold Opens</td>
<td>LCN</td>
<td>Dor-O-Matic</td>
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<tr>
<td>8) Wall Stops/Floor Stops, Flushbolts</td>
<td>Ives</td>
<td>Glynn Johnson, Trimco</td>
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<tr>
<td>9) Kick Plates</td>
<td>Ives</td>
<td>Trimco, Quality</td>
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<tr>
<td>10) Threshold/Weather-strip</td>
<td>National Guard</td>
<td>Reese, Zero</td>
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<tr>
<td>11) Silencers</td>
<td>Ives</td>
<td>Glynn Johnson, Trimco</td>
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<tr>
<td>12) Key Cabinet</td>
<td>Lund</td>
<td>Key Control</td>
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</tbody>
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9. Hardware finishes:
   Exterior Hinges and rooms that may contain moisture or chemicals (A/C, custodial, bathrooms, kitchens, science labs, storage, etc.) to be Stainless Steel (32D), Interior Hinges to be Satin Chrome (26D). Door Closers to be Aluminum. Locks to be Satin Chrome (26D), Exit Devices to be Satin Chrome (26D). Overhead Holders to be Satin Chrome (26D), Flat Goods to be Satin Chrome (26D) or Stainless Steel (32D) and the Thresholds to be Mill Finish Aluminum.

10. Hinges and pivots:
   a. Exterior hinges on all out swinging doors shall be ball bearing type furnished with non-removable pins (NRP).
   b. Interior butts shall be as listed.
   c. Doors 5’ or less in height shall have two (2) butts. Furnish one (1) additional butt for each 2’6” in height or fraction thereof.
   d. Dutch Doors: Provide two (2) hinges per leaf.
11. Keying requirements:
   a. All locks and cylinders shall be 11 Pin Schlage Primus key system (level 9) Everest 29 Primus-keyway, all bittings shall be issued by Schlage Lock through the College’s locksmith.
   b. Lock cylinders for all projects shall be keyed into the Campus’ existing grandmaster key system. Contact the college locksmith for additional information.
   c. Provide Two (2) each change keys per lock and Six (6) each grand master and master keys. All keys to be patent restricted.
   d. For each new construction or renovation project provide 200 Everest 29 Primus key blanks.
   e. All keys to be Primus originals.

12. All exterior (non-entry doors) shall be provided with a drip guard. Provide Pempko or equal.

13. Locksets requirements:
   a. Locksets shall be Heavy Duty ANSI Grade 1 – “D” Series (4000) Commercial Grade 1 Cylindrical type with large format interchangeable cores, unless specified otherwise, in “ND” series, Vandlgard, Rhodes design or “L” series 06A design as manufactured by Schlage at exterior doors.
   b. Where required by the College provide programmable units; “AD” series, as manufactured by Schlage or “MiFare Readers”. Units shall have the capability of being networked with other electronic locks or operate in a stand-alone mode of operation to be reviewed by the College Access Control Personnel.

14. Exit devices requirements:
   a. All devices shall be Von Duprin 98 Series ANSI Grade 1 in types and functions specified. All devices must be listed under “Panic Hardware” in accident equipment list of Underwriters Laboratories. All labeled doors with “Fire Exit Hardware” must have labels attached and be in strict accordance with Underwriters Laboratories.
   b. All exit devices shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 1,000,000 cycles must be provided.
   c. All surface strikes shall be roller type and come complete with a plate underneath to prevent movement and shall be provided with a dead-latching feature to prevent latchbolt tampering.
   d. Provide exit devices with large format interchangeable core cylinders.
15. Door Closer requirements:
   a. All closers shall be LCN 4011/4111 series ANSI Grade 1 having non-ferrous covers, forged steel arms separate valves for adjusting backcheck, closing and latching cycles and adjustable spring to provide up to 50% increase in spring power. Closers shall be furnished with parallel arm mounted on all doors opening into corridors or other public spaces and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Furnish with non-hold open arms unless otherwise indicated.

   b. Door closer cylinders shall be of high strength cast iron construction to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.

   c. Door closers shall utilize temperature stable fluid capable of withstanding temperature ranges of 120 degrees Fahrenheit to -30 degrees Fahrenheit, without requiring seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with the standards UBC 7-2 (1997) and UL 10C.

   d. Door closers shall incorporate tamper resistant non-critical screw valves of V-slot design to reduce possible clogging from particles within the closer. Closers shall have separate and independent screw valve adjustments for latch speed, general speed, and hydraulic backcheck. Backcheck shall be properly located so as to effectively slow the swing of the door at a minimum of 10 degrees in advance of the dead stop location to protect the door frame and hardware from damage. Pressure relief valves (PRV) are not acceptable.

16. Trim and Plates requirements:
   a. Kick plates, mop plates, and armor plates, shall be .050 gage with 32D finish. Kick plates to be 10” high, mop plates to be 4” high. All plates shall be two (2) inches less full width of door.

   b. Push plates, pull plates, door pulls, and miscellaneous door trim shall be shown in the hardware schedule.

17. Door Stops requirements:
   a. Doorstops shall be furnished for all doors to prevent damage to doors or hardware from striking adjacent walls or fixtures. Wall bumpers to be Ives WS407 series are preferred, but where not practical furnish floor stops Ives FS436/438 series. Where conditions prohibit the use of either wall or floor type stops, furnish surface mounted overhead stops equal to Glynn Johnson, 450 Series.

18. Door Silencer requirements:
   a. Furnish rubber door silencers equal to Ives SR64 for all new interior hollow metal frames, (2) per pair and (3) per single door frame.
19. Fasteners requirements are indicated:
   a. Hardware as furnished shall conform to published templates generally prepared for
      machine screw installation.
   b. Furnish each item complete with all screws required for installation. Typically, all
      exposed screws installation.
   c. Insofar as practical, furnished concealed type fasteners for hardware units that
      have exposed screws shall be furnished with Phillips flat head screws, finished to
      match adjacent hardware.
   d. Door closers and exit devices to be installed with closed head through bolts.

20. All doors at interior stairs shall be on hold open connected to Fire Alarm System
    unless indicated otherwise by Broward College.

08 80 00  Glazing

1. The Design Professional shall evaluate Low-E glass options for exterior applications with
   regards to visible light transmittance and solar heat gain as best suited for the project and
   the targeted energy saving goals, for projects pursuing LEED certification.

2. The Design Professional shall evaluate and include glazing strategies that increase day
   lighting properties throughout the space and reduce the requirement for electric lighting
   through the implementation of day lighting sensors, for projects pursuing LEED certification.

3. Contractor shall submit product data for glazing sealants used inside of the
   weatherproofing system, including printed statement of VOC content, for projects pursuing
   LEED certification.

4. Exterior products shall be designed and tested to be impact resistant as a system with
   frame in accordance with the latest edition of the Florida Building Code. Provide Product
   Approval/NOA Number written verification that the exterior window products provided and
   installed as a system or assembly meet or exceed requirements of the latest edition of the
   Florida Building Code and Supplements, for wind resistance of components and cladding
   with any local code amendment requirements.

5. The Design Professional shall provide Glass type schedule including thicknesses for each
   size opening and location.

6. Provide interior clear glass units typical unless the College requires tinted units.
   a. Doors, classrooms and offices: provide with clear tempered glass vision kits.

7. Where tinting of exterior glazing units shall be required, tinting of units is part of an integral
   laminated process and not applied.
8. Contractor shall provide qualification Data for installers, manufacturers of insulating-glass units with low-e coatings and sealant testing agency.

9. Safety glazing shall be permanently marked with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer’s name, type of glass, thickness, and safety glazing standard with which glass complies.

10. Provide sound insulating glass units as required by sound control assembly manufacturer to comply with sound control STC requirements.

11. Factory install glazed lights according to requirements of tested assembly to achieve STC rating indicated.

12. Sound insulating glass locations shall be coordinated with the project acoustic requirements.

08 90 00 Louvers and Vents


2. Provide Louvers with wind-driven rain performance of not less than 95 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 400 fpm and bearing the AMCA Certified Ratings Seal.

3. Provide Stainless Steel Louver Screens (Insect Screening) at the interior face of each exterior louver, secured to Louver Frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c. and with Louver Screen Frames fabricated with mitered corners to louver sizes indicated.

   a. Aluminum sheet for aluminum louvers, not less than 0.050-inch nominal thickness.
   b. Panel Finish: Same type of finish applied to louvers, but black color.
   c. Attach blank-off panels with sheet metal screws, continuously seal all edges to create a waterproof seal.
09 00 00  Finishes

09 00 50  General Material and Finish Standards

1. In general, all materials shall be assessed for long range, life-cycle cost analysis for projects pursuing LEED Certification.

2. The Design Professional shall coordinate all color and material color selections with the BCPM and BC Facilities Planner.

3. A material and finish schedule and sample board showing color code/name, reference # as illustrated in plans, shall be provided for interior finishes, such as paint, vinyl, base, carpet, tile, bathroom partitions, etc., as well as exterior finishes, such as paint, glazing, etc.

4. Samples of all finishes and finishing material shall be submitted to Broward College for approval. For any nonstandard finishes a field mock-up (minimum 4’ x 4’ with each texture finish) is required. Location to be coordinated with BCPM.

09 22 16  Non-Load Bearing Steel Framing

1. The Design Professional shall indicate interior framing systems (supports for partition walls, framed soffits, furring, etc.) and interior suspension systems (supports for ceilings, suspended soffits, etc.).

2. Fire test-response characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

3. For STC-Rated Assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

4. A/E to provide single or composite walls, floor-ceiling and roof-ceiling assemblies that provide specific sound transmission class (STC) ratings when separating a core learning space from an adjacent space:
   a. **STC-45** between Classrooms, labs and offices, if the adjacent space is a corridor, staircase, or office
   b. **STC-50** between Classrooms if the adjacent space is another instructional core learning space (classroom), speech clinic, Lab, or outdoors,
   c. **STC-53** between Classrooms, Labs, Conference rooms or Offices, if the adjacent space is a restroom,
   d. **STC-60** if the adjacent space is a music room, mechanical equipment room, cafeteria, gymnasium or indoor swimming pool.
Division 09
Finishes

e. Do not locate mechanical equipment rooms, restrooms, music rooms, gymnasiums, or any other noisy space adjacent to a class room or core learning space.

f. Classroom doors should be rated as **STC-30** or more, and music room doors as **STC-40** or more. Entry doors across a corridor should be staggered to minimize noise transmission.

5. Impact Insulation Class (IIC) is a rating for the ability of a floor-ceiling assembly to block impact/structure borne noise from transmitting to the space below. IIC ratings for floor-ceiling assemblies above core learning spaces should be between **IIC-45** to **IIC-50** (measured without carpeting on the floor).

6. In new construction, gymnasium, dance studios or other high floor impact activities shall not be located above core learning spaces.

7. In existing facilities **IIC-65-70** (depending on the volume of the space below) is recommended if gymnasia, dance studios or other high floor impact activities are located above core learning spaces.

8. Steel framing for framed assemblies: 20 gauge, 16" O.C. or less otherwise required by design loads and depth as required.
   a. Steel Studs and Runners: ASTM C 645 minimum.
   b. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges. Clip Angle: Not less than 1-1/2 inches, 0.068-inch-thick, galvanized steel.
   c. Hat-Shaped, Rigid Furring Channels: ASTM C 645 minimum base metal thickness: 0.0179 inch and depth as required.

9. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission. Configuration: Asymmetrical or hat shaped.

10. Cold-Rolled Furring Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.

11. Provide auxiliary materials that comply with referenced installation standards. Fasteners for Metal Framing: of type, material, size, corrosion resistance, holding power, and other properties to fasten steel members to substrates.

09 24 00  Portland Cement Plaster (Stucco)

1. Architect / Engineer to specify a design that minimizes the use of plastic accessories. Metal accessories will not be allowed unless otherwise approved by the BCPM.

2. Technical Services Information Bureau (TSIB Org.) to be used as the reference standard for stucco finishes.

3. Product Data for each product specified is required to be submitted.
4. Material Certificates shall be signed by the manufacturer for each kind of plaster aggregate certifying that the materials comply with specifications.

5. All cementitious materials are required to be delivered to the Project site in their original packages, containers, or bundles, labeled with manufacturer's name, product brand name, and lot number and are further required to be stored inside, under cover, and dry, protected from weather, direct sunlight, surface contamination, aging, corrosion, and damage from construction traffic and other causes.

6. The contractor shall comply with requirements of the referenced plaster application standards and the recommendations of the plaster manufacturer for environmental conditions before, during, and after plaster application including requiring that plaster not be applied when the ambient temperature is below 40 degrees F.

7. Metal ceiling supports for suspended and furred ceilings and soffits shall be sized to comply with ASTM C 1063. Contractor to provide specialty engineering signed and sealed drawings for any exterior metal framing work.

8. Trim pieces inclusive of corner beads, casing beads, control joints and expansion joints shall be indicated to be fabricated from high-impact PVC installed in bed of sealant with sealed joints.


10. Lime shall be specified as special non air-entraining hydrated lime for finishing purposes, ASTM C 206, Type S; or special non air-entraining hydrated lime for masonry purposes, ASTM C 207, Type S.

11. Sand Aggregate for Base Coats shall meet ASTM C 897.

12. Aggregate for Finish Coats is to comply with ASTM C 897 system and to be manufactured of natural sand.

13. Fiber for the Base and Scratch Coat only shall be specified as alkaline-resistant glass or polypropylene fine fibers 10 mil maximum width, 1/2 inch maximum long, free of contaminants, manufactured for use in Portland cement plaster.

14. The water for mixing shall be potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

15. A non-re-emulsifiable acrylic emulsion-type bonding admixture shall be used for the base coat in two-coat. Approved products include Thoroseal Acryl 60, manufactured by Harris Specialties Chemicals, Inc.; Xycrylic, manufactured by Xypex Chemical Corp.; and Sika Latex manufactured by Sika Chemical Corp.

16. Bonding agents applied to surface and left beyond manufacturer’s time recommendation shall be removed and reapplied.
17. The mix shall be compliance with ASTM C 926 for base-and finish-coat mixes as applicable to plaster bases, materials, and other requirements indicated, except that plastic cement and masonry cement are not permitted.

18. Base Coat Mixes and Compositions shall be as listed below for proportion of materials for respective coats in parts by volume for cementitious materials and in parts by volume of aggregate per sum of cementitious materials to comply with the following for each method of application and plaster base indicated. (Mix proportions may be adjusted within limits specified to attain workability.)

19. Fiber Content shall be as follows: Add fiber to brown coat of 3-coat mixes after ingredients have mixed for at least 2 minutes. Comply with fiber manufacturer's written instructions, but do not exceed 1 lb/cu. ft. of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

20. Three Coat Work Over Metal Lath (limited to protected horizontal applications) shall be as follows: Base-coat proportions as indicated below (comply with ASTM C-926):
   a. Scratch Coat: 1 part Portland Cement, 0 to 3/4 parts lime, 2-1/2 to 4 parts sand.
   b. Brown Coat: 1 part Portland Cement, 0 to 3/4 parts lime, 3 to 5 parts sand.
   c. Finish Coat: 1 part Portland Cement, 3/4 to 1 1/2 parts lime, 3 parts sand.
   d. For fire rated walls refer to FBC.

21. Two-Coat Work over Concrete Unit Masonry shall be as follows: Base coat proportions 1 part Portland cement, 3/4 to 1-1/2 parts lime, and 3 to 4 parts sand. Water to be mixed with bonding admixture in proportion as recommended by admixture manufacturer. For fire rated walls refer to FBC.

22. Job-Mixed Finish Coats shall be as follows: Proportion materials for finish coats in parts by volume for cementitious materials and parts by volume of aggregates per sum of cementitious materials: 1 part Portland Cement, 3/4 to 1-1/2 parts lime, 3 parts sand.

23. Mechanically mix cementitious and aggregate materials for plasters shall comply with applicable referenced application standard and with recommendations of plaster manufacturer.

24. The following standards for the Installation of Lath and Furring shall be specified only at surfaces with sheathing: Comply with ML/SF A 920, "Guide Specifications for Metal Lathing and Furring," and with the requirements of ASTM C 1063.

25. The installation of supplementary framing, blocking, and bracing at terminations in work and for support of fixtures, equipment services, heavy trim and similar work is to comply with details indicated or, if not otherwise indicated, to comply with applicable written instructions of lath and furring manufacturer.

26. Where lathing and metal support system abuts building structure horizontally and where a partition or wall abuts an overhead structure, the design shall be sufficiently isolated from structural movement to prevent transfer of loading from building structure. Further slip-or cushion-type joints to absorb deflections but maintain lateral support shall be indicated.
27. Both sides of control joints shall be framed independently so the detail does not bridge joints with furring and lathing or accessories.

28. Contractor shall clean plaster bases and substrates for direct application of plaster, removing loose material and substances that may impair the Work.

29. Contractor shall immediately before plastering, dampen the concrete and concrete unit masonry surfaces indicated for direct plaster application. The contractor must determine and apply the amount of moisture and degree of saturation that will result in optimum suction for plastering. **Metal lath over concrete or concrete unit masonry is not permitted.**

30. Control joints shall comply with the following criteria unless otherwise indicated by the A/E:
   a. Provide sealed pre-manufactured connector strips or interceptors at all junctions of screeds. Butt joints acceptable.
   b. Where an expansion or contraction joint occurs in surface of construction directly behind plaster membrane.
   c. Distance between Control Joints: Not to exceed 18 feet in either direction or a length-to-width ratio 2-1/2 to 1.
   d. Horizontal Surfaces such as suspended ceilings (soffits), not more than 100 sq. ft. in area.
   e. Where plaster panel sizes or dimensions change, is it specified to extend joints full width or height of plaster membrane.
   f. Install prefabricated expansion joints of 2-piece design where shown as "Expansion Joint" (1/4 inch joint width for interior work, 3/8 inch for exterior).
   g. Install channel screeds (reveals) where indicated. Where ends of channel sections meet, set in bead of sealant; set all splice plates in mastic.

31. Contractor shall apply plaster materials (including requirements to moist-cure plaster base and finish coats), composition, and mixes to comply with ASTM C 926 Plaster Application Standard, including written instructions for time between coats and curing in "Annex A2 Design Considerations".

32. It is prohibited to use materials that are caked, lumpy, dirty, or contaminated by foreign materials. No re-tempering acceptable.

33. Flat Surface Tolerances shall not deviate more than plus or minus 1/8 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed at any location on surface.
34. Contractor shall sequence plaster application with installation and protection of other work so that neither will be damaged by installation of other.

35. The following number of coats and thicknesses are required for 3-coat work on metal lath bases at horizontal surfaces:

a. 1st (scratch) coat 1/4 inch
b. 2nd (brown) coat 1/4 inch
c. 3rd (finish) coat 1/8 inch
d. Total (minimum) 5/8 inch

09 29 00  Gypsum Board

1. All gypsum board shall be a minimum of 5/8 inches thick (type X). Provide multiple 1/4” layers for curved walls.

2. Full height approved high moisture resistance panels shall be used in the following rooms: janitor closets, wet laboratory areas, drinking fountains, mechanical room, restrooms, kitchens, showers, bathrooms and dishwashing areas.

3. Gypsum board shall contain recycled content, including post-consumer waste. Contractor shall submit Product Data for products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content, for projects pursuing LEED certification.

4. Joint compound shall be low VOC content and contractor shall submit Product Data for joint compounds, documentation including printed statement of VOC content, for projects pursuing LEED certification.

09 30 00  Tiling

1. The following areas are to receive tile at wall surfaces only:
   a. Drinking fountains: back wall up to 60" A.F.F.
   b. Wet walls at restrooms: full height.
   c. Showers: entire wall perimeter at full height.
   d. Janitor’s closet – all walls

2. The Design Professional shall determine preferences for tile finishes from conferences with BCPM and BC Facilities Planner.

3. Glazed Ceramic Wall Tile: minimum 6” x 6” x 5/16” thick, plain face, cushion edge. Finish schedule shall indicate type and size at each condition.

4. Trim Units and Special Shapes shall be provided to match characteristics of adjoining flat tile and to comply with the following:
   a. External Corners: Bullnose shapes with round out base and top trim special shapes or stainless steel accessories.
b. Internal Corners: Field-butted square with square in-corner base and top trim special
   c. No visible cut tile edges shall be permitted
   d. Provide bullnose shape at top of non-full height wall applications.


**09 51 23 Acoustical Tile Ceilings**

1. Acoustical Tile Ceilings Tolerances shall be as follow:
   a. Free of irregularities and level to within 1/8-inch in 12 feet
   b. Maximum Deflection: 1/360 of span

2. Acoustical Tile Ceilings Suspension System shall be in compliance with ASTM C635, intermediate duty, exposed Tee system for 24” x 24” lay-in acoustical ceiling tiles, with white factory applied baked enamel finished grid, stabilizer bars, clips, splices and matching edge moldings.
   b. Refer to Appendix 09 01.

3. Provide Acoustical Ceiling Tile as follows at all locations except high moisture areas:
   a. Armstrong-Dune or approved equal
   b. Edge detail: Tegular
   c. Thickness: 5/8-inch
   d. Size: 24” x 24”
   e. Refer to Appendix 09 01.

4. Provide non sag / humidity resistant, washable, acoustical ceiling tile at food service areas restrooms, janitor’s closet or other high moisture areas as applicable.
   a. Armstrong - Optima Health Zone or approved equal
   b. Edge detail: Tegular
   c. Thickness: 1 inch
   d. Size: 24” x 24”
   e. Texture: smooth
   f.

**09 65 00 Resilient Flooring (applies to all vinyl composition tile (VCT), Resilient vinyl wall base and Resilient stair treads)**

1. The following areas shall receive resilient flooring:
   a. Storage rooms
   b. Corridors
   c. Science Labs
   d. Break rooms/lounge areas
   e. Health science areas (full sheet roll goods)
2. IT, data and electric rooms; provide floor coverings with static-control properties in compliance with ASTM F 150 with 100-V applied voltage.

3. Vinyl Composition Tile shall be in compliance with ASTM F 1066, Class 2 - Through pattern tile; 12" x 12" size, 3/32-inch thick; marbleized design. Acceptable Manufacturers: Armstrong, Kentile Floors, Inc., and Azrock or approved equal.

4. Accessories to include rubber transition strips for transition conditions between VCT and carpet.

5. Preparation and installation requirements for Vinyl Composition Tile:
   a. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
   b. Concrete substrates: prepare according to ASTM F 710. Alkalinity and adhesion testing: perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing. Moisture testing: perform tests recommended by manufacturer. Proceed with installation only after
      1) Substrates pass testing.

6. Preparation: Remove sub-floor ridges and bumps. Fill low spots, cracks joints, holes, and other defects with subfloor filler. Apply tile manufacturer's recommended primer.
   a. Tightly cement resilient flooring to sub-floor without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll at perimeter of each covered area to assure adhesion.
   b. Prohibit Traffic on floor finish for 48 hours after installation.
   c. Clean, Seal and Wax floor surfaces in accordance with manufacturer's instructions.

7. Provide extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   a. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
   b. Resilient Wall Base and Accessories: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.


9. Provide Cove base (with top-set toe) at areas receiving VCT and Straight (toeless) at areas to receive carpet with minimum thickness of 0.125 inch, 4 inches in height, smooth surface and pre-molded outside and inside corners.

    a. Tread material: Rubber, Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees with Lengths and depths to fit each stair tread in one piece.
09 66 23 Resinous Matrix Terrazzo Flooring (for Special applications as approved by Broward College)

1. Provide Resinous flooring including a penetrating two-component epoxy primer, aggregate, a three component free flowing epoxy undercoat including resin, hardener and filler, selected broadcast marking, and two two-component, high performance, clear epoxy sealers.

2. Contractor shall submit Product Data for adhesives and sealants, including printed statement of VOC content for projects pursuing LEED certification.

3. Contractor shall obtain primary resinous flooring materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Contractor shall have completed at least five projects of similar size and complexity. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.

4. Performance requirements:
   a. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
   b. FloorScore Compliance: Terrazzo floors shall comply with requirements of FloorScore Standard.

5. Project Conditions:
   a. Concrete substrate shall be properly cured for a minimum of 30 days.
   b. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.
   c. A vapor barrier must be present for concrete sub-floors on or below grade.
   d. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions. Moisture Testing: Test for moisture content by method recommended in writing by terrazzo manufacturer. Proceed with installation only after substrates pass testing.
   e. Include crack suppression at per mfg. recommendations.
   f. Protect finished floor per manufacturer recommendations. Protection of finished floor from damage by subsequent trades shall be the responsibility of the General Contractor.

6. The Design Professional shall indicate and detail control joints and expansion joints as applicable for the system installation.

7. The Design Professional shall coordinate all Manufacturer's product requirements, surface preparation and installation procedures for the desired application.
Resinous Flooring

1. All resinous flooring at all janitor closets, public restrooms, toilet and shower rooms, and in other locations as may be required by the College.

2. Contractor shall obtain primary resinous flooring materials, including primers, resins, hardening agents, and sealing or finish coats through one source from a single manufacturer.

3. Contractor shall obtain secondary resinous flooring materials including patching and fill materials, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

4. Contractor shall submit Product Data for adhesives and sealants, including printed statement of VOC content for projects pursuing LEED certification.

5. Moisture testing: Test for moisture content by method recommended in writing by resinous flooring manufacturer.

6. Flooring System Components: Resinous floor surfacing system consisting of primer, body coat(s) including resin, hardener, aggregates, and colorants (if any), and sealing or finish coat(s).
   a. Waterproofing Membrane: Resinous product of, or approved by, resinous flooring manufacturer and recommended by manufacturer for application indicated.
      1) Liner: provide waterproofing membrane liner at shower floors and full height of shower walls.
   b. Reinforcing Membrane: Manufacturer’s flexible resin recommended for crack isolation to help prevent substrate cracks from reflecting through resinous flooring. Provide fiberglass scrim embedded in reinforcing membrane.

7. Project Conditions for Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
   a. Comply with ASTM C811 requirements unless manufacturer’s published instructions are more stringent.
   b. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and re-circulates the shot by vacuum pickup.
   c. Repair damaged and deteriorated concrete according to resinous flooring manufacturer’s published recommendations.

8. The application of components of resinous flooring system shall be according to manufacturer's published instructions to produce a uniform monolithic wearing surface of thickness indicated.
   a. Slope to Drain: Provide resinous flooring with minimum 1/8-inch per slope minimum slope to floor drains.

9. Provide Integral 6" high Cove Base with rounded internal and external corners Install cove base according to manufacturer's published instructions and details including taping, mixing, priming, troweling, sanding, and top-coating of cove base.
10. Seal and Finish Coat(s) shall be applied including grout coat (if any) of type recommended by resinous flooring manufacturer to produce desired finish. Apply in number of coats and at spreading rates recommended in writing by the manufacturer.

11. Resinous flooring shall be cleaned not more than four (4) days before dates scheduled for inspections intended to establish date of Substantial Completion. Use cleaning materials and procedures recommended in writing by resinus flooring manufacturer.

09 68 13 Tile Carpeting

1. Provide modular, tufted textured loop carpet tile for office areas, computer labs, and other spaces as required by Broward College.

2. Delivery, storage and handling shall be in compliance with CRI 104.

3. Field conditions shall be in compliance with CRI 104 for temperature, humidity, and ventilation limitations. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

4. Standards for Carpet Tile:
   a. Standard Backing System: GlassBac Tile
   b. Color and pattern: As selected by Architect and approved by Broward College
   c. Fiber Type: Post-Consumer content type 6 nylon
   d. Pile Characteristic: Tufted Textured Loop pile
   e. Pile Thickness: .093 for finished carpet tile according to ASTM D 6859
   f. Primary Backing/Backcoating: Manufacturer's Standard GlasBac® Tile
   g. Size: Standard Size: 19.69 inches x 19.69 inches
   h. Applied Soil-Resistance Treatment: Manufacturer's standard material: Protekt®.
   i. Antimicrobial Treatment: Manufacturer's standard material

5. Provide adhesives having VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

6. Concrete slabs shall comply with ASTM F 710 and the following:
   a. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer. Proceed with installation only after unsatisfactory conditions have been corrected.

7. Provide the following sealer where unsatisfactory moisture readings of up to 90% or where pH levels of up to 11.0 are encountered.
   a. Following Architect's approval; provide Driseal (manufactured by XL Brands) or equal concrete moisture sealer penetrating system.
   b. Sealer shall be compatible with carpet tile adhesive and acceptable to concrete slabs installer.
8. Floor preparation requirements:
   a. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
   b. Use trowel able leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
   c. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
   d. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
   e. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

9. Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

10. Music rooms shall receive anti-microbial carpet at instrument performing locations.

11. Dance room and gymnasium floors shall be floating cushioned wood.

12. Vinyl wall coverings shall not be specified for any location without written approval from BCPM.

09 69 00 Access Flooring (at mainframe server rooms only)

1. Access floor system, where indicated on the design documents, shall consist of modular and removable fully encased cementitious filled welded steel panels supported on all four edges by structural steel members which are designed to bolt onto adjustable height pedestal assemblies forming a modular grid pattern.
   a. Panel shall be easily removed by one person with a suction cup lifting device and shall be interchangeable except where cut for special conditions.

2. Access floor system Basis of Design shall consist of ConCore® 1250 access loor panel supported by a bolted stringer understructure system. Alternative products shall meet or exceed all requirements and must receive prior written approval by Broward College.

3. Pedestal assemblies shall be corrosive resistant, all steel welded construction with an adjustment range of +/- 1" for finished floor heights 6" or greater. Zinc electroplating shall be prohibited on all pedestal components, including head plate, threaded rod, adjustment nut, pedestal tube, base plate and all fasteners.
4. Stringers shall support each edge of panel. Steel stringer shall have conductive galvannealed coating. Zinc electroplating shall be prohibited on stringers and stringer fasteners.

5. Floor panels shall consist of a top steel sheet welded to a formed steel bottom pan filled internally with a lightweight cementitious material. Mechanical or adhesive methods for attachment of the steel top and bottom sheets are unacceptable.
   a. Floor panels shall be protected from corrosion by electro-deposited epoxy paint. The use of zinc electroplating shall be prohibited.
   b. Cementitious fill material shall be totally encased within the steel welded shell except where cut for special conditions. Note: this greatly reduces the potential for dust in the environment from exposed cement materials.
   c. Where required by the project, include directional perforated airflow panels: perforated steel airflow panels designed for static loads of 1000 lbs. shall be interchangeable with standard field panels and shall have 25% open surface area with the following air distribution capability
      1) Panel without damper: 746 cfm at 0.1-inch of H2O (static pressure).
      2) Panel with damper at 100% open position: 515 cfm at 0.1-inch of H2O (Static pressure).
   d. Where required by the project, include Grate airflow panels: die case aluminum grate panels designed for static and rolling loads shall be interchangeable with standard field panels. Coordinate load bearing capacities with project requirements.

6. Surface of floor panels shall be finished with static control resilient floor covering material.
   a. Tile coverings that require trim edge shall be applied to the panel's top surface and shall not wrap around the panel's edge.

7. Installation requirements:
   a. Pedestal locations shall be established from approved shop drawings so that mechanical and electrical work can be installed without interfering with the pedestal installation.
   b. Installation of access floor shall be coordinated with other trades to maintain the integrity of the installed system. All traffic on access floor shall be controlled by access floor installer. No traffic but that of access floor installers shall be permitted on any floor area for 24 hours to allow the pedestal adhesive to set. Access floor panels shall not be removed by other trades for 72 hours after their installation.
   c. Floor system and accessories shall be installed under the supervision of the manufacturer's authorized representative and according to manufacturer's recommendations.
   d. No dust or debris producing operations by other trades shall be allowed in areas where access floor is being installed to ensure proper bonding of pedestals to subfloor.
   e. Access floor installer shall keep the subfloor broom clean as installation progresses.
   f. Partially complete floors shall be braced against shifting to maintain the integrity of the installed system where required.
   g. Additional pedestals as needed shall support panels where floor is disrupted by columns, walls, and cutouts.
h. Understructure shall be aligned such that all uncut panels are interchangeable and fit snugly but do not bind when placed in alternate positions.

i. Finished floor shall be level, not varying more than 0.062" in 10 feet or 0.125" overall.

09 91 00 Painting

1. Interior paints and coatings products shall be in compliance with VOC limits indicated by the latest edition of the applicable LEED Reference Guide for projects pursuing LEED certification.

2. Contractor shall submit product data for paints and coatings, including printed statement of VOC content for all projects.

3. The Design Professional shall list each product by name and indicate total thickness of paint, per coat, by "dry mil" or "wet mil" thickness (according to which is recommended by the paint manufacturer) for each application. (MPI system reference will not be accepted.)

4. Project conditions: Do not paint in rain, fog, mist, or when relative humidity exceeds 85 percent, or to damp or wet surfaces.

5. Paint materials not displaying manufacturer's identification as a standard, best grade product will not be accepted.

6. Provide pure, non-fading, applicable color pigment types to suit substrates and service life specified.

7. Surface preparation requirements: Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.
   a. Ferrous Metals: Clean ferrous surfaces that are not galvanized or shop-coated of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning
   b. Galvanized Surfaces: Clean per SSPC-SP1 using detergent and water or a degreasing cleaner then prime as required.
   c. Aluminum Surfaces: Remove all oil, grease, dirt, oxide and other foreign material by cleaning Per SSPC-SP1 Using detergent and water or a degreasing cleaner then prime as required.

8. Application requirements: Provide additional coats when undercoats, stains or other conditions show through the final coat or paint, until paint film is of uniform finish, color and appearance.
   a. Access Panels and Removable or Hinged Covers: Paint backsides of these items to match exposed finished surfaces.
   b. Prime Coats: Apply prime coat to surfaces required to be painted (or finished) that have not received a factory-prime coat.
i. Re-Coat primed or sealed surfaces where there is evidence of "suction spots" or unsealed areas in prime coat to insure no "bleed-through" of the finish coat, or other defects due to insufficient priming or sealing.

9. Requirements for pigmented (opaque) finishes: Completely cover to provide opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be accepted.

10. The completed work shall match approved samples for color, texture and coverage.

11. Provide Basis of Design products from preferred manufacturer: Sherwin Williams. Subject to compliance with requirements other acceptable manufacturers include the following:
   a. Devoe Paint
   b. Glidden Co. (Glidden)
   c. Benjamin Moore and Co.
   d. PPG Industries
   e. Pratt and Lambert (P&L)

12. Interior Paint Schedule by substrate:
   a. Concrete - (Interior Walls & Ceilings, Poured Concrete, Precast Concrete, Cement board, Tilt-Up, Cast-In-Place) including PLASTER - (Walls, Ceilings)
      i. Latex Systems: Low Odor – Zero VOC Finish
      ii. Semi-Gloss Finish for walls
      iii. Flat Finish for ceilings

   b. Epoxy Systems (Pre-catalyzed Water Based): For high traffic or high abuse areas - Semi-Gloss Finish for walls

   c. Concrete - (Ceilings): Dryfall Waterborne Systems – For large interior concrete ceiling areas such as parking garages - Flat Finish

   d. Masonry - (Interior CMU - Concrete, Split Face, Scored, Smooth, High Density, Low Density, Fluted)
      i. Latex Systems: Low Odor – Zero VOC Finish
      ii. Semi-Gloss Finish

   e. Metal - (Aluminum, Galvanized)
      i. Latex Systems: HI-Performance – Zero VOC Finish – For metal doors and frames. (Interior or Exterior)
      ii. Semi-Gloss Finish

   f. Urethane System (Water Based): For use on existing field painted handrails and high abuse areas. (Interior or Exterior) - Gloss Finish

   g. Metal - (Galvanized; Ceilings, Duct work)
      i. Dryfall Waterborne Topcoats (for use at 10'-0" A.F.F. min)
      ii. Flat Finish
iii. Primers in this case are optional if the Ceilings - Structural Steel, Joists, Trusses, and Beams are already primed. Contractor shall check for adhesion and compatibility prior to painting. Spot prime any bare areas with S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series or equal. Verify elevation per mfg. requirements.

h. Metal (doors and frames)
   i. Shop Primer: Manufacturer’s standard, one coat of baked-on rust inhibiting prime paint in accordance with ANSI A 224.1; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.
   ii. Apply a smooth coat of even consistency to provide a uniform dry film thickness.

i. Metal - (Structural Steel Columns, Joists, Trusses, Beams, Miscellaneous & Ornamental Iron, Structural Iron, Ferrous Metal)
   i. Latex Systems: HI-Performance – Zero VOC Finish
   ii. Flat Finish

j. Dryfall Waterborne Topcoats (For use at 10'-0" A.F.F. min.) - Flat Finish

k. Wood - (Trim): For special applications as approved by Broward College.
   i. Latex Systems
   ii. Semi-Gloss Finish (equipment rooms and janitor closets only)
   iii. Stain and Varnish System: For Wood Doors
   iv. Satin Finish

l. Drywall - (Walls & Ceilings): For Classroom, Offices, storage areas and similar.
   i. Latex Systems: Low Odor - Zero VOC Systems
   ii. Semi-Gloss Finish (equipment rooms and janitor closets only)
   iii. Egg-Shell Finish
   iv. Flat Finish for ceilings only
   v. Epoxy System (Water Base): For Hallways, high traffic and high abuse areas.
   vi. Semi-Gloss Finish
   vii. Egg-Shell Finish:

m. Concrete - (Floors): Mechanical, exterior electrical rooms and similar applications. Add sand/paint for all utility rooms, exterior accessible mechanical/electrical rooms.
   i. Latex Systems
   ii. Low Luster Finish

13. Exterior Paint Schedule by Substrate:
   a. Concrete - (Stucco, Tilt-up, Precast, and Cast-in-place)
      i. Previously painted concrete surfaces: 1st Coat: Sherwin Williams Loxon Conditioner, A24-100 Series, or equivalent product. (Coverage: 200-300 sq ft/gal)
ii. New/ bare concrete surfaces: 1st & 2nd Coats: Sherwin Williams Loxon XP Waterproofing System, A24 Series, or equivalent product. (14.0 to 18.0 wet mils; 6.4 to 8.3 DFT mils per coat)

iii. Textured Coating System for Tilt-up surfaces: Textured Finish

b. Masonry (Concrete Masonry Units [CMU]- Cinder or Concrete Block)
   i. Latex Systems
   ii. Flat Finish

c. Metal - (Aluminum, Galvanized)
   i. Latex Systems for Galvanized Metals: Painted or unpainted roof-related fabrications
   ii. Gloss finish

d. Latex Systems for Aluminum roof-related fabrications - Flat Finish

e. Metal - (Misc. Iron, Ornamental Iron, Structural Iron & Steel, Ferrous Metal)
   i. Latex Systems: Roof-related fabrications painted or unpainted
   ii. Gloss finish
10 00 00 Specialties

10 11 00 Visual Display Surfaces

1. The following items to be furnished and installed by the general contractor: Marker boards and Tack boards.

2. Provide Porcelain-Enamel Marker-board Assembly: balanced, high-pressure, factory-laminated Markerboard assembly of 3-ply construction consisting of backing sheet, core material, and porcelain-enamel coated steel face sheet with low-gloss finish.


4. Where the size of visual display boards or other conditions require support in addition to normal trim, provide structural supports to suit project conditions.

10 14 00 Signage

1. Refer to Appendix 10 01 for interior signage.

2. The construction documents shall indicate room identification signage for each interior room that includes the building number and room number and any applicable suffix (i.e., "A", "B", etc.). Coordinate requirements with BC Project Manager and BC Facilities Planner.

3. Requirements for room signage:

   a. All rooms, unless noted otherwise, shall receive 7"x7" Room Identification, Acrylic Interior Sign consisting of frame with slider insert (Refer to Appendix 10 02) for changeable message and acrylic lens.

   b. All classrooms, conference rooms and offices shall receive 8 ¾"x11 ¼" Acrylic Interior Sign consisting of frame with slider insert for changeable message and acrylic lens in compliance with Signage Graphics provided in the Appendix in addition to the 7"x7" Room Identification Sign indicated.

   c. All mechanical rooms, electrical rooms, restrooms, shower areas, locker rooms, janitorial rooms and data rooms shall receive 7"x7" Room Identification, Solid Acrylic Interior Sign consisting of black background with white letters in compliance with Signage Graphics provided in Appendix 10 01.
4. Emergency Evacuation signage:
   a. **Emergency Evacuation Map and Map Holder**: Provide 17-1/2"Wx15"H clear acrylic, non-glare, scratch resistant frame for 17"Wx11"H insert. Provide (Basis of Design) Seton Emergency Evacuation Map Holder model 94291 or equal. Confirm quantity and locations with BC Project Manager and BC Fire Marshall. Refer to Appendix 10 04 for details.

5. Building identification signage for each Building exterior shall be cast aluminum letters with mill finish that identify the building name and building number.

6. Signage shall be in compliance with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction. Interior Code Signage: Provide signage as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to, the following:
   a. Illuminated Exit Signs.
   b. Fire Doors.
   c. Room Capacity.
   d. Elevator Signs.
   e. Stairway Identification.
   f. Signs for Accessible Spaces.

10 21 13 **Toilet Compartments**

1. Provide solid plastic toilet compartments and urinal partition Basis of Design products by Scranton Products, or equal as approved by Broward College.

2. Provide doors, panels and pilasters as follows:
   a. High density polyethylene (HDPE), single thickness panel. Waterproof and nonabsorbent, with self-lubricating surface, resistant to marks by pens, pencils, markers, and other writing instruments.
   b. 1 inch thick with edges rounded to 1/4 inch radius.
   c. Recycled content: Minimum 25 percent or as required by project.
   d. Color: as selected by architect and approved by Broward College Facilities Planner.

3. Provide hardware as follows:
   a. Hinges: 8 inches long, fabricated from heavy-duty extruded aluminum with bright dip anodized finish, wrap-around flanges, adjustable on 30-degree increments, through bolted to doors and pilasters with stainless steel, Torx head sex bolts. Hinges operate on field-adjustable nylon cams, field adjustable in 30 degree increments.
   b. Door Strike and Keeper: 6 inches long, fabricate from heavy-duty extruded aluminum with bright dip anodized finish, with wrap-around flanges secured to

c. Latch and Housing: Heavy-duty extruded aluminum surface mounted unit designed for emergency access.

d. Coat Hook/Bumper required at all stalls. Combination type, chrome plated Zamak, sized to prevent door from hitting mounted accessories.

e. Door Pulls: Chrome plated Zamak or manufacturer’s standard unit for outswinging doors.

4. Required components:
   a. Doors and Dividing Panels: 55 inches high, mounted 14 inches above finished floor.
   b. Pilasters: 82 inches high, fastened to pilaster sleeves with stainless steel tamper resistant Torx head sex bolt.
   c. Pilaster Sleeves: 3 inches high, one-piece molded HDPE, secured to pilaster with stainless steel tamper resistant Torx head sex bolt.
   d. Wall Brackets: 54 inches long, heavy-duty aluminum, bright dip anodized finish, fastened to pilasters and panels with stainless steel tamper resistant Torx head sex bolts. Provide continuous metal brackets at all panel joints for privacy.
   e. Headrail: Heavy-duty extruded aluminum, anti-grip design, clear anodized finish, fastened to headrail bracket with stainless steel tamper resistant Torx head sex bolt and at top of pilaster with stainless steel tamper resistant Torx head screws.
   f. Headrail Brackets: 20 gage stainless steel, satin finish, secured to wall with stainless steel tamper resistant Torx head screws.

5. Provide, unless otherwise directed, 24-inch wide in-swinging doors for ordinary toilet stalls and 32-inch wide (clear opening) out-swinging doors at stalls equipped for use by the handicapped.

10 26 00 Wall and Door Protection

1. Provide bumper rail and corner wall protection in all spaces with exception of offices. Refer to Appendix 10 06 for details.

2. Bumper rail assembly: continuous Snap-On plastic cover installed over continuous retainer; designed to spring back when hit.

10 28 00 Toilet, Bath and Janitorial Accessories

1. All toilet accessory items (including those to be provided by the College and contractor installed) contractor shall confirm full-functionality and dimensional fit.
2. Clearances shall comply with the requirements of the Florida Accessibility Code and as follows:
   a. Provide 36-inch minimum clearance width in all toilet compartments
   b. Provide 1'-6" minimum from centerline of lavatory to nearest adjacent wall

3. Bobrick shall be listed as the preferred manufacturer, or approved equivalent.

4. Provide fixed, non-tilted, stainless steel mirror units at handicap accessible lavatories.

5. Contractor shall furnish and install the following accessories at all public use washrooms:
   a. Grab bars: configuration and length to be noted in drawings

6. Owner-Provided/Contractor installed Equipment:
   a. Liquid soap dispensers
   b. Paper Towel Dispenser: Roll paper dispenser type
   c. Toilet Paper Dispenser: Jumbo roll dispenser
   d. Waste receptacles (owner will install unless units need to be installed on wall).

7. Contractor shall furnish and install custodial accessories at all janitor closets:
   a. mop and broom holder with shelf.

8. Contractor shall furnish and install accessories at all public use shower rooms:
   a. Extra heavy-duty shower curtain rod
   b. Shower curtain
   c. Folding shower seat (at all accessible shower stalls)
   d. Vandal resistant soap dish
   e. Robe hook

9. Sanitary napkin and tampon vendor unit shall not be specified or installed.

10. For typical toilet, bath and janitorial accessories finish, layout and installation details refer to Appendix 10 07.

10 44 00 Fire Protection Specialties

1. Locate hose and valve cabinets so the centerline of the hose valve is in accordance with NFPA Pamphlet 14. Locate fire extinguishers and fire extinguisher cabinets in accordance with the Florida Fire Prevention Code.

2. Maintain the full fire rating and acoustical rating of walls wherever hose and valve cabinets and fire extinguisher cabinets are installed

3. Fire hose cabinet units shall be steel with baked enamel finish, flanged, semi-recessed mounted types (similar to fire extinguisher cabinets) large enough to accommodate a fire extinguisher beside the fire hose. Provide each cabinet with a lockable, full glazed, clear acrylic type door.
4. Whenever possible, all valves and fittings for fire department connections shall be rotated approximately 22-1/2 degrees down from vertical to facilitate easy hose connection.

5. Provide semi-recessed type fire extinguisher/valve cabinets with 2 1/2-inch rolled edge trim projection and full clear acrylic glazed door with lock. Basis of Design Larsen's Lock with clear anodized aluminum finish from the Architectural Series.

6. Provide manufacturer's standard fire extinguisher brackets appropriate for the type of fire extinguisher to be supported.

7. Identify fire extinguishers with wall mount 3 way view projecting sign above with graphic symbols. Provide Basis of Design Seton Model 84502 aluminum product or equal. Maintain all code required clearances.

10 51 13 Plastic Lockers & Benches

1. Provide solid plastic HDPE lockers formulated from a homogenous color- throughout compound carrying a 25 year warranty. Basis of Design product Scranton Products; Tufftec Lockers or approved as equal.
   a. Door Style: Solid panel with horizontal vents, top and bottom.
   b. Hinges: Self-closing and completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
   c. ADA compliant recessed door handle and latch and lock.
   d. Combination Padlocks to be provided by the College.
   e. Equipment: Equip each locker with identification plate and the following, unless otherwise required: Double tier units: One double-prong ceiling hook and two single-prong wall
   f. Finish: Color as selected by the BC planner.
   g. Tiers: as required.
   h. Sloped tops or soffits to extend to top of lockers.

2. Provide locker benches to be fabricated by same manufacturer as solid plastic lockers.

3. Installation requirements:
   a. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates, channels, or blocking as required, using concealed fasteners.
   b. Anchor single rows of lockers to walls near top and bottom of lockers.
11 00 00  Equipment

11 66 50  Gymnasium Equipment

1. All proposed equipment shall meet standards set forth by the National Collegiate Athletic Association (NCAA) and the USA Volleyball.

2. Product Data shall be provided for each type of product indicated on the drawings:
   a. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
   b. Motors: Show name plate data, ratings, characteristics, and mounting arrangements.

3. Shop drawings for gymnasium shall equipment include: plans, elevations, sections, details, attachments to other work, and the following:
   a. Method of field assembly for removable equipment, connections, installation details, mountings, floor inserts, attachments to other work, and operational clearances.
   b. Transport and storage accessories for removable equipment.

4. Samples for Verification shall be provided by Installer for the following products:
   b. Volleyball Floor Insert: a full sized unit.
   c. Volleyball Post Standard: a full sized unit with net tensioner.
   d. Pad Fabric: a sample not less than 3 Inches Square, with specified treatments applied. Mark face of material.

5. Design Professional shall provide Coordination Drawings and documents including:
   a. Court layout plans, drawn to scale, and coordinating floor inserts, game lines, and markers applied to finished flooring.
   b. Qualification Data: For Installer and Professional Engineer.
   c. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation including loads, point reactions, and locations for attachment of gymnasium equipment to structure.
   d. Product Certificates: For each type of gymnasium equipment, signed by product manufacturer.
   e. Warranty: Special warranty as specified in this Section.

6. All close out submittals shall include instructions for the Operation and Maintenance for all gymnasium equipment including emergency manuals, operation manuals, and maintenance manuals.

7. Construction documents shall call for minimum qualifications to be met for both fabricator of products and installers. Installers shall be trained and approved by product manufacturer.
8. Source Limitations: Obtain each type of gymnasium equipment through one source from a single manufacturer.

9. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

10. Project conditions shall be identified on the construction documents and coordination of equipment locations shall occur prior to final installation.
   a. Environmental Limitations: Install gymnasium equipment after all spaces are enclosed and weatherproofed, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
      i. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.
   
   b. Coordinate floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire suppression system components, and partition assemblies.

11 66 60 Gymnasium Equipment Materials

1. Aluminum alloy and temper recommended by manufacturer for type of use and finish indicated shall be met.
   a. Extruded Bars, Profiles, and Tubes: ASTM B 221.
   c. Flat Sheet: ASTM B 209.

2. Steel shall comply with the following:
   a. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
   b. Steel Tubing: ASTM A 500 or ASTM A 513, cold formed.
   c. Steel Sheet: ASTM A 1011/A 1011M.

3. Equipment support cable sizes shall meet the Manufacturer's standard, galvanized steel aircraft cable with a minimum breaking strength of 7000 lb. Provide fittings complying with cable manufacturer's written instructions for size, number, and method of installation alloy steel chain rated for overhead lifting per ASTM A 391/A 391M, with commercial-quality, steel connectors and hangars.

4. Castings and hangers are malleable iron, comply with ASTM A 47/A 47M, and meet the grade specified for structural loading.

5. Equipment wall-mounting board's finish, size, and quantity shall meet the drawing requirements and specifications prior to mounting gymnasium equipment according to manufacturer's written instructions.

6. Specified anchors, fasteners, fittings and hardware shall meet the manufacturer's standard specifications.
7. Specified grout shall be nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 with minimum strength recommended in writing by gymnasium equipment manufacturer.

116670 Basketball Equipment

1. Equipment Manufacturer and provided products shall be in compliance with NCAA's Basketball Rule Book Standard requirements. Ensure that the chosen manufacturer offering the products is incorporated into the scope of work and substitutions are not permitted without authorization from both Broward College and the Design Professional.

2. Protruding fasteners or exposed bolt heads on front face of backboards are prohibited.

3. Backboards shall be overhead supported or wall braced depending on design requirements. Backboards may include the following types:
   a. Stationary Type per the manufacturer's standard assembly.
   b. Folding Type per the manufacturer's standard assembly for backboard, ensure that the specified hardware and fittings permit the backboard folding according to the project specifications in one of the following ways:
      c. Forward-folding, front-braced
      d. Forward-folding, rear-braced
      e. Backward-folding
      f. Side-folding

4. Wall-Mounted Backboards specifications shall contain complete assembly instructions, extending from wall, including support framing to building structure, bracing, cables, chains, pulleys, fittings, hardware, pipe anchors, equipment pads, and fasteners, tubing, and shapes. Design of framing shall minimize vibration during play. Types of framing may include the following:

5. Backboard framing specifications shall call for the frame to be made of steel pipe,
   a. Center-Mast Frame: welded, welded and bolted or clamped, with side sway bracing.
   b. Dual-Mast Frame: welded, welded and bolted or clamped, with cross bracing.

6. Goal Height Adjuster: Goal Height shall be adjustable from 8 to 10 feet with gear-drive mechanism, locking in any position within adjustment range, with visible height scale attached to side of framing. Operation of mechanism may be one of the following:
   b. Electric with integral gear-drive motor, with limit switches preset to goal heights.

7. Backboard Safety Device shall be designed to limit free fall if support cable, support chain, pulleys, fittings, winch, or related components fail.

8. Retractor Device shall retract both support and safety cables, chains, and straps away from play of the basketball when backboard is in playing position.
9. Winch hoist: provide heavy-duty, fully enclosed worm-gear, brake, cable drum, cable, and fittings, for mounting; and in addition, shall be designed to move and hold backboard in any raised or lowered position with one of the following methods:
   b. A Portable Winch Operator: with a portable electric motor-drive device, including an adaptor to fit crank mechanism.

10. Backboard Electric Operator: provide operating machine of size and capacity recommended by manufacturer for equipment specified, with electric motor and factory-rewired motor controls, starter, gear-reduction unit, and remote controls. Coordinate wiring requirements and electrical characteristics with building electrical system.

11. Basketball Backboard shall comply with the following:
   a. Shape and Size shall be: Rectangular or Fan shaped and meet the dimensions set forth in the NCAA’s Basketball Handbook.
   b. Material shall be predrilled with holes or preset inserts for mounting goals, and consists of one of the materials as follows:
   c. Fiberglass: Not less than 1-1/2-inch-thick composite backboard consisting of not less than two 3/16-inch-thick, molded fiberglass panels laminated together over faces and edges.
   d. Glass: Not less than 1/2-inch-thick, transparent tempered glass. Provide glass with impact-absorbing resilient rubber or PVC gasket around perimeter in a fully welded frame, with steel subframe, reinforcement, and bracing and with mounting slots for mounting backboard frame to backboard support framing with a method as follows:
   e. Standard Mount: Provide steel corner reinforcement with mounting slots for mounting backboard frame to backboard support framing at standard mounting centers.
   f. Direct Mount: Designed for mounting backboard frame to center mast of backboard framing to maximize relief of stresses on backboard frame and glass.

12. Rim-Restraining Device: Complying with NCAA rules and designed to ensure that basket remains attached if glass backboard breaks.
   a. Target Area and Border Markings: Permanently etched in white color, marked in pattern and stripe width according to NCAA Basketball Handbook rules.
   b. Target Area and Border Markings: Marked in pattern, stripe width, and color according to NCAA Basketball Handbook rules.
   c. Finish: Where applicable, finish per manufacturer’s standard factory-applied finish, with a white background.

13. Goal Mounting Assembly specifications shall be compatible with the goal, backboard, and support framing; with hole pattern for goal attachment, and shall meet the following material requirements:
   a. Glass Backboard Goal Mounting Assembly: Goal support framing and reinforcement designed to transmit loads from goal to backboard frame and to minimize stresses on glass backboard.
   b. Direct Mount: Designed for mounting goal directly and independently to center mast of backboard support framing so no force, transmitted by ring, is directly applied to backboard and rigidity and the stability of goal are maximized.
14. Basketball Goal: provide flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.

15. Basketball Net: provide 12-loop-mesh net, between 15 and 18 inches long, is sized to fit rim diameter, and as is composed of one of the material as follows:
   a. Cord shall be made from white cotton, nylon, or plastic.
   b. Competition Cord shall be antiwhip, made from white nylon cord not less than 120- or more than 144-gm thread.
   c. Chains (outdoor) shall be nontangle and nonstretch type, designed so that it will not scratch or impede the ball. The chain shall be made from zinc-coated steel chain.

16. Backboard Safety Pads: backboard thickness shall be indicated and shall extend continuously along bottom and up sides of backboard and over goal mounting and backboard supports as required by the NCAA Basketball Handbook.

17. Attachments may include: Peel-and-stick tape, adhesive, bolt-on, or per Manufacturer's recommendation.

18. Color shall be approved by Broward College and selected by Design Professional.

11 66 80 Volleyball Equipment

1. Equipment Manufacturer specified shall be qualified to provide products that are in compliance with USA Volleyball Rule Book's standard requirements. Ensure that the chosen manufacturer offering the products is incorporated into the scope of work and substitutions are not permitted without authorization from both Broward College and the Design Professional.

2. Floor Insert shall consist of solid-brass, chrome-finished steel, or aluminum floor plates; and a steel pipe sleeves, concealed by the floor plate, with capped bottom end, sized with ID to fit post standards set forth in the USA Volleyball Rule Book. Inserts shall securely anchor pipe sleeve in structural floor, or below the finished floor in a concrete footing; with anchors designed for securing floor insert to floor substrate as indicated by Design Professional or Manufacturer's Recommendations. When not in use, floor plates shall cover inserts in one of the following methods:
   a. Flush with adjacent flooring: floor plate may be self-locking, lockable, or with a hinge access cover.
   b. Recessed with an insert to match finished flooring, and be flush with adjacent floor: floor plate may be self-locking, or lockable, with a hinged access cover.
   c. Designed for use with a floating wood floor and be flush with adjacent flooring: floor plate may be a lockable swivel access cover.
   d. Manufacturer provide a minimum or three tools for unlocking access covers.
   e. Post Standard provide removable, paired volleyball post standards (with center post standard for multicourt play) as indicated in the USA Volleyball Handbook.
f. Posts may be:
   • Fixed, adjustable, or telescoping height;
   • Designed for easy removal from permanently placed floor insert supports;
   • Fabricated from steel, extruded-aluminum, or combined steel and extruded-aluminum pipe or tubing;
   • Equipped with non-marking plastic or rubber end cap or floor bumper to protect permanent flooring;
   • Finished with manufacturer’s standard factory-applied, baked powder-coating finish.

3. Nominal Pipe or Tubing Diameter may be 3-inch, 3-1/2-inch, or 4-inch OD (outside diameter) at the base.

4. Net Height Adjuster equipment shall allow for height adjustments, complete with fittings; designed for positioning net at heights, as required, and hold net at selected height during play.

5. Height Markers shall be clearly marked at regulation play heights as indicated in the USA Volleyball Handbook.

6. Net: Provide 32 foot long net and contain the following elements:
   a. Width and Mesh shall meet a 36 inches width with a minimum 4-1/2-inch-square mesh made of black polyester string (4-inch-square mesh for competition).
      1) Hem Band Edges to finish all sides of net as required.
   b. Dowels shall be no less than 1/2-inch-diameter fiberglass or 1-inch-diameter wood. Provide two dowels per net threaded through each side hem sleeve for straightening net side edges.
   c. Net Antennas shall be 3/8-inch- diameter, high-tensile-strength, extruded fiberglass or plastic rods, 72 inches long, extending above top hem band of net, with alternating white and red bands according to competition rules. Provide two antennas per net.
   d. Clamps shall be designed to secure antenna to top and bottom of net.
   e. Boundary Markers shall clearly delineate the court play area.

7. Net Tensioning System shall be designed to adjust and hold tension of net. The system shall be fully enclosed, nonslip winch with cable length and fittings for connecting to net lines, positive-release mechanism, and handle. Provide end post with post top pulley, and opposing post with welded steel loops, hooks, pins, or other devices for net attachment and post top grooved line guide.

8. Bottom Net Lock Tightener specifications shall be provided by manufacturer, offer a standard quick-release-type tension strap, spring-loaded self-locking tensioner, turnbuckle, pulley, or other device and linkage fittings designed to quickly and easily tighten bottom line or net.

10. Safety Pads shall comply with NCAA requirements. Provide pads consisting of material no less than 1-inch-thick, with multiple-impact-resistant foam filler covered by puncture-and tear-resistant PVC-coated polyester. Provide pads with a hook-and-loop closure or attachments for the following components:
   a. Post Standards: Wraparound style, designed to totally enclose each standard to a height of not less than 72 inches; 1 per post.
   b. Net Lines: Four per net.
   c. Judges’ Stands: Designed to totally enclose each unit.
   d. Fabric Cover Flame-Resistance Ratings: Passes NFPA 701
   e. Fabric Color: as selected by Broward College.
   f. Graphics: Optional as selected by Broward College.

11. Wall Storage Rack: provide a standard unit designed for mounting on walls and for storing post standards in vertical position with retaining arms, fittings for padlock, and mounting hardware; number of units as required to provide storage for specified equipment

12. Storage Cart: provide standard wheeled unit designed for transporting and storing volleyball equipment and passing through 36-inch-wide or wider door openings. Fabricate units of welded steel tubing with heavy-duty casters, including not less than two swivel casters. Fabricate wheels from materials that will not damage or mark floors; number of units as required to provide transport and storage for specified equipment.

11 66 90 Safety Pads

1. Safety Pad surface-burning characteristics shall meet ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Standard include:
   a. Flame-Spread Index: 25 or less
   b. Smoke-Developed Index: 450 or less.

2. Pad Covering: provide a safety pad fabric covering fabricated from puncture-and-tear-resistant, not less than 14-oz./sq. yd PVC-coated polyester or nylon-reinforced PVC fabric treated for fungicide for mildew resistance; with surface-burning characteristics indicated, and lined with fire-retardant liner.

3. Wall Safety pad shall consist of padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.

4. Wall Corner pad shall consist of no less than 1-1/4-inch-thick, multiple-impact-resistant, closed-cell polyethylene-foam filler, covered on both sides and all edges by fabric covering with backer board and manufacturer's standard anchorage to wall.

5. Column safety pads shall cover the exposed flange of columns to the height indicated on Design Professional's drawings. Pads shall consist of no less than 1-1/4-inch-thick,
multiple-impact-resistant, closed-cell polyethylene-foam filler, covered on both sides and all edges by fabric covering with backer board and manufacturer's standard anchorage to column.

6. Wraparound safety pads for round columns shall fully cover the exposed round column to height indicated on the drawings. Pads shall consist of no less than 2-inch-thick, multiple-impact-resistant, bonded polyurethane-foam filler, 6.0-lb/cu. FT density, covered on both sides and all edges by fabric covering with hook-and-loop, or cord lace and grommet attachment to column.
1. Non Powered Roller Shades
   a. Acceptable Manufacturer for Roller Shade Systems and Controls (Base of design) MechoShade Systems, Inc. or equal.
   b. To be installed at all exterior office and classroom windows.
   c. Refer to Appendix 12 01.

2. Powered Shades
   a. Shade Motors:
      i. Quiet [44 – 46 db] Intelligent Encoded Motor and Control System: Tubular, asynchronous (non-synchronous) motors, with built-in reversible capacitor operating at 110v AC (60hz), (230v/50 hz (AC) single phase, temperature Class A, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
      ii. Conceal motors inside shade roller tube.
      iii. Maximum current draw for each shade motor of 2.3 amps @ 110 V (.9 amps @230 V AC).
      iv. Use motors rated at the same nominal speed for all shades in the same room.
   b. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade motor and tube assembly. Spring assisted lift systems shall not be accepted.
   c. Quiet intelligent Encoded Motor System (software, two-way communication): Specifications and design are based on the Intelligent Motor Control System / Whisper Shade-IQ™ Motor System) as manufactured by MechoShade Systems, Inc. Other systems may be acceptable providing all of the following performance capabilities are provided. Motor control systems not in completed compliance with these performance criteria shall not be accepted as equal systems.
   d. Quiet operation of up to 46dBa within 3’ feet, open air.
   e. Upper and lower stopping points (Operating limits) of shade bands shall be programmed into motors via a hand held removable program module / configurator.
   f. Intermediate stopping positions for shades shall allow for up to three (3) repeatable and precise aligned positions.
   g. Up to 103 available alignment points including 3-user programmable predefined intermediate positions, for a total of 5-defined and aligned positions. All shades on the same switch circuit with the same opening height shall align at each intermediate stopping position.
   h. Provide wall switches.
3. Shade Cloth
   a. Visually Transparent Single-Fabric Shadecloth: MechoShade Systems, Inc., ThermoVeil group, single thickness, opaque non-raveling 0.030-inch (0.762mm) thick vinyl fabric, woven from 0.018-inch (0.457 mm) diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl, in colors selected from manufacturer’s available range.
   b. Dense Basket Weave: “1300 series”, 5 percent open, 2 by 2 dense basket-weave pattern.
   c. Color: Gray
   d. Warranty: 10-year Limited

4. Furniture systems and non-attached FF&E items are provided by the College unless determined otherwise.

5. Hardscape drawings shall clearly identify locations and quantities of specified site furnishings. Drawings shall indicate requirements through drawing layouts, details, and material schedules.

6. Contractor to provide samples for each exposed product and for each color, texture and finish specified prior to ordering the selected furnishings.

7. A product schedule for site furnishings shall be provided by the Design Professional. The schedule shall use the same catalog designations provided by the manufacturer, specify all ordering components, finishes and colors.

8. All site furnishing drawing details are to show proper anchoring methods to hardscape elements in order to deter theft or movement. Acceptable methods include:
   a. Direct burial
   b. Surface Mount

9. Site furnishing maintenance manuals shall be provided after installation work is complete.

12 48 13 Entrance Floor Mats and Frames

   1. College to provide walk off mats. Permanent recessed mats not allowed.

12 93 50 Site Furnishings

12 93 90.13 Bicycle Racks

   1. Design Professional shall reference basis of design product by Barco Product (www.barcoproducts.com) galvanized metal tubes, 7 capacity rack, surface mount to concrete slab, or approved equal.
12 93 90.23 Trash and Litter Receptors

1. College to provide trash and litter receptors.

12 93 90.33 Site Seating and Tables

1. Site seating and table styles shall meet the following design standards:
   a. Benches: Provide recycled plastic A-fame type, length as required.
   b. Seat and Table combinations: Provide recycled plastic hexagon tables with integral seating for 6 including a handicap accessible space.
   c. Tables shall be installed on hard surfaces (concrete, pavers, asphalt) not on grass.

2. The Design Professional shall provide Broward College with product cut sheets specifying material, design and overall layout of selected site furnishings for approval. Product cut sheets shall match catalog information provided on layout drawings as designated by Design Professional. Provide products by one of the following acceptable manufacturers:
   a. Barco Products (www.barcoproducts.com),
   b. Prestwick Group, Inc. (www.prestwicklimited.com), or
   c. Upbeat Site Furnishings (www.upbeat.com)

12 93 90.43 Bollards and Wheel Stops

1. The Design Professional shall provide Broward College with product cut sheets specifying material, design and overall layout of bollard furnishings and parking lot wheel stops for approval.
   a. Wheel Stops: Provide Basis of Design Product Premium Rubber Car Stop, Item #06FY1770 by Barco Products with # HRDWR-3WS or equal. Concrete alternate shall be considered.
   b. Bollards: Provide round dome top, concrete filled, or galvanized steel with plastic sleeve (white or yellow) as required. Bollards shall be FDOT compliant when used in traffic applications.

12 93 90.63 Planters

1. Free standing planter styles shall meet the following design standards:
   a. Provide concrete planters with integral drainage and irrigation spaced appropriately to allow access for maintenance of adjacent structures.
   b. Planters when fully loaded should be easily disconnected from irrigation source and easily moved with a forklift.
1. Preferred manufacturers offering elevators that may be incorporated into the Work include, but are not limited to, the following:
   a. Otis Elevator Co.
   b. Schindler Elevator Corp.
   c. ThyssenKrupp Elevator

2. Provide manufacturer’s standard enameled-steel car enclosures with removable wall panels, suspended ceiling, trim, accessories, access doors, doors, power door operators, sills (thresholds), lighting, and ventilation.

3. Minimum requirements:
   a. Hole-less Type: for buildings 3 stories or under, or machine-room-less traction type for buildings 4 stories and over.
   b. Rated Load: 3500 lb. min. or as required to suit project. Provide min. 5,000 lb. rated loads at all laboratory/science buildings typical.
   c. Wireway to include cabling that will support IP cameras and access control.
   d. Controls: Automatic recall.
   e. Car Enclosures: As follows unless otherwise required:
      i. Inside Width: 80 inches.
      ii. Inside Depth: 65 inches.
      iii. Inside Height: 95 inches.
      iv. Front Walls Graffiti and Scratch resistant: Satin stainless steel with integral car door frames or as approved by the College.
      vi. Sides and Rear Wall Panels: Satin Stainless Steel.
      vii. Reveals: Enameled Steel.
      ix. Door Sills: Aluminum.
      x. Ceiling: Luminous ceiling with LED fixtures.
      xii. Floor prepared to receive resilient floor tile

4. Additional requirements for elevators:
   a. Provide inspection certificate in each car, mounted under acrylic cover with satin Stainless-steel frame.
   b. Provide protective blanket hooks in all four sides of each car and one complete set of full-height blankets.

5. The Design Professional shall coordinate specific building equipment clearances with elevator openings and capacity in the case of Laboratory Buildings or similar. Note that items such as fume hoods and other lab specific equipment may require specific clearances.
21 22 00 Clean-Agent Fire Extinguishing Systems

1. Documents call for extinguishing-agent containers: Steel tanks, with manifold for multiple storage containers [and with reserve-supply storage containers].
   a. Extinguishing Agent: [HFC 227ea] [FK-5-1-12] [IG-541].
   b. Discharge Nozzles: One-piece brass or aluminum alloy.
   c. Control Panels:
   d. 120/240-V ac.
   e. Mounting: [Recessed flush with surface] [Surface].
   f. Separate supervised circuits for each independent hazard area.
   g. Automatic switchover to standby batteries.
   h. Storage container, low-pressure indicator.
   i. Detection Devices:
   j. Ionization detectors.
   k. Photoelectric detectors.
   l. Remote air-sampling detectors.
   m. Manual Stations:

2. [Surface] [Semi recessed] mounted with clear plastic hinged guard.
   b. Abort switch.
   c. EPO switch.

3. Switches:
   a. Low-agent pressure switches.
   b. Power transfer switches.
   c. Door closers.

4. Alarm Devices
   a. Bells
   b. Horns
   c. Strobe lights.
22 00 00 Plumbing

22 05 13 Common Motor Requirements for Plumbing Equipment

   b. Service Factor: 1.15.
   c. Multispeed Motors: Variable torque
   e. Enclosure Material: Cast iron for motor frame sizes [324T] and larger; rolled steel for motor frame sizes smaller than [324T]

22 05 33 Heat Tracing for Plumbing Systems

1. Plastic-insulated, series-resistance heating cables:
   a. Heating Element: Single- or dual-stranded resistor wire. Terminate with waterproof, factory-assembled nonheating leads with connectors at both ends.
   b. Electrical Insulating Jacket: Minimum 4.0-mil (0.10-mm) Kapton with silicone jacket or Tefzel.

22 05 53 Identification for Plumbing Piping and Equipment

1. Documents call for color-coding - Existing Piping: Identify all existing piping systems by color-coding. This procedure requires the color coding of pipe and the painting of arrows indicating the direction of flow. Specific colors for existing piping systems are as follows:
   a. Condensate - Orange
   b. HWS and HWR - Medium Green
   c. HWS and HWR (Reheat) - White with Green band
   d. Domestic Cold Water - Dark Green
   e. Domestic Hot Water - Light Green
   f. Acid Piping – Yellow
   g. Fire Protection – Red
   h. Propane Gas - Gloss Rust
   i. Gas Utility Piping – Yellow

22 11 19 Domestic Water Piping Specialties

1. Loose key stops for sinks, lavatories, hose bibs, and wall hydrants.

2. Hose bibs and wall hydrants: Zurn (option: J R Smith).

3. Valves: All valves 2-1/2-inch and smaller shall be NIBCO S-136 or approved equivalent. Valves over 2-1/2 inches shall be NIBCO F619 Valves to be full-port ball valves (no gate valves).
22 13 16 Sanitary Waste and Vent Piping

1. Sanitary sewer piping: Cast iron bell and spigot for use below grade, and NO-HUB for above grade installations. Schedule 40 PVC may be used (with College approval) on a single story building. Copper drainage tube (DWV) may be used for waster arms and traps above grade.

22 13 19 Sanitary Waste Piping Specialties

1. Floor drains with automatic trap primers shall be provided in all toilet rooms, janitorial closets and mechanical equipment rooms.
2. Floor Drains, Roof Drains, and Cleanouts: Zurn (option: J R Smith)

22 13 23 Sanitary Waste Interceptors

2. Oil Interceptors: Factory-fabricated cast iron or steel.

22 13 29 Sanitary Sewerage Pumps

1. Submersible, quick-disconnect, double-seal effluent pumps:
   a. Number of Pumps: One
   b. Pump Casing: Cast iron, with open inlet.
   c. Impeller: abrasion-resistant cast iron, closed or semiopen design.
   d. Pump and Motor Shaft: Stainless steel

2. Submersible, quick-disconnect, progressing-cavity, grinder sewage pumps:
   a. Number of Pumps: Dual
   b. Pump Body: Cast iron
   c. Pump Bearings: Radial and thrust types.
   d. Pump Shaft: Steel.
   e. Rotor: Stainless steel.
   f. Seal: Packing gland and mechanical types.
   g. Motor: Hermetically sealed, capacitor-start type.

22 14 13 Facility Storm Drainage Piping

1. Equipment drains and condensate: Provide copper DWV above grade and Schedule 40 PVC below grade.

22 15 19 General Service Packaged Air Compressors ad Receivers

1. Oil-free, reciprocating air compressors:
   a. Compressor(s): Two stage.
   b. Mounting: Freestanding
   c. Receiver: Vertical, steel tank.
22 30 00 Plumbing Equipment

1. Water heaters: Use point of use units whenever possible. Generally use electric units up to 85 gallons and gas heaters for larger tanks. All water heaters shall be ASHRAE 90 rated and glass lined. Show on the plumbing fixture schedule.

22 40 00 Plumbing Fixtures

22 42 00 Commercial Plumbing Fixtures

1. Plumbing fixtures: Provide complete list and catalog cut sheets to the College prior to the completion of Construction Documents. Assign “P” numbers to each fixture required and show on the Drawings (including risers and detail sheets). Acceptable manufacturers include the following:
   a. American Standard basis for design
   b. Kohler
   c. Eljer

2. Drinking Water Fountains:
   a. Include one water / bottle filler combination drinking fountain per floor.
   b. Refer to Appendix 22 01.

22 62 19 Vacuum Equipment for Laboratory Facilities

1. Documents call for packaged, oil-free, rotary, sliding-vane vacuum pumps:
   a. Vacuum Pump(s): One
   b. Mounting: Freestanding
   c. Receiver: Vertical, steel tank.
   d. Automatic control switches to alternate lead-lag vacuum pumps for duplex vacuum pumps.

22 63 00 Gas Systems for Laboratory Facilities

1. Documents call for testing procedures: Thoroughly flush and leak test completed piping systems before any connections are made to equipment or existing chilled water lines. Perform leak test using 125 PSIG nitrogen for a minimum of 24 hours and all joints soap tested.

22 66 53 Laboratory Chemical-Waste and Vent Piping

1. Documents call for that laboratory sinks and floor drains will be drained in a Code-compliant manner with chemically-resistant piping to a neutralization tank. Independent vent(s) will be piped to the roof with the same piping materials. Piping will be ChemDrain Corzan CPVC manufactured by Charlotte Pipe and Foundry Company. Neutralization tanks will be manufactured by Zurn, Orion, or Schier.
23 00 00 Heating, Ventilating, and Air Conditioning

23 00 01 General HVAC Requirements

1. Mandatory Prefabrication / Installation Meeting: The general contractor shall include all associated trades in a mandatory pre-fabrication and pre-installation meeting on site. The sheet metal contractor shall be responsible for providing coordinated shop drawings for final coordination with all other trades.

2. Standards: All equipment and devices shall bear U.L. label, the label of an industry recognized approved testing agency or A.G.A. certification for said item of equipment or device. All electrical devices must be U.L. approved.

3. Drawings: Architectural and structural drawings take precedence over mechanical drawings with reference to the building construction. Mechanical drawings are diagrammatic and indicate the general arrangement and extent of work. Architectural drawings indicate more exactly the desired relationship between diffusers, registers, lighting fixtures, equipment, electric panels and devices, plumbing fixtures, and other items which remain exposed in the completed building. Exact locations and arrangement of materials and equipment shall be determined, with the acceptance of the Architect/Engineer, as work progresses to conform in the best possible manner with the surroundings and with the adjoining work of other trades. Where locations of equipment, devices or fixtures are controlled by architectural features, establish such locations by referring to dimensions on Architectural drawings and not by scaling drawings.

4. All electrical rooms shall be air conditioned.

5. A minimum of 75 cfm differential has been shown for positive and negative rooms. Provide building pressure and be positive about 0.06 inches reference to outdoor pressure.

6. Commissioning should be performed by thirty party.

7. Roof mounted equipment, exposed to the environment, is not permitted.

8. Specified HVAC systems will be selected with the following design conditions:
   a. Summer
   b. Outside Air Temperature: 90°F dry bulb and 78°F wet bulb
   c. Inside Conditions: 74°F and maximum 60% relative humidity
   d. Winter
   e. Outside Air Temperature: 46°F
   f. Inside Conditions: 70°F and maximum 60% relative humidity

9. Documents incorporate life-cycle considerations and a holistic approach with respect to energy conservation, and avoid over-designing of systems.
   a. Energy Conservation: Refer to State Requirements for Educational Facilities (SREF) concerning heat recovery and thermal storage. The College wishes to maximize of all feasible energy conservation measures. Consult with local electric utility and provide current program information to the BCPM for consideration for each project.
10. Documents call for plans, elevations, sections, and detail drawings to fully show the extent, nature and requirements of mechanical work. Plan notations shall identify the following:
   a. rooms and their usage
   b. locations for ducts, VAV’s and accessories
   c. piping and accessories
   d. equipment and accessories

11. Descriptive notations must be used with symbols.
   a. Floor Plans and Site Plans: Show all ducts, piping and equipment properly located and drawn to scale.
   b. Renovation Work: Determine where structural limitations will permit component installation and indicate those locations on the Drawings with accurate dimensions.
   c. New Construction: Coordinate component installation and locations with other design disciplines.
   d. Maintenance Access: Show coil pull, filter pull and motor access areas for all air handling units.
   e. Service Piping: Show all chilled water piping with insulation on a 3/8”or 1/4” scale plan with elevations to ensure access and serviceability.

12. Architect/Engineer has confirmed that clear space and in-sight requirements for the installation of mechanical equipment has been met. Contract documents shall leave no question that clear space requirements can be met.

13. Electrical Provisions for HVAC design: Scope of Divisions 22 and 23 shall include the electrical requirements which are indicated to be integral with mechanical work and which can be summarized to include (but not necessarily be limited to) the following:
   a. Motors.
   b. Motor starters.
   c. Wiring from mechanical equipment to electrical work termination (junction box or disconnect switch).
   d. Control switch, pilot lights, interlocks and similar devices.
   e. Electrical heating coils and similar elements in mechanical equipment.
   f. Electrical work specified in Division-23 for the HVAC control system.
   g. Drip pans to protect electrical work.

14. Motors, Starters, Switches: Provide with all motorized mechanical equipment unless otherwise indicated.

15. Piping: Do not run mechanical piping directly above electrical (or electronic) equipment which is sensitive to moisture.

16. Provisions for openings: Provide all openings required for work performed under Division 23.
17. Provide sleeves or other approved methods to allow passage of items installed under any section of Division 23.

18. Interruption of existing services: Any interruption of existing services shall be coordinated in advance with the B C P M. Shutdown time and duration of critical services shall be decided by the Owner. Contractor shall provide shutoff valves at point of tie-in to minimize downtime.

19. Cleaning and protection

   a. Ductwork and Components: Keep the interior of the duct system free from dirt and rubbish and other foreign matter. All fan motors, switches, and other items, shall also be protected from dirt, rubbish and other foreign matter during building construction. Thoroughly clean all components of the ductwork and remove all dirt, scale, oil and other foreign substances which may have accumulated during the installation process.

   b. Equipment: All mechanical equipment provided shall be thoroughly cleaned of all dirt, oil, concrete, etc. Any dents, scratches or other visible blemishes shall be corrected and the appearance of the equipment made "like new" and to the satisfaction of the BCPM. Keep the interior of the equipment free from dirt and rubbish and other foreign matter.

   c. Upon completion, and before final acceptance of the work, all debris, rubbish, leftover materials, tools and equipment shall be removed from the site.

20. Shop drawings

   a. Submit shop drawings for all items, services and systems included in the project.

   b. Shop drawings shall clearly show Technical and descriptive data in detail equal to or greater than the data given in the item specification. Indicate all characteristics, special modifications and features. Where performance and characteristic data is shown on the drawings or specified, submitted data shall be provided in a degree which is both quantitatively and qualitatively equal to that specified and shown so that comparison can be made. Present data in detail equal to or greater than that given in item specification and include all weights, deflections, speeds, velocities, pressure drops, operating temperatures, operating curves, temperature ranges, sound ratings, dimensions, sizes, manufacturers' names, model numbers, types of material used, operating pressures, full load amperages, starting amperages, fouling factors, capacities, set points, chemical compositions, certifications and endorsements, operating voltages, thicknesses, gauges and all other related information as applicable to particular item.

   c. Shop drawings technical information brochure

   d. Submit to BCPM within fifteen days after Notice to Proceed, a hard-cover, 3-ring binder, 8-1/2" x 11" submittal package. Provide correct designation on outside cover and on spine of binder, i.e., mechanical. An electronic (AutoCAD/PDF format) copy shall also be submitted. All shop
drawings shall be submitted at one time; partial submittals will not be accepted.

e. The first page shall list all the Project related information (Broward College Project Number, Campus, Building Number, Architect/Engineer, Contractor, and all major subcontractors and suppliers name and contact information) for this Project. The second page in the submittal package shall be a photocopy of the Division 23 Index from the project specific specifications.

f. Provide reinforced separation sheets tabbed with the appropriate specifications section reference number and typed index for each section.

g. Shop drawing technical and descriptive data shall be inserted in the brochure in proper order on all items. Mark the appropriate specification section or drawing reference number in the right hand corner of each item. Provide complete information, including, but not limited to, wiring and control diagrams, scale drawings showing that proposed substitute equipment will fit into allotted space (indicate all service access, connections, etc.), test data, and other data required to determine if equipment complies fully with the specifications. All typewritten pages shall be on contractor or equipment manufacturer printed letterhead.

h. Shop drawings for piping systems and duct systems (mandatory). The HVAC systems in this project are of a higher than normal complexity and will require the mechanical/sheetmetal contractor to produce shop drawings for piping systems and duct systems. All shop drawings shall be done in minimum Autocad/PDF format and shall be of sufficient scale to verify clearances and equipment locations. Autocad base files of the building will be provided to the contractor. Shop drawings shall show actual approved mechanical equipment dimensions and all maintenance and operational clearances required. Shop drawings shall also include sections through congested areas such as the corridors of the first and second floors including lighting, multiple levels of ductwork, etc. All trades should be coordinated. Title drawings shall include identification of project and names of Architect, Engineer, Contractor, subcontractor and/or supplier, date, be numbered sequentially and shall indicate the following:

i. Architectural and structural (as required) backgrounds with room names and numbers, etc., including but not limited to plans, sections, elevations, details, etc.
   1. Fabrication and Erection dimensions.
   2. Arrangements and sectional views.
   3. Necessary details, including complete information for making connections with other work.
   5. Descriptive names of equipment.
   6. Modifications and options to standard equipment required by the contract.
   7. Leave blank area, size approximately 4 by 2-1/2 inches, near title block (for Engineer’s shop drawing stamp imprint).
In order to facilitate review of drawings, insofar as practicable, they shall be noted, indicating by cross reference the contract drawings, note, and/or specification paragraph numbers where item(s) occur in the contract documents.

Also provide shop drawings, using architectural reflected ceiling plans, which indicate locations of the following (to be verified by Contractor): Air distribution devices, sprinkler heads, lights and access panels.

Air handling unit and ductwork configuration shop drawings

Contractor shall submit a shop drawing for each air handling unit. Such shop drawings shall meet the following requirements:

1. Be drawn at not less than a scale of $1/4" = 1'-0"$. Contractor may elect to use a larger scale if he desires (i.e., if drawing of unit is at $1/4" = 1'-0", 1/2" = 1'-0" may be used.).

2. Clearly show all proposed ductwork configuration changes (sizes, routing, and similar differences) which are different in any respect from the Drawings. Extent of shop drawings shall show all ductwork to and from each unit beginning with and terminating at those points where ductwork is intended to remain unchanged as shown on Drawings. Coordinate with other trades for potential conflicts.

3. Where proposed changes affect any other work such as structure, housekeeping pads, piping, equipment, electrical work or any other work, shop drawings shall clearly show those proposed changes.

4. Where Drawings show units in plan only, shop drawings shall show proposed units in plan and also in elevation in ½" scale. Elevation shall include all related components and controllers associated with the units.

5. Shop drawings shall also show exact locations of related work (such as bar joists, columns, beams, sound attenuators, and like items) which affect the proposed ductwork routing and unit location and configuration.

6. Each section of each air handling unit shall be clearly identified in plan and elevation views. Indicate access door orientation, filter pull, coil and miscellaneous clearances (i.e. blower motor, coil section, fan section, filter section, mixing box section, etc.).

7. Include copy of all operating manuals.
8. Failure to submit these shop drawings together at the same time with the air handling unit shop drawings will result in total disapproval of the proposed air handling units. Time delays or other reasons will not be considered.

21. Maintenance information: Submit for acceptance Maintenance Information consisting of manufacturer's printed instruction and parts lists for each major item of equipment. After acceptance, insert information in each Technical Information Brochure. Refer also to other sections which may describe maintenance.

22. Manufacturer’s acceptance: Acceptance by Manufacturer’s Representative (for major items of equipment): At completion of construction and after performance verification information as above-mentioned has been gathered, submitted and accepted, provide one copy of this information to the manufacturer’s representative. Work required under this section shall include having the representative examine the performance verification information, check the equipment in the field while it is operating, and sign a startup certification and at final completion, an acceptance certification for record. Submit a copy of the certification on each major item of equipment for each brochure. Certification shall be inserted on each brochure with the performance verification information and submittal data. Certifications shall be submitted before equipment is placed into operation and prior to request for final acceptance.

23. System warrantee: The work required under Division 23 shall include a one year warrantee. This warrantee shall be by the Contractor to the Owner to replace for the Owner any defective workmanship, equipment, or material which has been furnished under this Contract at no cost to the Owner for a period of one year from the date of acceptance of the System. This warrantee shall also include reasonable adjustments of the system required for proper operation during the warrantee period. Explain the provisions of warrantee to Owner at the "Instruction in Operation Conference".

24. Owner’s demonstration and training: The Contractor shall give notice in writing to the BCPM that they are ready to give the Owner an "Instruction in Operation Conference". After the above mentioned request is received, the BCPM will notify the Contractor the time and date the conference can be held with the Owner. At the end of the conference, a copy of the memo certifying Instruction in Operation and Completed Demonstration shall be signed by the Contractor, Subcontractor and Owner and a copy inserted in each brochure.

25. Acceptable manufacturers: Acceptable Manufacturers: Materials and Equipment specified in these contract documents are accepted only in regards to general performance and quality. It shall be the Contractor's responsibility to insure that acceptable materials and equipment meet or exceed the efficiencies, capacities, electrical characteristics, performance and quality of the equipment herein specified. Acceptable equipment must also generally conform, without extensive modification of related systems to the accessories, weights, space and maintenance requirements, etc., of the specified equipment. Any modification to related systems of this or other
trades shall be made at the Contractor's expense and the Contractor shall be responsible for coordination between trades. Any difference in capacity, efficiency, electrical characteristics, weights or quality of product, etc., between specified materials and equipment and acceptable alternates shall be submitted to the BCPM and Architect/Engineer for acceptance within 15 days of Notice to Proceed.

26. Operating and Maintenance Manuals:

a. Provide three Instructions and Maintenance Manuals.
b. Hardback three-ring loose-leaf binders.
c. Title sheet with job name, Contractor's, subcontractor's control subcontractor and related contractor's or material supplier's names, addresses and phone numbers.
d. Index of contents.
e. A signed copy of acknowledgment of instructions to the Owner or his authorized representative. Two additional copies of the signed acknowledgment shall be sent directly to the Architect as soon as possible after receipt.
f. Typewritten operating instructions for the Owner's personnel describing the following for each piece of equipment and systems:
   i. How to start and stop each piece of equipment.
   ii. How to set equipment and systems for normal operation.
   iii. Normal restarting procedures before contacting the service contractor.
   iv. Complete description of functions and operations of each piece of equipment including description of how equipment operates in conjunction with automatic control systems.
   v. Instructions for cleaning, oiling, greasing, fueling and similar tasks.
   vi. Approved shop drawings and submittal data and parts and maintenance booklet for each item of material and equipment furnished under this Division, including (but not limited to) the following: Spare parts list and source of supply for each equipment item; List of valves with location, service, size, model and operating position; Diagrams clearly indicating automatic control hook-up; any as-built wiring diagrams as called for in other sections of this division as needed to show how equipment controls interface with related systems.
   vii. Copies of certificates of inspection.
   viii. Guarantees/Warranties.

27. Verbal and Video Maintenance Operating Instructions:

a. Contractor to provide verbal, hands-on, operating and maintenance instruction to Owner's authorized personnel for each equipment item and system. Instruction shall be given by competent personnel and videotaped. Video to be submitted with O&M manuals submittal.

b. Duration: Total instruction period for all systems of this Divisions 22 and 23 shall be issued not less than fifteen (15) working days from the Certificate of Occupancy.
28. Verbal instruction at the site for the following equipment items and systems shall be given jointly by the contractor and the authorized manufacturer's service representative:
   a. Air Handling Units (4 hours)
   b. Chillers, Cooling Towers (5 hours each)
   c. Exhaust Fans (2 hours)
   d. Pumps (2 hours)
   e. Fan Coil Units (2 hours)
   f. Terminal Units (2 hours)
   g. Energy Recovery Ventilators (2 hours)
   h. DDC Controls (24 hours)

23 05 13 Common Motor Requirements for HVAC Requirements

1. Acceptable Motor Manufacturers:
   a. General Electric.
   b. Westinghouse.
   c. Baldor Electric Co.
   d. Emerson.
   e. Lincoln.
   f. Reliance Electric
   g. Gould Electric

2. Provide motors for continuous duty conditions in which they will be required to perform; i.e., general purpose, splash-proof, explosion proof, standard load, high torque, or any other special type as required by the equipment motor manufacturer's recommendations. Unless otherwise indicated or required, motors shall be open drip-proof type.

3. Motors installed outdoors shall be totally enclosed fan cooled (TEFC) type.

4. Motor enclosures shall be of the type recommended by the equipment manufacturer for the specific application.

5. All motors shall be furnished for starting in accordance with electric utility company's requirements and shall be compatible with the motor starter and driven load. Motors shall not exceed full-rated nameplate load when operated at any point along the driven equipment's characteristic performance curve. The motor service factor shall not be used to justify exceeding nameplate amperage.

6. Motors designated to operate with a variable frequency drive shall be approved by the manufacturer of the variable frequency drive equipment and the manufacturer of the motor to insure quiet and stable continuous operation over the entire speed range.

7. Verify the circuit voltage and phase being furnished to the motor. All motors shall be 1800 rpm unless noted otherwise. Motors shall operate with electrical input voltage variations of plus or minus 1 percent of nameplate rating or frequency variations of plus or minus 5 percent of nameplate rating.
8. Design: Provide NEMA Design B for normal starting torque with Standard MG1-12.42 Class B insulation unless noted otherwise or required by the equipment on which the motor is being used, except that motors for variable-speed service shall have Class F insulation.

9. Motors shall be designed for operation in 40 degree C. ambient at 1.23 service factor on sine wave power at the base voltage and frequency and shall have all copper windings.

10. Motors shall meet or exceed the locked-rotor (starting) and breakdown (maximum) torques for the NEMA rating. Locked rotor current shall not exceed 6 times full-load current. Motor current density and heating characteristics shall be such that the motor insulation will not fail if subjected to locked-rotor current for 20 seconds.

11. Efficiency: Motors 1 horsepower and larger shall be high efficiency design. Nominal efficiency of each motor shall be tested in accordance with NEMA MG 1-12.54.1 and shall be labeled on the motor nameplate in accordance with NEMA MG 1.12.54.2.

12. Compliance: Motor starters included as an integral part of a factory pre-wired control panel shall be provided by the manufacturer of the equipment it serves. All motor starters shall comply with the requirements of Section titled "MOTOR CONTROLLER" in Division 26.

13. Overload Protection: Unless otherwise indicated, all 3 phase motor starters shall be provided with thermal overload relays on each phase sized in accordance with the actual nameplate full load ampere rating. Single-phase motors shall be furnished with built-in motor overload protection.

14. Installation: Install material and equipment in accordance with details shown on the drawings, submittal drawings and manufacturer's instructions.

15. Power: All power wiring shall be installed according to the requirements of Division 26.

16. Interlock: Unless otherwise noted, all interlock wiring, such as remote line volt thermostats, fan speed controllers, etc. shall be installed by the supplier of that equipment. Interlock wiring shall be installed according to the requirements of Division 26, ELECTRICAL.

17. Control: All control wiring exposed in mechanical equipment rooms, fan rooms, return air plenums, etc. shall be in conduit.

18. Three Phase: NEMA design B, three-phase, squirrel cage induction type designed for 1800 rpm synchronous speed for operation in 40°C ambient at 1.15 service factor at constant speed on the scheduled voltage. Motors shall be insulated with Class B insulation material and shall be cast iron, drip proof, horizontal foot mounted type with ball bearings. Two speed motors shall be provided as scheduled and shall be two winding type.

19. Single Phase: Squirrel cage induction type designed for 1800 rpm synchronous speed for operation in 40°C ambient at 1.15 service factor at constant speed on the scheduled voltage. Motors shall be insulated with Class B insulation materials and shall be two winding capacitor start type with steel enclosure, drip proof, horizontal foot mount and ball bearings.
20. Electric motors which are designated to be high efficiency type shall also comply with the section describing high efficiency motors.

21. Scheduled Horsepower: The horsepower scheduled or specified are those nominal sizes estimated to be required by the equipment when operating at specified duties and efficiencies. In the case of pumps, these horsepower are non-overloading and may also include provisions for future planned impeller changes. If the actual horsepower for the equipment furnished differs from that specified or shown on the drawings, it shall be the Contractor's responsibility to insure that proper size feeders, breakers, starters, etc. are provided at no change in contract price.

22. Any TEFC motors shall have Class F insulation. Drip proof protected motors shall have Class B insulation.

23 09 00 Instrumentation and Control for HVAC

1. Electrical/mechanical work: All controllers shall be manufactured or shipped as integral with Division 23 equipment:
   a. All electric motors and other electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.).
   b. All control circuits (including conduit and boxes) from the Division 26 panels to point of use including the necessary circuit breakers.
   c. All other control circuits, including conduit and boxes.
   d. All control connections to equipment.
   e. All control connections to controllers, switches, motors and other mechanical systems electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.).
   f. Auxiliary control devices.
   g. All control devices (thermostats, pressure switches, flow switches, humidistats, etc.) and make control circuit connections thereto.
   h. Any and all electronic and electric control devices and electric connections thereto.

2. Furnish: All controllers which are generally manufactured and/or shipped as separate but companion items to Division 23 equipment (such as centrifugal chiller starters which are matched with the chillers but are not physically an integral part of the chiller assembly.)

3. Auxiliaries and accessories: Include all auxiliaries and accessories for complete and properly operating systems.
23 05 16 Expansion Fittings and Loops for HVAC Piping

1. Documents call for expansion fittings for HVAC piping to be twin reinforced rubber spheres or flexible-hose type.

2. All temperature gauges are mounted in wells.

23 05 18 - Piping: Condensate Drain

1. Provide condensate drain piping from cooling coil drain pans.

2. Pipe: Type M or Type L hard drawn copper conforming to ASTM Spec. B88.

3. Fittings: Wrought copper, solder joint, pressure type conforming to ANSI B16.22.


5. Piping shall be sloped uniformly toward drain, and provided with trap seal having a depth, in inches, equivalent to one and one-half (1-1/2) times the total static pressure of the respective fan system. Traps shall be assembled using elbows and tees with threaded brass plugs to permit cleaning of trap and drain line. Piping shall be installed in a neat manner and shall be not smaller than full size of the equipment drain connection or three-quarters inch (3/4") whichever is larger.

6. Joints and connections shall be made permanently air, gas, and water tight.

7. Solder Joints: Cut pipe square using cutting tool which does not crimp pipe. Remove all burrs using pipe reamer and taking care not to flare the pipe end. Thoroughly clean the outside of pipe and the interior of the fittings using a fine sand cloth. Apply non-corrosive paste flux to the cleaned surfaces immediately and apply solder and heat, in accordance with manufacturer's instructions, to complete joint.

8. Equipment Connections: Connections to copper drain nipples may be made with solder joints provided care is exercised not to damage equipment, its insulation or finish. Connections to equipment having steel nipples shall be made using screwed to solder adapters with Teflon tape applied to male threads prior to assembly.

9. Routing: Unless otherwise indicated, route pipe discharge of equipment to nearest floor drain.

23 05 23 General-Duty Valves for HVAC Piping

1. Valves 2-1/2-inch and smaller to be NIBCO S-136 or approved equivalent. Valves over 2-1/2 inches shall be NIBCO F619.
23 05 29 Hangers and Supports for HVAC Piping and Equipment

1. Provide all angles, brackets, clamps, anchors, inserts, rods, braces, frames, hangers nuts and bolts, and other miscellaneous steel and hardware items as may be required for the proper support of equipment, piping systems, HVAC systems, plumbing systems.

2. **All horizontal piping and ductwork shall be supported from the structure.**

3. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:
   a. F&S Manufacturing Corp.
   b. Fee and Mason Manufacturing Co.

4. Hangers In Contact With Copper Piping: Shall be copper plated or Teflon coated. Hangers shall be Fed. Spec. WW-H-171E, Type 9. Acceptable: Grinnell Fig. 97 or 97C, or equivalent.

5. Hangers (other than in Contact with Copper Piping): Shall have manufacturer's standard finish. Hangers shall be of the following types:
   a. Pipe 3" and Larger: Fed. Spec. WW-H-171E, Type 1. Acceptable: Grinnell Fig. 260 or equivalent.
   b. Pipe 2-1/2" and Smaller: Fed. Spec. WW-172E, Type 6. Acceptable: Grinnell Fig. 104 or equivalent.

6. Isolators: Refer to the Section, if included in this Division, which describes vibration isolation.

7. Pipe Roller Stands: Shall be Fed. Spec. WW-H-171D, Type 47. Acceptable: Grinnell Fig. 171, or equivalent.

8. Pipe Roller Hangers: Shall be Fed. Spec. WW-H-171E, Type 42. Acceptable: Grinnell Fig. 171, or equivalent.

9. Pipe Alignment Guides: Acceptable: Grinnell Fig. 256, or equivalent.


11. Insulation Shields: Shall be Fed. Spec. WW-H-171D, Type 41. Acceptable: Grinnell Fig. 167, or equivalent.


13. Inserts: Preset Type: Malleable iron with removable interchangeable nuts having lateral adjustment of not less than one and five-eighths inches. Continuous inserts shall have a capacity of 2,000 lb. per foot and shall be hooked over reinforcing. Acceptable: C-B
Universal Fig. 282; Unistrut Products Co., P3200 or P3300; B-Line Systems, Inc., Series B-32.1, or equivalent.

14. Rod: Carbon steel, black threaded bolt ends or continuous thread, sized with safety factor of five (5). Acceptable: Grinnell Fig. 140 or 146, or equivalent.

15. Pipe: Hangers shall be spaced to prevent sag and to permit proper drainage. All piping shall be run parallel with the lines of building, unless otherwise indicated on drawings. The hanger spacing and placement shall be such that after the covering (insulation and finish) is applied, there will be not less than 1/2” clear space between finished covering and other surfaces, including the finished covering of parallel adjacent pipes. Hangers for insulated pipes shall be sized to encompass the insulation, finish and metal insulation shield (a metal insulation shield shall be provided for each hanger or support). Vertical piping shall be supported with pipe riser clamps at every floor penetration, unless specifically indicated otherwise on the drawings. Hangers and supports shall not be placed at greater than the following intervals:
   a. Pipe 1” and Smaller: Eight foot (8’) centers and not more than two feet (2’) from a change in direction (offsets, elbows, and tees).
   b. Pipe 1-1/4” through 2-1/2”: Ten foot (10’) centers and not more than two feet (2’) from a change in direction (offsets, elbows and tees).
   c. Pipe 3” and Larger: Fourteen foot (14’) centers and not more than two feet (2’) from a change in direction (offsets, elbows, and tees).

16. POWDER (GUNPOWDER) ACTUATED FASTENERS are not allowed.

17. Steel Decking: On projects where floor or roof slabs are installed over steel decking, drill or punch web of steel decking and insert hangers with washers before the concrete fill is poured in place.

18. Hangers shall be plumb within one-half inch (1/2”) in four feet (4’) and spaced as required for service intended.

23 05 48 – Vibration Isolation Equipment

1. Provide vibration isolation supports for all equipment and ductwork as may be required to prevent transmission of vibration to building structure. This shall include air handling units, fans, ductwork, and similar items.

2. Products of the following manufacturers will be acceptable, provided they comply with all of the requirements of this specification: Consolidated Kinetics; Mason Industries; Amber-Booth; Keflex; Flexonics; Vibration Eliminator Company or equivalent. Any model numbers listed are from one or more of these manufacturers and are given to provide an example of item(s) required.

3. All vibration isolation equipment shall be both recommended by the manufacturer and approved by the Architect/Engineer for each particular application on this project.
4. Unless otherwise noted, spring type vibration isolators shall be used for all motor driven equipment. It shall be the responsibility of isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance, prevent the transmission of objectionable vibration and meet noise criteria referenced herein.

5. Steel components shall be phosphated and painted. All nuts, bolts and washers shall be zinc electroplated.

6. Structural steel bases shall be thoroughly cleaned of welded slag and primed with zinc-chromate or metal etching primer.

7. All isolators exposed to weather shall have steel parts PVC coated or hot-dip galvanized. Aluminum components shall be etched and painted. Nuts, bolts and washers may be zinc electroplated.

8. Spring Mounts, Open Type, Unrestrained (Unit SMOU): Free standing springs; laterally stable; minimum horizontal-to-vertical spring rate (Kx/Ky) of 1.0: 1/2-inch neoprene acoustical friction pads between bottom baseplate and the supporting surface; leveling bolts; provision for bolting the mount to the equipment (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; 1-inch minimum static deflection (unless otherwise specified); submittals shall include spring diameters, deflections, free spring heights, solid spring heights and operating heights. Be similar to Mason Type SLF; Korfund Series L; Amber-Booth Type SW.

9. Spring Mounts, Open Type, Restrained (Unit SMOR): Free standing springs; laterally stable; 1/2 inch neoprene acoustical friction pads between bottom baseplate and the supporting surface; leveling bolts; provision for bolting the mount to the equipment (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; 1-inch minimum static deflection (unless otherwise specified); restraint consisting of welded steel channel ends for outdoor installation and welded steel studs for indoor installation; restraint shall have restraining bolts connecting top plate and lower housing to limit vertical rise of isolated equipment when load is reduced; vertical clearance of 1/8 to 3/8 inch shall be maintained between spring top plate and housing (leveling bolts shall be adjusted to maintain this clearance). Submittal shall include spring diameters, deflections, free spring heights, solid spring heights and operating heights. Be similar to Mason Type SLR; Amber-Booth Type CT.

10. Spring Mounts, Housed, Unrestrained (Unit SMHU): Springs free standing within their housing; laterally stable; 1/2 inch neoprene acoustical friction pads between bottom baseplate and the supporting surface; leveling bolts; provision for bolting the mount to the equipment (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; 1-inch minimum static deflection (unless otherwise specified); welded steel housing; vertical clearance of 1/8 to 3/8 inch shall be maintained between spring top plate and housing (leveling bolts shall be adjusted to maintain this clearance). Submittal shall include spring diameters, deflections, free spring heights, solid spring heights and operating heights. Be similar to Mason Type C.
11. Neoprene and Spring Hangers, Vertical Deflection (Unit NSHV): Steel housing for undampened support of the spring; Provisions for attachment of hanger rods; reinforced neoprene washer and grommet to break up metal to metal contact; free standing spring; 1 inch minimum static deflection (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection. Submittals shall include spring diameters, solid spring heights, free spring heights, deflections, overall hanger dimensions and maximum hanger rod diameter which can be accommodated by the hanger. Be similar to Mason Type DNHS: Amber-Booth Type BSR.

12. Neoprene and Spring Hangers, Vertical and Angular Deflection (Unit NSHVA): Shall contain a laterally stable steel spring and 0.3" reflection neoprene or fiberglass element in series. A neoprene neck shall be provided where the hanger rod passes through the steel box supporting the isolator mount to prevent metal to metal contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Mason Type 30N.

13. Neoprene and Spring Hangers, Vertical Deflection, Position Type (Unit NSHVP): Steel housing for undampened support of the spring; provisions for attachment of hanger rods; reinforced neoprene washer and grommet to break up metal to metal contact; free standing spring; 1 inch minimum static deflection (unless otherwise specified); spring diameters not less than 0.8 of the compressed height of the spring at rated load; springs shall have a minimum additional travel to full compression of 50% of the rated deflection; be capable of holding the supported item at fixed elevation during installation with secondary adjustment to transfer the load to the spring while maintaining a fixed position; scale and pointer to indicate the deflection. Submittals shall include spring diameters, solid spring heights, free spring heights, deflections, overall hanger dimensions and maximum hanger rod diameter which can be accommodated by the hanger. Be similar to Mason Type PCDNHS: Amber-Booth Type PBS.

14. Neoprene and Spring Hangers, Vertical and Angular Deflection, Position Type (Unit NSHVAP): Shall contain a laterally stable steel spring and 0.3" deflection neoprene or fiberglass element in series. A neoprene neck shall be provided where the hanger rod passes through the steel box supporting the isolator mount to prevent metal to metal contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Be capable of holding the supported item at the fixed elevation during installation with secondary adjustment to transfer the load to the spring while maintaining a fixed position; scale and pointer to indicate the deflection; similar to Mason Type PC30N.

15. Neoprene-In-Shear Hangers (Unit NH): Steel housing for undampened support of the neoprene; provisions for attachment of hanger rods; neoprene-in-shear isolator; similar to Mason Type HD, Amber-Booth Type HRD.

16. Neoprene-In-Shear Mounts (Unit NM): Double deflection neoprene-in-shear mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene-
covered. The top and bottom surfaces shall be neoprene ribbed and bolt holes shall be provided in the base. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang; steel rails shall be by same manufacturer as vibration isolators and equivalent to Mason Industries Type DNR. Mounts shall be Mason Industries Type ND, Consolidated Kinetics Type RD or Vibration Mounts and Controls Series RD.

17. Flexible Pipe Connectors: Same internal diameter as the pipe in which the connector is installed (not necessarily internal diameters of inlets or outlets of equipment).

18. Both recommended by the manufacturer and approved by the Architect/Engineer to be suitable for handling the conveyed fluid at all conditions (maximums and minimums of temperatures, pressures, velocities, etc.) encountered for each particular application.

19. Of proper design to absorb the combination of vibratory and/or expansion or contraction motions (lateral and/or axial and/or angular) encountered at each installation point (for example, do not use hose type where axial motion is encountered at the installation point unless so recommended by the manufacturer and approved by the Architect.

20. Stainless steel bellows type (Unit SSB): Heavy duty steel restraining rods and spacers; laminated steel bellows; steel flanges; permit axial, lateral and angular movement; rated to withstand 180oF operating temperature and 150 psig working pressure for chilled water; 250oF operating temperature and 150 psig working pressure for heating hot water; similar to Keflex Series 151 or 301.

21. Stainless steel hose type (Unit SSH): Rated to withstand 180oF operating temperature and 150 psig working pressure; have flanges except 2-1/2 inch and smaller sizes may have screw type fittings installed with a union at one end or with screw-on flanges at both ends; net flexible lengths shall be at least 6 pipe diameters for pipe up to 5 inch ID and not less than 36 inches for pipe 6 inch ID and greater; corrugated bellows with stainless steel wire braid restraining sheath; similar to Flexonics Type RW, RF or Series 400, Mason Type BSS, Keflex Series SSH.

22. Acoustic Seals (Unit AS): Consist of an S-shaped molded synthetic rubber seal attached with stainless steel clamps to the pipe wall sleeves and to carrier piping. Wall sleeves shall be two pipe sizes larger than the carrier pipe and/or its insulation. Amber-Booth Type 301.

23. Steel Equipment Frames (Unit SEF): Frames shall consist of structural steel sections sized, spaced and connected to form a rigid base which will not twist, rack, deform or deflect in any manner that will negatively affect the operation of the supported equipment or the performance of the vibration isolation mounts. Frames shall be of adequate size and plan form to support basic equipment units and motors plus any associated pipe elbow or duct elbow supports and electrical control elements or other components closely related and requiring resilient support in order to prevent vibration transfer from equipment to the building structure. Frames shall include side mounting brackets for attachment to Unit SMOU isolator or other specified isolator. The clearance between the underside of any frame or mounted equipment unit and the top of the building structure below shall be at least 2 inches.
24. Neoprene Pads (Unit NP): Waffle or ribbed pattern neoprene pads shall be fabricated from 40-50 Durometer neoprene. Mason Type W.

25. All isolators shall be installed in strict accordance with the manufacturer's instructions and shall be properly adjusted prior to requesting final inspection or the performance of any vibration testing specified.

26. Each item of equipment (machinery, piping, etc.) which is provided with vibration isolation equipment shall rest in its intended, proper operating position (i.e., exactly level, etc.) after installation of vibration isolation equipment. Approval of such vibration isolation equipment by Architect/Engineer shall not relieve the Contractor of this responsibility.

27. Equipment which is specified to rest on concrete housekeeping pads shall have Unit NP pads unless otherwise indicated.

28. Piping in air handling unit/equipment rooms (m.e.r.'s):
   a. Isolators for equipment are described elsewhere in this specification; and it shall be the responsibility of the vibration isolation manufacturer to coordinate the selection of piping supports with equipment supports to provide for a carefully engineered system designed to accommodate expansion and contraction without creating excessive stress at any equipment connections or in any portion of the piping.
   b. Hangers for horizontal piping shall be installed at regular intervals. Pipe risers shall be supported at the base of the riser. Submit hanger schedule.
   c. The first three piping supports away from any given piece of vibrating equipment to which piping is connected shall be selected for an operating spring deflection not less than that specified for the equipment isolators. All other vibration isolation supports for horizontal piping shall have a minimum operating deflection of 3/4" with capability of 50% additional travel-to-solid. All supports for pipe risers shall have deflection capability at least four times the expansion or contraction to be accommodated.
   d. Temporary anchors, where required, shall be installed to permit pre-adjustment of springs in risers. Pre-adjustment procedure, which is intended to control direction of pipe movement and final operating deflection of the springs, shall be detailed in submittal data.
   e. Permanent limit stops shall be installed to prevent excessive vertical motion of risers in the event water is drained from system. Locations and other details of these limit stops shall be submitted to Engineer for acceptance.
   f. Piping connected to vibration isolated equipment shall be installed so that it does not strain or force out of alignment vibration isolators supporting the basic equipment, nor shall pipes restrict such equipment from "floating" freely on its respective vibration isolation system.
   g. Drain piping connected to vibrating equipment shall not physically contact any building construction or non-isolated systems or components.
h. Do not allow the weight of the pipe to be carried by walls through which the pipe passes.

29. Isolator Locations:

a. Ceiling hung piping to air handling units: Provide neoprene and spring hangers, vertical and angular deflection (Unit NSHVA) at the first three support points of pipe runs connected to the vibrating equipment or at all support points along the first 50 feet of pipe runs connected to the vibrating equipment, whichever length is greater, but not to exceed length of mechanical equipment room.

b. Floor supported piping to air handling units: Provide resilient support for floor supported piping same locations as specified above for ceiling hung piping. Provide open type unrestrained spring mounts (Unit SMOU) for first three support points; use neoprene-in shear mounts (Unit NM) thereafter and both with supplemental supports as required by job conditions.

30. Acoustic Seals: Provide acoustic seals (Unit AS) at all wall, ceiling and floor openings through which pipe runs from equipment rooms into adjoining spaces.

31. Basic Isolator Types:

a. Floor Supported Piping: Unit SMOU, SMOR or SMHU, as applicable.

b. Piping Suspended from Above: Units NSHVA or NSHVAP, as applicable.

32. Static Deflection: As recommended by the vibration isolation manufacturer as dependent upon size, length and weight of applicable piping and its conveyed fluid.

33. Acoustic Seals: Provide acoustic seals (Unit AS) at all wall, ceiling/floor openings through which pipe runs into adjoining spaces.

34. Air handling units, factory-packaged

   a. Floor Mounted:

      i. Spring mounted (Unit SMOU) with 1 inch minimum static deflection when AHU motor is 5 hp. or less; spring mounts with 2 inch minimum static deflection when AHU motor is 7-1/2 hp. or greater. Instead of bolting the units to the spring mounts, provide height saving brackets. If the AHU manufacturer includes internal isolators inside the equipment and does not recommend external isolation, external isolation is not required.

      ii. Flexible duct connections as specified in "Duct System Accessories" section.

      iii. Steel equipment frame (Unit SEF) manufacturer's standard unit frame or base is not sufficiently stiff and rigid to permit point vibration isolation.
b. Suspended from Building Structure:
   
   i. Spring hangers (Unit NSHV) with 1-inch minimum static deflection when motor is 5-HP or less; spring hangers (Unit NSHV) with 2-inch minimum static deflection when motor is 7-1/2 HP or greater.
   
   ii. Flexible duct connectors as specified in Section entitled "Ductwork".

35. Fan coil units and fans, in-line centrifugal light duty:

   a. Flexible duct connectors as specified in "Ductwork".
   
   b. Neoprene-in-shear hangers (Unit NH).

36. VAV terminal units: Flexible duct connectors as specified in "Ductwork".

37. Main supply/return ductwork in mechanical rooms: Neoprene-in-shear hangers (Unit NH).

**23 05 53 Identification for HVAC Piping and Equipment**

1. Provide complete identification of the mechanical systems including piping, valves and equipment as noted herein.

2. This section directly relates to piping and the interconnected equipment and component items for the following systems:

   a. Refrigerant Piping.
   b. A/C Condensate.
   c. Domestic Hot and Cold Water.

3. Piping and interconnected equipment and component items for the following systems shall be identified. Identification of the following systems shall not preclude the identification of other systems where identification of such other systems may be specified in other sections.

4. Systems requiring identification as work of this section are:

   a. Chilled Water.
   b. A/C Condensate.
   c. Domestic Hot and Cold Water.
   d. Fire Protection/Sprinkler.
   e. Storm Drainage.
   g. Acid Waste and Vent Systems.

5. Shop drawings: Refer to Section entitled "General Mechanical Provisions". Provide schedule of colors, lettering, tagging, handling and similar items to clearly identify proposed method of identification for **FIRE PROTECTION, PLUMBING AND MECHANICAL** systems.
6. Valve Schedules: Submit valve schedules for each related piping system.

7. Product Data: Submit product data for each type of product indicated.

8. Samples: Provide samples for color, letter style, and graphic representation required for each identification material and device.


10. Duct marker/identification labels and stencils. VAV marker/identification labels and stencils (including temperature sensors).

11. Pipe dimensions as used in this section refer to the total outside dimensions (diameters) of both the pipe and its insulation (if any).


13. Acceptable Manufacturers: W. H. Brady Co., 2223 West Camden Road, Milwaukee, WI 53201; Seton Name Plate Corporation, 592 Boulevard, New Haven, CT 06505, or equivalent.

14. Markers: Must have approved color coded background, proper color of legend in relation to background color, approved legend letter size, approved length and flow arrow indicator.

15. Pipes 3/4" through 5" O.D.: Seton "Setmark" Type SNA marker or equivalent.

16. Pipes 6" O.D. and Greater: Seton "Setmark" Type STR marker or equivalent.

17. Bands: Color coded in minimum widths of 2-1/4" for pipe through 12" O.D. and 4" for pipe 14" O.D. and greater. Brady B-500 Vinyl Cloth, B-350 PermaCode or B-946 Outdoor Fil or equivalent as applicable.

18. Valve Tags: Each tag shall designate appropriate service and valve number. Be securely attached with meter seals with 4-ply 0.018 copper smooth wire, or brass "S" hooks, or brass jack chain in a manner to allow easy reading. Provide either of the following types:

   a. Brass Type: Minimum 19 gauge polished brass; 1-1/2" min. diameter. Acceptable: Seton Style 250-BL or equivalent.

   b. Aluminum Color Coded Type: Anodized aluminum; 2": min. diameter. Acceptable: Seton Style 2070 or equivalent.

   c. Aluminum Alloy Type: 16 gauge sheet aluminum: depressed type letters filled with black enamel. Face and periphery of satin finish Alumilite, Alcoa 204A2 or equal, free from burns and scratches. Seton Type 4 or equivalent.

   d. Fiber Glass Type: 1/16" thick glass fiber reinforced resin. 2" x 2" size of 2-1/2" x 9" size as necessary to identify item. Brady Series No. 2297 or equivalent.
19. Labels: Provide either of the following types:

a. Plastic Type: Outdoor grade acrylic plastic to withstand weather, abrasion, grease, acid, chemical and other corrosive conditions; 1/16” min. thickness. Sized 3/4 x 2-1/2, 1 x 2-1/2, 1 x 3 or 1-1/2 x 4 as necessary to identify item. Seton “Setonite” or equivalent.

b. Ductwork: All HVAC systems ductwork shall be provided with duct identification labels in color-coded labeling per Seton Code Self-Adhesive Duct Markers. System shall identify the equipment served (i.e. (EF-2) and the duct service (i.e. EXHAUST).

c. Apply only after completion of insulation, painting and cleaning work so that final identification is not disfigured by such other work.

d. Coordinate with actual composition and operating temperatures of surface on which identification is to be placed so that proper permanent adhesion of markers and labels to surface is obtained.

e. Locate marking and banding where practical such that groups of pipe are identified at similar location for ease of visual tracking. For example, mark and band parallel runs of pipe which are side-by-side at the same general place.

f. Small pipes less than 3/4” diameter may be identified with tags similar to those specified for valves.

g. Adhere or affix all identification items permanently except where removal may be necessary for maintenance or service.

20. Provide Markers and Bands on piping as follows:

a. Pipe Concealed in Inaccessible Locations (e.g., Chases, Underground): No identification required.

b. Pipe Concealed in Accessible Locations (e.g., Ceiling Plenums): Markers every 30 feet of pipe length. Bands every 15 feet of pipe length.

c. Pipe Exposed in Equipment Rooms: Markers every 15 feet of pipe length for pipe through 12 inches O.D. and every 30 feet for pipe 14 inches O.D. and greater.

d. Bands every 10’ of pipe length for pipe through 12” O.D. and every 25’ for pipe 14” O.D. and greater.

e. Exterior Pipe, Exposed: No identification required unless otherwise indicated.

21. Valve tags shall be installed on the following items:

a. All motorized valves (except those valves associated with direct control of flow to air handling apparatus whereby the valve may be identified by reference to the item of equipment it serves).
b. All fire protection system valves located in mains and branches (except those valves in fire hose cabinets).

c. All manual valves which perform functions other than isolation of an equipment item for servicing. This includes, but is not limited to, valves in valve stations, remote locations where use is not evident due to proximity of equipment or other piping, and similar locations.

d. Small piping (other than domestic water) where markers are impractical.

e. Small but critical equipment items on which it is impractical to install labels.

22. Valve Tag List: Prior to substantial completion, provide a complete list of all valves having tags. Indicate the following on such list:

   a. Valve size.
   b. Valve location.
   c. Valve type.
   d. Service application.
   e. Valve manufacturer and model number.
   f. Pressure class and allowable working pressure.

23. Provide labels of proper size on mechanical system equipment including but not limited to, pumps, chillers, tanks, major piping components such as air separators, air handling equipment, fans, control panels, terminal units, flow stations, reheat coils and similar items.

24. Provide identification labels on the acoustical ceiling “TEE” grid or access door directly below VAV Terminals, duct heaters, fire dampers, etc. with nomenclature identifying the device above the ceiling.

25. Duct markers: Engraved, “color-coded” laminated plastic. Include directional arrow and duct service for each system (such as AHU-1-Supply, AHU-2 Return, EF-1 Exhaust, etc.). Include contact type, permanent adhesive. Prepare all surfaces prior to installing identification.

26. Warning Tags: Pre-printed or partially pre-printed, accident-prevention tags, of color-coded laminated plastic. Color shall be yellow with black lettering.

   a. Nomenclature: Large-size primary caption such as DANGER, CAUTION, etc.
   b. Mechanical Equipment Rooms: Provide warning tags on ductwork, piping and other items where headroom clearances are less than seven feet off the finished floor.

27. Colors for piping systems, ductwork and equipment which are required to be painted shall be as follows for those systems which may be applicable to this project:

   a. Domestic Cold Water: Medium green enamel with domestic cold water legend.
b. Domestic Hot Water and Domestic Hot Water Recirculation: White insulation with yellow tape or metal bands with domestic hot water (domestic hot water recirculation) legend.

c. Chilled Water Piping: Blue mastic with blue tape or bands with chilled water supply (or return) legend.

d. Fire Protection Piping: Red with fire line legend.

e. Sprinkler Piping: Red with sprinkler legend.

f. Roof/Storm Drainage Piping: Light green with storm water legend.

g. Sanitary Sewer and Vent Piping: Brown with sanitary sewer (vent) legend.

h. Electrical conduit (not specified as painted in other divisions of these specifications): Silver.

i. Supply Air Ducts: Green.

j. Fume Hood Exhaust Air Ducts: Red.

k. Outside Air Ducts: Blue.

l. Return Air/Relief Air Ducts: Brown.

28. Identification: Coordinate colors and finishes with pipe, duct and equipment identification.

23 07 13 INSULATION, HVAC

1. Provide all work necessary to insulate all equipment, piping, ducts and other items related to the piping and duct systems.

2. This section directly relates in particular to sections which describe the following:
   a. Piping systems.
   b. Duct systems.
   c. Cooling equipment.

3. Vessels, tanks, stacks, and other items which contain or convey fluids which are at such temperatures as to create condensation or surface temperatures which are hazardous or where heat loss or gain prohibits proper system operation.

4. Shop Drawings: Refer to the Section entitled "General Mechanical Provisions". Shop drawings shall contain complete descriptive and engineering data, including flame spread and smoke developed ratings (ASTM E84 test method) on all materials and adhesives. Where finishes, covers, or jackets are specified, provide complete data on same. Shop drawings shall contain specified information on: densities, conductivities, conductances, or resistances as required to establish conformance with the specified values or materials. Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be submitted with shop drawings. Submit shop drawings before any work is commenced.

5. Storage of Materials: Do not store fiberglass insulation within the building until it has been "dried in". If no other dry space is available and this insulation must be installed or stored before the building is "dried in" and completely enclosed, provide polyethylene film cover for protection.

6. Applicable Codes: The total insulation system including insulation, sealant, finishes, etc. shall comply with or exceed all code requirements. All materials and adhesives used shall
conform to the requirements of NFPA 90A as to flame spread and smoke developed ratings.

7. Terminology: Throughout this section, insulation products may be described as regards the location, surface or other point at which they are to be applied. Except in special cases (where a detailed indication or description will be given), the majority of conditions can be defined in whole or in part by use of (but not necessarily limited to) any or all of the following words:
   a. "Internal" or "External".
   b. "Interior" or "Exterior".
   c. "Concealed" or "Exposed".
   d. "Protected" or "Unprotected".

8. Definitions: Wordage used to describe locations, surfaces or other points or conditions shall be defined as follows as related to this section. Where the ascertainment or determination of locations, surfaces and other conditions is obvious from the intent of use of the item (e.g., roof-mounted ductwork, underground piping, etc.) or from other information, then the following words may not be required. If any ambiguity should occur, provide bid based on the most severe condition; however, obtain clarification from Architect/Engineer prior to installation:
   a. "Internal" and "External": Relates to an item or its surface which is to be insulated or uninsulated. Does not relate to the confines of the building, structure or other entity in which the item is located. (Examples: internal/external surfaces of ductwork, pipe, air handling units or other such items.)
   b. "Interior": Relates to the location of an item as to whether the item is within a heated, ventilated, air conditioned or otherwise controlled environment of the building, structure or other entity in which the item is located. "Interior" is always "Protected". (Examples(s): Interior ductwork, interior piping, interior air handling units.)
   c. "Exterior": Relates to the location of an item as to whether the item is outside (i.e., exterior to) a heated, ventilated, air conditioned or otherwise controlled environment of the building, structure, facility or other entity which the item serves or relates. "Exterior" generally means that the item is surrounded by the ambient outside environment. "Exterior" is considered "Unprotected" unless otherwise described. (Examples(s): exterior rooftop air handling units, exterior ductwork, exterior cooling tower.)
   d. "Concealed" and "Exposed": Relates to the visibility of an item. "Concealed" implies out-of-sight from normal view by an occupant, user or employee of the facility when such person is performing their normal function. "Exposed" implies that the item is readily visible by such a person when that person is performing a normal function. (Examples(s): "Concealed interior ductwork" would be out-of-sight in a ceiling plenum, whereas "exposed interior ductwork" would be readily visible in a mechanical equipment room or in a room which intentionally had no ceiling system.)
   e. "Protected" and "Unprotected": Relates to an exterior item which may or may not be sheltered from the outside elements but which exists in contiguous contact with
the ambient environment without benefit of any direct heating, ventilating or air conditioning. (Example(s): Piping or ducts located in an open crawl space beneath a building would be "protected/concealed"; in an open parking garage such piping or ducts would be "protected/exposed". Piping or ducts on a rooftop would be "unprotected" and usually "exposed").

9. Materials: Materials listed are those used as basis of design; equivalent products of acceptable manufacturers will be accepted. Materials must be approved and recommended by the insulation product manufacturer for the particular application(s).

10. Flame and Smoke Ratings: Application of insulation materials may require, in many cases, that the final insulation system comply with NFPA 90A with regard to maintaining a flame spread rating of 25 or less and a smoke developed/fuel contributed valve of 50 or less. In such cases, verify that the materials comply with the indicated flame spread and smoke developed ratings.

11. Acceptable Manufacturers: Manufacturers which are listed are those manufacturers who may make one or more of the insulation products required. Listing of a manufacturer does not necessarily mean the manufacturer is approved for all applicable insulation conditions. Each listed manufacturer must still comply with the specific requirements of each insulation condition to be acceptable for the particular application. Acceptable manufacturers of insulation-related products include (but are not necessarily limited to) the following: Armstrong; CertainTeed; Knauf; Manville; Owens-Corning; Pittsburg Corning; Rubatex; Dow Corning Corporation; Duro Dyne Corporation; 3M Co.; United McGill Corporation

12. Fiberglass Insulation: Inorganic fibrous glass. Flame spread of "25" or less and smoke developed rating of "50" or less per ASTM E 84.

   a. Board: Rigid or semi-rigid form, faced or unfaced as indicated. Stiffness of 475 EI, 800 EI or 1400 EI as indicated.

   b. Blanket: Flexible form; faced, unfaced or coated as indicated.

   c. Preformed: Jacketed or unjacketed as indicated.

13. Insulation Products:

   a. Type PI-1: Pipe insulation, preformed cellular glass. Pittsburg-Corning "Foamglass" or equivalent.

   b. Type PI-2: Pipe insulation, preformed jacketed fiberglass. Jacketed with factory-applied kraft reinforced foil vapor barrier jacket. Jacket closure system of double pressure-sensitive adhesive on longitudinal joints; self-sealing butt strips at circumferential joints; provide positive vapor barrier seal. Thermal conductivity (K) of 0.24 at 100oF. Owens-Corning Fiberglas ASJ/SSL-II; Manville Micro-Lok with AP-T Plus jacket; CertainTeed 500 Snap-On; or equivalent.

   c. Type DI-1: Duct insulation, fiberglass flexible blanket wrap. Composed of flexible blanket of glass fiber factory laminated to a reinforced foil kraft (FRK) vapor barrier
with a minimum 2-inch taping and stapling flange on one edge. Suitable for operation at temperatures from 400°F to 250°F. Thermal conductivity of 0.31 at 750°F. Minimum density of three-quarter (3/4) pound per cubic foot. Provide in thickness of (2.2) inches unless otherwise specified as 2-1/2 or 3-inch thickness. Owens-Corning All Service Faced Duct Wrap; Manville R-Series Microlite; CertainTeed Standard Duct Wrap; or equivalent.

d. Type DI-2: Duct insulation, fiberglass semi-rigid board. Composed of resin bonded glass fibers faced with a foil scrim-kraft (FSK) reinforced laminate of aluminum foil and kraft bonded to provide a metallic surface finish vapor barrier; alternate vapor barrier facing (if specifically indicated) is an all service jacket (ASJ) of high intensity white bleached, chemically treated kraft paper reinforced with fiberglass yarn mesh and laminated to aluminum foil with fire-retardant adhesive to impart a clean, white appearance. Conductivity (K) of not greater than 0.23 at 750°F. Provide in thickness of one (1) inch unless otherwise indicated. Provide with minimum density of 3-pcf unless 6-pcf is specifically indicated. CertainTeed Industrial Insulation Board Type IB-300 (or IB-600); Manville 800 Series Glas Type 814 (or 817); Owens-Corning 700 Series Industrial Insulation Board Type 703 (or Type 705); or equivalent.

14. Insulation Adhesives, Mastics and Sealants:


b. Adhesive (Type A-F1): For adhering fiberglass blanket and board insulations (Types DI-1, DI-2) to metal substrate such as ductwork. Insulcoistic I-C 201, Foster 85-20 or equivalent.

c. Mastic, General Purpose (Type M-GP1): Non hardening vapor barrier general purpose mastic. For use where indicated or otherwise applicable. Foster GPM 35-00 or equivalent.

15. Insulation Finishes, Jackets and Covers:

a. Finish Fabric, General Purpose (Type FF-GP1): Nylon membrane. For use generally with fiberglass duct insulations (Types DI-1, DI-2) at joints or seams or as may be indicated. Apply using Foster GPM 35-00 or equivalent.

b. Jacket, Pipe, PVC (Type JP-PVC): All purpose, UL-rated, white vinyl jacket, with or without self-sealing feature. Pittsburg-Corning "UNI-JAC" or equivalent.

c. Jacket, Pipe, Aluminum (Type JP-A1): Aluminum jacketing, 0.016 inches thick, type 3003 alloy, H-14 temper, circumferentially corrugated, with a continuously laminated moisture barrier of one mil polyethylene film and a protective layer of 40 lb. virgin kraft paper. Childers Products Co. "Corolon"; General Aluminum Supply Co. (Gasco); Insulcoistic "Alcorjac" or equivalent.

d. Pipe Fitting Covers, PVC (Type PFC-PVC): Insulated polyvinyl-chloride fitting covers in shapes as required; with fiberglass insulation insert. Suitable for
temperature range of 0°F to 450°F. Flame spread rating of 25 or less and smoke developed rating of 50 or less when kept below 150°F. Acid, alkali and chemical resistant. Suitable for painting if required. Manville Zeston 25/50 PVC Insulated Fitting Covers or equivalent.

e. Pipe Fitting Covers, Aluminum (Type PFC-A1): Aluminum fitting covers, 0.020 inches minimum thickness, type 3003 alloy, H-14 temper prefabricated fitting covers with baked epoxy moisture barrier for pipe sizes through 24". Field fabricate fitting covers for pipe sizes larger than 24" using 0.020 inches thick aluminum roll jacketing with laminated polyethylene/kraft moisture barrier. Childers Products "Ell-Jacs", "Gore Ell-Jacs", "Tee-Jack", "End-Caps", and "Flange Jacs" or equivalent.

16. Related Products:

a. Wire (Type W-1): Dead soft, 16-gauge, stainless steel.

b. Straps (Type ST-1): Stainless steel T-304 (18-8) soft annealed with deburred edge with stainless steel wing seals. Childers Products "Febstraps" or equivalent.

c. Tape (Type T-1): High tensile strength rope stock flat back paper pressure sensitive tape. Pittsburg-Corning "PC Tape No. 25" or equivalent.

d. Screws (Type S-1): Aluminum pan head type "A" slotted #8 by 1/2-inch.

17. Field Forming, Fitting and Finishing: Where preformed insulation products are indicated as being acceptable for a particular application, provide field formed, fitted and finished insulation systems if such application is more practical (such as due to size, configuration or dimensions which may be outside of the availability ranges for size, dimension and/or thickness of preformed products).

18. Pre-installation:

a. Do not apply insulation adhesives, materials or finishes until the item to be insulated has been completely installed and tested and proved tight and suitable for insulation.

b. Prepare surfaces to be clean and dry before attempting to apply insulation.

19. Insulation Shields: Provide hanger or pipe support shields of 16 gage (minimum) galvanized steel over or embedded in the insulation. Shield shall extend halfway up the pipe insulation cover and at least 6" on each side of the hanger. Securely fasten shield with pipe straps at each end.

20. Valves, Cocks and Specialties: Insulate as for the related piping system in which they are located unless otherwise indicated.

21. Factory Pre-insulated Components: Where equipment and other system components are specified in other sections to have factory installed insulation, then no additional insulation is required as work of this section unless additional non-factory-installed insulation is specifically described. Examples of such equipment and components which may not
require additional insulation include, but are not necessarily limited to, boiler vessels, chiller evaporators, air handling units, airside terminal units, and similar items.

22. Minimum Thicknesses: Insulation thicknesses which are indicated are minimum thicknesses. Contractor may provide the same insulation material in greater thickness as an aid to installation and handling procedures or due to material availability and procurement considerations.

23. Branch Run-outs: Branch run-outs are considered to be individual supply/return pipes to individual terminal heating or cooling units (duct mounted coils, airside terminal units with heating coils, fan coil units, humidifiers, and similar small equipment). The supply/return pipe to such units is not considered to be a branch run-out if the length of the supply or return pipe exceeds 12'-0" in length to the coil/unit connection.

24. Insulation Thickness for Piping Systems:

   a. Basis: Insulation thicknesses for piping are given for insulation installed in the locations indicated. Thicknesses are based on the various conditions of temperature, usage and environment which are typically encountered.

   b. Applicable Thicknesses: All thicknesses as applicable to all conditions may not be given in this section article. Where an insulation thickness for a particular application is specified to be of other thickness than may be listed in this section article, "INSULATION THICKNESSES FOR PIPING SYSTEMS", then provide the insulation in the thickness indicated in other portion of this section which specifically describes the particular insulation application and its required insulation thickness. Thicknesses for other than piping insulation are given in the specific description of the particular application or description of the particular material used.

   c. Ambient Conditions: Unless otherwise indicated, ambient conditions for the purpose of describing insulation thicknesses are related to cold applications to prevent condensation or excessive heat gain (e.g., chilled water pipe, cold vessels) and are related to hot applications to prevent harm to personnel or to prevent objectionable heat loss to the environment (e.g., hot water pipe, hot vessels, hot stacks).

      i. These conditions are generally:
         1. Interior: 80°F and 80% RH.
         2. Exterior: 90°F and 80% RH.

   d. Thickness Requirements: Thicknesses are given below based on the following information:

      i. General type of fluid or process involved (e.g., chilled water, hot water, and refrigerant).

      ii. General location and, if necessary, conditions related to temperature (either or both internal or external to the insulation barrier) and ambient environment of the insulated item.
iii. Pipe size range.

iv. Refrigerant Piping Systems: Location or Description
Pipe Size (inches)
Insulation Thickness Interior Up to 2" 1-1/2"

25. Refrigerant piping systems

a. Interior, Concealed/Exposed (e.g., ceiling plenums): Insulate with prefabricated, FIBERGLASS pipe insulation. Butter joints with joint sealant (FF-GP1). Mastic shall be applied in strict accordance with the manufacturer's recommendations.

b. Exterior: Same as for "Interior, Concealed" with the additional requirement to provide full aluminum jacketing and accessories on all exposed refrigerant suction piping, elbows and fittings.

26. Duct systems

a. Locations and extent of both internal and external insulation for duct systems are described in section entitled "Ductwork" and/or by the "Duct Type and Location Schedule" on the Drawings.

b. Internal Insulation: Ductwork which is required to be insulated internally (acoustically/thermally lined) shall be insulated as work of the section entitled "Ductwork".

c. External Insulation: Ductwork which is required to be insulated externally shall be insulated as work of this section.

d. Factory Insulation: Ductwork which is factory manufactured with internal or external insulation is not to be additionally insulated as work of this section unless specifically stated. Such factory insulated ductwork generally consists of flexible externally insulated ductwork and double walled acoustically thermally lined ductwork.

e. Interior, Concealed (e.g., ceiling plenums): Where external insulation is required, insulate externally with 2.2 inch thick fiberglass blanket wrap (Type DI-1). Adhere duct insulation using adhesive (Type A-F1) applied in accordance with the manufacturer's recommendations. Where duct width exceeds twenty-four inches (24"), the insulation shall be additionally secured to the bottom of the duct using mechanical fasteners spaced one foot (1') on center. Insulation shall be applied with edges tightly butted, and all joints and breaks in the vapor barrier sealed using glass fabric and mastic applied in conformance with manufacturer's recommendations.

f. Interior, Exposed, (e.g., air handling unit rooms, areas without ceilings, etc.): Where external insulation is required, insulate with 1-1/2"-inch thick semi-rigid fiberglass
board (Type DI-2). Adhere to ductwork with adhesive (Type A-F1). Finish joints and seams with finish fabric (Type FF-GP1).

27. Duct systems equipment
   a. General: Insulate as follows unless detailed to a greater extent on the Drawings.
   b. Fire Damper External Surfaces:
      i. Externally Insulated Duct Locations: Extend duct insulation up face of fire damper to damper sleeve. Seal insulation edges with 4-inch minimum width duct tape.
      ii. Internally Insulated Duct Locations: Provide additional external insulation from a point on the duct 12 inches from the fire damper to the fire damper and on the face of the fire damper to the fire damper sleeve. Seal insulation edges with 4-inch minimum width duct tape.
      iii. Air Distribution Devices: Insulate the backs of all ceiling diffusers and other air outlet devices installed in other than return air plenums as specified for interior concealed ducts.

28. Cold equipment and related components
   a. Condensate Drain Piping From Cooling Equipment:


23 09 23 Direct-Digital Control System for HVAC

1. Furnish all labor, materials, equipment, and service necessary for modifications and additions to the existing DDC temperature control system in the building, as defined by ANSI/ASHRAE Standard 135B2001, Direct Digital Controls, electronic interfaces and actuation devices, as shown on the drawings and as described herein. The existing Broward College DDC infrastructure is Andover. All controls for this renovation project shall be provided by Andover, Inc. and shall be accordance with the Broward College DDC standards and requirements.

2. The control system shall use an open architecture that matches the existing campus control system. No substitutions shall be accepted.


4. The System shall provide a Web-Based Graphical User interface where the owner may make all adjustments, settings, and changes through the same software during any single session without having to launch an additional piece of software.
5. The control contractor shall be responsible for all control electrical requirement’s necessary for the installation of the control system including valve actuators, damper actuator’s, etc. No additional costs’ will be incurred by the Owner for lack of coordination for the electrical work required for the new control systems.

6. Installation

   a. All work described in this section shall be installed, wired, circuit tested and calibrated by trained electricians and mechanics qualified for this work and in the regular employment of the control contractor.

   b. The installing office shall have a minimum of five years of experience in the installation of DDC temperature control systems. The installation work shall not be subcontracted.

   c. The temperature control contractor’s office and base of operation where at least five employees report to work shall be within a 50-mile radius of the job site. During the warranty - period the contractor shall respond be able to warranty calls within 6 hours.

   d. All control valves, damper motors, thermostats, sensors, air flow switches, transformers, transmitters, transducers, controllers, panels & enclosures, or any type of control component shall be appropriately selected, matched and engineered to provide a seamless and functional system.

   e. All temperature control and interlock wiring shall be installed in conduit in exposed areas. Where concealed or allowed by Division 26 PVC jacketed cable may be used in concealed areas as long as bundles are neatly strapped and supported every three feet.

   f. Where applicable, the control contractor will ship all VAV controllers to the VAV vendor’s factory for factory mounting and wiring of controls. The VAV vendor will furnish factory mounting, wiring, damper actuator, control transformer and inlet sensor.

   g. All power wiring for control panels or any control device requiring 120 VAC shall be provided by division 26. The control contractor shall be responsible for contracting independently with the general building’s electrical contractor for providing all power requirements for the control equipment.

   h. Tags, charts and Identification:

      i. Tags: Tag automatic control valves, dampers and controlled devices in an approved manner

      ii. Drawings: Provide 11” X 17” as-built shop drawings attached to each panel.

      iii. VAV Terminals: Provide Labels on the ceiling grid tee or access door at hard ceilings for VAV terminals. Locate labels below the VAV terminal. Refer to Section 23 05 53 for Identification requirements.
7. Submittals

   a. Furnish and provide 10 copies of a complete submittal composed of introduction, control drawings with sequences and specific information sheets showing pictures and engineering data of provided equipment.

   b. Drawings shall indicate:
      i. Show footprint of the complex showing approximate equipment and node locations. When possible the footprint AutoCAD drawing files shall be available from the consultant.

      ii. LAN routing of cable or bus from node to node indicating data-line protection and building entry.

      iii. System architecture schematically shows the complete communication structure of the system.

      iv. Flow diagrams of each uniquely controlled system showing components and their relative placement and the path of piping or ductwork as it relates to the conditioning of its respective fluid.

      v. Wiring schematics showing the controller terminals and all connected component terminals, showing point-to-point wiring.

      vi. Sequence of operation for each piece of system or subsystem describing the operation.

      vii. Provide manufacturer's instructions and drawings for installation, maintenance and operation of all purchased items.

8. Upon the completion of the project 5 copies of maintenance and operations manuals shall be produced with as-built control drawings, technical data, and maintenance and troubleshooting data as well as programming manual for all automation to be turned over to the owner.

9. General Requirements:

   a. Provide modifications to the existing Global Controller and Graphical user interface to a file server connected to a network of programmable or stand-alone terminal unit controllers. System modifications must be capable of up to 10 simultaneous users in the base bid software and use all standard web-browser features.

   b. All DDC Controllers for terminal units, air handlers, central mechanical equipment and Windows based operators' terminal(s) shall communicate with each other and share information.

   c. Generate Graphic Screens for all mechanical equipment, floor plans, a main quick look screen detailing all equipment on one screen with status and area temperatures.
d. Use Broward College’s standard sensor and process signals. Normal 10K ohm, 1K ohm stainless steel sensors shall be used. Provide standard 0-10vdc or 4-20mA control signals on all modulating devices.

e. The project shall be inclusive of all costs. Systems that require the payment of any type of royalty fees will not be permitted or used. This shall also apply to replacement parts.

f. All scheduling, Alarming and Trending shall be an inherent part of the Automation Software, built by the manufacturer as an integral part of the Graphical User interface.

g. The Controllers and Software protocol shall both be recognized an ANSI standard.

10. Basic System Features:

a. Specified control of space temperature, usage scheduling, optimum starting, equipment failure reporting, and override timers for off-hours usage.

b. Graphic screens. Refresh rates of all screens regardless of the amount of information shall be within a maximum of 10 seconds.

c. Complete energy management firmware, including self-adjusting optimum start, demand limiting, and global control strategies and logging routines for use with total control systems.

d. Priority password security systems to prevent unauthorized use. Each user shall have an individual password. Each user shall be assigned which control functions they have access to.

e. Equipment monitoring and alarm function including information for diagnosing equipment problems.

f. The complete system including but not limited to terminal unit controllers, Global controllers and Operator terminals shall Auto-restart, without operator intervention, on resumption of power after a power failure.

g. Direct access to any point in the system from the global controller interface shall include all physical, Pseudo type, logical, or software points and values.

h. Each field panel capable of independent control and stand-alone operation.

i. Equipment runtime totalization of fans, heaters, etc., capable of alarm generation and alarm dial out to remote sites.

j. All DDC hardware and software shall be designed and manufactured by U.S. corporations. All hardware shall be U.L. listed with integral labels showing rating.
k. Support fiber-optic LAN communications as well as hardwire.

l. Both Ethernet Level and MS/TP level controllers shall be of the same protocol; BACnet.

m. Operator’s workstation software shall be modified as required to accommodate the renovations. The Energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing the Single Open protocol of the successful vendor. Software shall include password protection, alarming, logging of historical data, full graphics including animation, full suite of field engineering tools including graphical programming and applications Systems using operating systems other than that described above are strictly prohibited.

11. Quality assurance

a. Responsibility: The supplier of the DDC shall be responsible for inspection and Quality Assurance for all materials and workmanship furnished by him.

b. Tools, Testing and Calibration Equipment: Provide all tools, testing and calibration equipment necessary to ensure reliability and accuracy of the DDC System.

12. Reference standards

a. The latest edition of the following standards and codes in effect and amended as of date of Supplier’s Proposal, and any subsections thereof as applicable, shall govern design and selection of equipment and material supplied:


13. Warranty

a. Warranty shall cover all costs for parts, labor, and associated travel, and expenses for a period of one year from completion of system demonstration.

b. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the Vendor. The maximum acceptable response time to provide this service at the site shall be 6 hours.

c. This warranty shall apply equally to both hardware and software.

14. Materials/acceptable manufacturers: All materials and equipment used shall be standard components, of regular manufacture for this application. All systems and components shall have been thoroughly tested and proven in actual use. Approved Manufacturers are limited to the following: Andover Controls (BACnet System only). No other manufacturers shall be approved for use with Broward College without BCPM prior approval.
15. System terminal/ windows

a. Installed DDC System Displays:
   
i. Graphic files shall be created utilizing scanned full color photographs of system installation, AutoCAD drawing files of field installation drawings and wiring diagrams from as-built drawings. System shall be capable of displaying graphic file, text and dynamic point data together on each display. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units.

b. All displays shall be generated and customized in such a manner by the local supplier that they fit the project as specified. Displays shall use Standard English for labeling and readout.

c. Systems requiring factory programming for graphics or DDC logic are specifically prohibited.

d. Digital points shall be displayed as On/Off or with customized text.

e. Analog points shall be displayed with operator modifiable units.

f. Analog points may also be assigned to an area of a system graphic, where the color of the defined area would change based on the analog points value.

g. All dynamic point information shall be updated on the Operators terminal display CRT once every 1 second. Devices in the field shall act any changes by the operator on within 2 seconds maximum.

h. Displays may be modified via Web communications and through the Internal Intranet as well.

16. Security System:

a. Provide security system that prevents unauthorized use unless operator is logged on.

b. System shall maintain a log of all user activities while logged onto the system. Provide for easy viewing of all items in user log, including time and date of login, logoff and all activities in between.

17. Display of Scheduling Information:

a. Display of all schedules shall show all information in easy to read format for each schedule. This includes all on/off times for each day along with all optimum start information.

b. Holiday schedules shall show all dates that are to be holidays. Each day assigned as a holiday shall display as "All Off" or show the times scheduled for that day.
c. Event schedules shall be shown in the same graphical format. After event has elapsed, control returns to normal schedule.

d. Operator shall be able to change all information for a given Weekly, Holiday or Event schedule if logged on with the appropriate security access.

18. Alarm Indication and Trending:

a. System alarms may be directed to terminals, PDA’s, Web Enabled phones, printers, digital or analog pagers.

b. Provide log of alarm messages. Alarm log shall be archived. Each entry shall include point descriptor and address, time and date of alarm occurrence, point value at time of alarm, time and date of point return to normal condition, time and date of alarm acknowledgement.

c. Alarm messages shall be in plain English and shall be user definable on site or via remote Communication and email. System shall provide a minimum of 20 user definable messages for each zone controlled.

d. System shall periodically gather samples of point data stored in the field equipment and archive the information on the Operator terminals hard disk. Archive files shall be appended with new sample data, allowing samples to be accumulated over several years. Systems that write over archived data shall not be allowed. Samples may be viewed at the operator’s terminal in a Trend Log. Trend log displays shall be in spreadsheet format.

e. System software shall be capable of graphing the trend log point data. Software shall be capable of creating graphs in the following forms as a minimum: Bar charts, Log/Linear graphs, Bubble graphs, x-y graphs, Log/Log graphs, Area graphs (2D or 3D), Pie charts, Scatter graphs, Polar graphs, High-Low-Close graphs.

f. Operator shall be able to change trend log setup information as well. This includes information to be trend logged as well as interval at which information is to be logged. All points in the system may be logged. All operations shall be password protected.

19. Energy Log Information:

a. System shall periodically gather energy extended log data stored in the field equipment and archive the information. Archive files shall be appended with the new data, allowing data to be accumulated over several years. Systems that write over archived data shall not be allowed. Log data may be viewed in a spreadsheet format. Provide capability for operator to scroll through all Energy log data vertically (time axis) and horizontally (point sample columns). System shall automatically open archive files as needed to display archived data when operator scrolls through the data vertically. Display all Energy log information in standard engineering units.
b. System software shall be capable of graphing the Energy log data. Software shall be capable of creating graphs in the same format as trends log indicated earlier.

c. Operator shall be able to change the Energy log setup information as well. This includes which meters to be logged and meter pulse value. All meters monitored in the system may be logged. All operations shall be password protected.

20. GLOBAL CONTROLLER

a. The existing global controller shall provide UPS and battery backed real time clock functions. It shall also provide system communications to programmable and application specific controllers in the field. Global controllers shall share information in a Peer-to-Peer manner utilizing a high-speed LAN communication network over common network speeds used by the District.

b. Programming shall be object oriented using control program blocks. Provide documentation in flow chart form for all programming as part of the final system As-Built documentation.

c. Provide means to view inputs and outputs to each program block in real time as program is executing.

d. Communication to field devices shall be via individual two wire communication trunk(s). Communication baud rates 78,000 baud or higher.

e. System shall be furnished with a controller that resides on a High speed Ethernet LAN. Each controller must be capable of directly accessing all points of connected unit controllers whether physical, pseudo or logical type, or Software points and values.

21. Remote Communications: Provide Windows Professional compatible software, which allows operator to view and change all information, associated with system on color graphic displays. Operator shall be able to change all parameters in this section from off-site location including all programming of global controllers and programmable terminal unit controllers.

22. Schedules:

a. Each Global Controller shall have at a minimum:
   i. 64 Weekly time schedules (7 day)
   ii. 64 Holiday schedules (300 programmable days each)
   iii. 20 Event schedules (300 programmable days each).

b. Each schedule may be assigned to any point, controller, or program in the system.

c. Each schedule (Weekly, Holiday and Event) shall be capable of performing an optimum start. Optimum start calculation shall be based on outside air temperature and zone air temperature.
d. Holiday schedule shall be provided to allow operation of system based on different schedule on specified holidays.

e. Event schedules shall be identical to Holiday schedule format and requirements.

f. Operator may define and setup all schedule information, via portable computer on site or via remote communications. This includes all times, dates and optimum start parameters. These functions shall be password protected

23. Terminal unit controllers

a. Where applicable, provide programmable and application specific Terminal Unit Controller as needed to comply with sequence of operation, point list and drawings. All Terminal Unit Controller units shall be completely stand-alone with no loss of control if communication with global controller is interrupted. All control parameters; DDC programs and local variables such as set-point information shall be stored in EEPROM on board each Terminal Unit Controller allowing the operator to change information as desired.

b. All points on drawings, in sequence of operation and on point list shall be connected to and controlled by DDC units.

c. Communication shall be via two-wire communication trunk as specified above. Any type of Terminal Unit Controller shall communicate on the same communication trunk. System shall communicate to one Terminal Unit Controller regardless of whether other Terminal Unit Controllers on the same communication line are powered and connected.

24. Programmable Terminal Unit Controllers:

a. Each programmable Terminal Unit Controller shall be completely programmable via field computer or via remote communications.

b. This controller shall be programmed to perform custom strategies for system based on information from all points in the field.

c. Program and program parameters shall be stored in EEPROM. Battery backed RAM shall not be accepted for this level of controller.

25. Application Specific Terminal Unit Controllers:

a. Application Specific Terminal Unit Controllers shall be completely stand-alone controllers for unitary type controls such as VAV terminal boxes, heat pumps, AC units, fan coils, etc. All programs shall be resident in controller for complete stand-alone operation.

b. EEPROM technology shall be used for storage of program parameters such as set points, limits, etc., controllers utilizing a battery for backup of program parameters shall not be allowed.
26. Temperature sensors
   a. All temperature sensors to be solid-state electronic, factory calibrated to within one-half degree F, totally interchangeable. Wall sensors to be housed in enclosure appropriate for application. Duct and well sensors will be electronically identical with housing appropriate for application. Provide appropriate wells for installation by others.
   b. Provide Digital display zone sensor for all wall sensors unless indicated otherwise on drawings.

27. Digital Display Zone Temperature Sensor:
   a. Sensor may contain digital display and user function keys along with temperature sensor or have blank plate, as defined by owner. Sensor may function as occupant control unit and allow occupant to raise and lower set-point and activate terminal unit for night override use all within limits as programmed by building operator. Sensor shall also allow service technician access to terminal unit controller functions for use as system setup and test and service tool. Systems that require a Hand held field service tool shall furnish a minimum of one (1) to the owner.
   b. Provide means for occupant to view room set-point, room temperature and outside air temperature at each controller. Override time may be set and viewed in 0.1-hour increments. Override time count down shall be automatic, but may be reset to zero using function keys on unit.
   c. Display shall also be used for status and alarm indication as described in the sequence of operation.

28. Web Browser Clients:
   a. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer J or Netscape Navigator J. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
   b. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.
   c. The Graphical User Interface provides the Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
29. The Web browser client shall support at a minimum, the following functions:
   a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
   b. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

30. Storage of the graphical screens shall be in the fileserver, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

31. Real-time values displayed on a Web page shall update automatically without requiring a manual refresh of the Web page. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to modify common application objects, such as schedules, calendars, and set points in a graphical manner.

32. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

33. Instruments and controlled devices
   a. Transmitters/Transducers: Provide special transmitters and sensors for specific applications as required. Transmitters shall provide an industry standard process signal across an acceptable range of engineering units such as 2-10vdc, 4-20mA.
   b. Room Temperature Sensors: Space temperature sensors shall be by Veris Industries per the Broward College Standard requirements.
   c. Humidity Sensors: Where specified Humidity sensors shall be by Veris Industries, KMC Controls, or Mamac Systems.

34. Motorized Control Dampers: Motorized dampers shall be parallel blade for two-position control and opposed blade for proportional control applications. Dampers shall be galvanized, with nylon bearings. Blade edge and tip seals shall be included for all dampers. Leakage through the damper shall not exceed 20 CFM per square foot at 4” w.g. (based on a 48” x 48” test sample). Blades shall be 16-gauge minimum and 10” wide maximum and frame shall be of welded channel iron. Approved manufacturers are: Penn Ventilator, Ruskin damper.

35. Damper Motors: Damper actuator motors shall be gear-driven direct coupled mounting. All damper actuators shall be floating, modulating or two-position as indicated. Actuators shall be sized to allow for sufficient torque for the given application to prevent stalling or binding. All Actuators shall have clutch release mechanisms to allow manual opening and closing of damper or valve. Approved manufacturers are: Belimo Air Controls.
36. Prior to starting work:
   a. Carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
   b. Notify the Owners Representative or Contractor in writing of conditions detrimental to the proper and timely completion of the work.

37. Install in accordance with manufacturer's instructions.

38. Provide all miscellaneous devices, hardware, software, interconnection installation and programming required to insure a complete operating system in accordance with the sequences of operation and point schedules.

39. Location and installation of components
   a. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Sensors shall be away from doors, directly under return air grilles and not on exterior walls. Obtain BCPM approval on locations prior to installation.
   b. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration and high temperatures.
   c. Identify all equipment and panels. Provide permanently mounted tags to all panels.
   d. Provide stainless steel or brass thermal wells suitable for respective application and for installation under other sections; sized to suit pipe diameter without restricting flow.

40. Interlocking and control wiring
   a. All wiring shall be installed in a neat and professional manner in accordance with Division 16 and all state and local electrical codes.
   b. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions.
   c. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Any requirement for wiring outside of buildings shall use Fiber Optic cable except within mechanical/electrical equipment.
   d. Provide auxiliary pilot duty relays on motor starters as required for control function.
   e. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed in a neat and inconspicuous manner per local code requirements.
f. Provide 120-vac control power to all control panels and 120-vac powered devices. Provide 120-vac control power for all magnetic motor starters at the starter.

41. Field services
   a. Prepare and start DDC System under provisions of this section.
   b. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
   c. Provide Owner's Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

42. TRAINING
   a. Provide application engineer to instruct owner in operation of systems and equipment.
   b. Provide basic operator training for a minimum of 3 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs.
   c. Provide training above as required up to 16 hours as part of this contract.

43. Demonstration
   a. Provide systems demonstration under provisions of Section 23 01 00.
   b. Demonstrate complete operating system to Owner's Representative.

44. Sequence of operations: Per construction documents.

SECTION 23 09 25 - VARIABLE FREQUENCY DRIVES

1. General: Provide Variable Frequency Drives of the latest design and technology to provide adjustable frequency/speed control of motors, as indicated herein and on the Construction Documents. It is the intention of these specifications that the VFD controller shall be completely solid-state variable voltage source design.

2. Quality assurance
   a. Single Manufacturer: All VFD units shall be provided by a single manufacturer.
   b. Parts and Service: The VFD Manufacturer shall maintain, as part of a national network, Engineering and Parts service facilities to provide start-up service, emergency service calls, repair work, service contracts, maintenance and training of customer personnel.
c. Standards: The VFD shall comply with latest IEEE 519 – “Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems”, and the latest applicable standards of ANSI, NEMA and the NEC. As a minimum, the full load output current rating of the drive shall be equal to 1.2 times the equivalent motor horsepower full load current as listed by National Electric Code Table 430-230).

d. Harmonics: The VFD's shall limit harmonic distortion reflected onto the source distribution system to a voltage and current distortion level as defined by IEEE 519. Harmonic calculations shall be provided with submittal. Field testing and certification is required as indicated separately in this specification.

   i. IEEE 519 Calculations, provided by the VFD manufacturer, indicating calculated harmonic distortion levels with equipment being provided. Point of common coupling shall be at the secondary of the utility company transformer.

   ii. Warranty Information

e. General: Refer to paragraph entitled “SUBMITTAL” in Section 230100. Include the following material and performance data:

   i. Manufacturers literature

   ii. Performance data

   iii. Installation instructions

   iv. Maintenance instructions

   v. Manufacturer's Start-Up, Checkout and Instructions

3. Factory testing and calculations

   a. Factory Testing and Warranty: Each VFD shall be factory tested to ensure reliability. Testing shall include component thermal cycling, logic system simulation tests and full load operation tests.

4. Point of Common Coupling: Field testing of each VFD at the point of common coupling is required to determine harmonic feedback onto the distribution system. The harmonic distortion at this point shall be limited to the voltage and current levels defined by IEEE-519. Voltage: 5% = 100 x Total Harmonic Voltage (total units) Fundamental Voltage

5. Manufacturers: The VFD shall be Yaskawa. Other manufacturers are not acceptable and will not be considered.

6. Requirements: All requirements of these specifications must be fully met for the VFD to be officially approved.
7. Variable frequency drive

a. General: The Variable Frequency Drive shall be capable of converting the input voltage from to variable frequency, three phase AC power for variable torque motor control continuously from 10 percent to 100 percent of base speed. A transformer shall not be used to adjust the input or output voltage. All general options and modifications shall mount within the VFD enclosure. The voltage-to-frequency ratio shall be automatically adjusted to maximize energy savings.

b. Duty: The adjustable frequency system shall be continuous centrifugal duty stepless VFD matched to the motors provided with the equipment (i.e. fans and pumps). The VFD's shall be capable of operating any motor, regardless of manufacturer, with a load rating within the capacity of the VFD's. 230925 VFD Spec for the Manufacturer.

c. Microprocessor Based: The VFD's shall provide a microprocessor-based adjustment of three-phase motors.

d. Pulse: The VFD's shall be of the 6 pulse for motor HP <100 and 12 pulse or greater for motor HP > 100, Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. VFD's utilizing a third power section are not acceptable.

e. Operating Conditions: Standard operating conditions shall be:

   i. Incoming Power: Specified Voltage +5% to -10% and 60 hertz +/-2 hertz power to a fixed potential DC bus level.

   ii. Humidity: 0 to 95% non-condensing and non-corrosive (indoor applications).

   iii. Altitude: 0 to 3,300 feet above sea level.

   iv. Ambient Temperature: 0 to 40 degrees C (indoor applications).

f. Rotating Motor: The VFD's shall be able to start into a spinning motor. The VFD's shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFD's shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor in the preset method of starting.

g. Housing: VFD's located in dry interior spaces shall be housed in a NEMA 1 enclosure; VFDs located outside or in damp locations shall be provided with NEMA 3R weatherproof enclosure.

h. Power Factor: Power Factor Correction capacitors shall not be utilized to meet motor performance criteria.

i. Front Door: The front door of the controller shall include a door interlock disconnect switch. This shall prevent opening of the unit until the disconnect is in the off position. Input fuses shall be provided.
j. Manual Reset: The output power circuitry of the unit shall include a manual reset motor overload relay interlocked with the "on" circuitry of the unit. This shall be an adjustable solid-state device to allow easy field adjustment to motor nameplate amps.

k. Minimum Withstand Rating: The entire Variable Frequency Drive assembly (drive, bypass and all components) shall be capable of a minimum withstand rating as indicated on the electrical drawings, for a minimum 3-cycles. The VFD assembly nameplate shall indicate that the entire assembly (not individual components) is rated at this minimum withstand rating.

l. UL Listing: The entire Variable Frequency Drive assembly (drive, bypass and all components) shall be UL-listed as a single assembly. Individual component listings only shall not be acceptable. UL test data indicating that the entire assembly has been tested and approved by UL shall be submitted to the Engineer for review.

8. Control and monitoring functions

a. General: All VFD’s programmable parameters shall be adjustable from a digital operator keypad located on the front door of the VFD or equivalent, convenient arrangement without opening the front door. Parameters shall include:

   i. Programmable maximum and minimum frequency.

   ii. Programmable acceleration and deceleration times.

   iii. Selectable carrier frequencies, V/Hz, and critical frequency avoidance lockout.

   iv. Adjustable electronic overload and torque limits.

   v. Keypad lockout and factory default overrides.

b. Display: The VFD’s shall have a minimum of 8 character display indicating monitored functions.

c. Additional Features: The VFD’s shall be additionally equipped with a digital operator station mounted on the enclosure.

d. Interface: The VFD’s shall include the proper system interfaces.

e. H-O-A Switch: The front door of the unit shall have a "hand/off/auto" switch.

f. Acceleration/Deceleration: Acceleration time from 0 to full speed shall be adjustable from 30 to 300 seconds. Deceleration time shall be independently adjustable for the same range. A maximum frequency (speed) adjustment shall be available to allow less than 50 Hz output. A minimum frequency adjustment shall be available to set a minimum output frequency.
9. Protection

   a. The VFD’s shall be provided with means to protect itself and the motor from the following “faults”:

      i. Overload.

      ii. Speed compensated overcurrent.

      iii. In-rush current limit (adjustable 50 to 230%).

      iv. Under voltage and overvoltage.

      v. Over temperature.

      vi. Short Circuit (3-phase and line-to-line).

      vii. Ground fault.

      viii. Input and output phase loss.

      ix. Over frequency.

10. Bypass motor controller requirement

   a. Starter: VFD assembly shall contain a separate, across-the-line magnetic starter, sized to match motor and arranged for manually-activated emergency use in event of VFD system failure, controlled by same input data as VFD system.

   b. Bypass: The front door shall include the manual bypass switch. The bypass section door shall include a "VFD-Off-Bypass" selector switch. In bypass mode the motor shall run at full speed directly from normal power. No electronic circuit shall be employed in the bypass mode. Motor protection thermal overload shall be provided in "bypass" and "normal" mode.

   c. Transfer: Manual bypass shall provide all the circuitry necessary to safely transfer the motor from the VFD to the power line, or from the line to the controller, while the motor is at zero speed. The bypass shall not be located in the VFD section of the cabinet.

   d. Interlock: The bypass option shall include a door interlocked, main power input disconnect, providing positive shutdown of all input power to both the bypass circuitry and the VFD.

   e. Factory Installed: Manual bypass with magnetic contactors shall be factory installed. Field modification of the VFD to provide manual bypass is not permitted.

11. Provide Variable Frequency Drive for each motor identified as requiring a VFD or variable speed operation.
12. Floor mounted variable frequency drive units shall be installed on housekeeping pads.

13. Wiring Diagrams: The VFD shall be provided with all necessary wiring diagrams for installation and power wiring from the manufacturer.

14. Coordinate each VFD with the motor served and with the Controls System, paying specific attention to the signal input/output and the ground source.

15. Startup: The VFD manufacturer shall provide, at no additional cost to the owner, a start-up service package by a factory trained field service engineer for all VFDs provided. Service shall include inspection, final adjustments, operational checks, functional checks of spare parts (if provided) and a final report for record purpose. Start-up service shall be provided for each VFD. Start-up shall be performed with the cooperation of the controls sub-contractor, where applicable.

16. Warranty: The service package shall include a comprehensive (replacement parts and labor) two-year warranty from date of Owner Acceptance or Substantial Completion (whichever is later) for all VFDs provided.

17. Training: Provide a minimum of 16 hours of training for all VFDs for the Owner and Owner’s maintenance personnel.

SECTION 23 23 13 - REFRIGERANT PIPE, VALVES AND SPECIALTIES

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

2. Provide refrigerant piping systems, complete in all respects, between the system components and connected equipment.

3. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.

4. Copper pipe - Refrigerant system piping shall be ASTM B 88, Type L (refrigerant grade), dehydrated and sealed, seamless, uniformly dead soft temper.

5. Fittings - Refrigerant grade, wrought copper, long radius, solder joint type. ASME B16.22.


7. Flux - Non-corrosive, specifically designed for silver brazing.
8. Valves and specialties

   a. Service Valves: 500-psig pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.

   b. Solenoid Valves: Comply with ARI 760; 250 deg F (121 deg C) temperature rating and 400-psig (2760-kPa) working pressure; forged brass, with polytetrafluoroethylene valve seat, 2-way, straight-through pattern, and solder-end connections; manual operator; fitted with suitable NEMA 250 enclosure of type required by location, with 1/2-inch (16-GRC) conduit adapter and [24] [120]-V, normally [closed] [open] holding coil.

   c. Thermostatic Expansion Valves: Comply with ARI 750; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.

   d. Straight or Angle-Type Strainers: 500-psig (3450-kPa) working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen of 80 to 100 mesh in liquid lines up to 1-1/8 inches (30 mm), 60 mesh in larger liquid lines, and 40 mesh in suction lines; with screwed cleanout plug and solder-end connections.

9. Moisture/Liquid Indicators: 500-psig maximum working pressure and 200 deg F (93 deg C) operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.

10. Replaceable-Core Filter-Dryers: 500-psig (3450-kPa) maximum working pressure; heavy gage protected with corrosion-resistant-painted steel shell, flanged ring and spring, ductile iron cover plate with steel cap screws; wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets and the following:

   a. Filter Cartridge: Pleated media with integral end rings, stainless-steel support, ARI 730 rated for capacity.

   b. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730 rated for capacity.

11. PIPE SIZES - Refrigerant pipe sizes which may be shown on drawings are nominal. Provide sizes not less than sizes indicated and in compliance with size recommended by the manufacturer(s) at the connected equipment. Provide change in sizes if such change is in accord with manufacturer's recommendation and with Architect/Engineer's approval. Size piping to maintain minimum velocity of 500-fpm in horizontal lines and 1000 fpm in vertical risers for proper oil return; provide double suction risers and hot gas risers as may be necessary to accomplish this.
12. Refrigerant specialties - Refrigerant valves, driers, expansion valves, and similar items shall be provided with each system. Where refrigerant access valves are not furnished by the manufacturer, they shall be field installed to enable charging and checking the system.

13. Joints and connections
   
   a. All joints and connections shall be made permanently refrigerant tight.
   
   b. Solder Joints: Cut tubing square using tubing cutters, with sharp cutting wheels, so as not to crimp the tubing ends. Remove all burrs using a pipe reamer and taking care not to flare the ends of the tube. Thoroughly clean the outside of the pipe and the inside of the fitting using a fine sand cloth. Apply non-corrosive paste flux to the cleaned surfaces immediately and apply silver solder and heat in accordance with manufacturer's instructions. Use care not to damage equipment or refrigerant specialty items when making up joints (protect from excessive heat).
   
   c. Scale Prevention: During brazing, keep pipe system full of inert gas to prevent scale formation.
   
   d. Mechanical Joints: Where the Contractor uses refrigerant tubing sets, follow the manufacturer's installation instructions explicitly, including the use of special tools, when making up the joints. Where pre-charged tubing and equipment is provided, do not cut into the system to install access valves.

14. Hangers and supports - Refer to other sections describing hangers and supports. Isolate copper tubing from contact with any dissimilar metals.

15. Evacuation and charging - When other than completely factory charged equipment and piping systems are used, they shall be evacuated and charged as follows: Charge the system with dry nitrogen and refrigerant and leak test all joints including factory piping within the units. Repair all leaks by disassembling and remaking the joint. After all leaks are corrected, evacuate the system to an absolute pressure of 0.2" mercury. System shall hold this vacuum for twelve hours with no noticeable rise in pressure. After passing vacuum test, break vacuum twice using refrigerant and re-evacuate for a minimum of two hours each time. Charge the system in the manner and with the type and amount of refrigerant specified for the equipment and in accordance with accepted refrigeration practice.

16. Refrigerant piping conduit - Install any refrigerant piping which is below slab or grade in Schedule 40 PVC piping. Size conduit as necessary to properly install piping. Provide long bend sweeps. Install so that conduit will drain and not trap water. Protect ends of conduit from entry by vermin, insects and water.

17. Arrange piping generally as shown and such that service access is facilitated. Keep refrigerant lines as short and direct as possible with a minimum number of joints. Provide sleeves through floors, walls or ceilings, sized to permit installation of full-thickness insulation; seal air tight after installation of piping and insulation.
18. Provide flexible piping arrangement in hot gas discharge line of compressor. Such arrangement shall consist of a piping loop or similar measure to prevent transmission of objectionable vibration.

19. Provide a removable core filter-drier in liquid line. In-line filter-driers are acceptable in individual circuits of less than 10-ton nominal capacity. Provide a full size valve bypass around this filter-drier. Provide shut-off valves to isolate the filter drier while flow is through the bypass and also a shutoff valve in the bypass so that filter-drier can be put into use.

20. Provide a refrigerant charging connection in the liquid line upstream from the filter-drier.

21. Provide a moisture indicating sight glass in the liquid line downstream from the filter-drier. Install in vertical line if possible and a sufficient distance downstream from any valve such that the resulting disturbance does not appear in the glass.

22. Provide a filter-drier with isolating shut-off valves and with valve bypass only if compressor is not equipped with a suction line filter or screen.

23. Keep piping free from traps unless otherwise indicated. Install vertical pipe plumb. Pitch horizontal piping only where slope is desirable.

24. Provide shut-off valves at inlet and outlet to all condensers, receivers and evaporators to permit isolation for service. If possible, use angle valves to minimize pressure drop. Use angle valves in all cases at receivers. Use globe valves only when angle valves are impractical.

25. Provide solenoid valves upright in horizontal lines only, unless their design allows installation in vertical pipe.

26. Where compressor(s) do not have pump down control and the compressor(s) associated evaporator coil(s) do not have bottom suction header connections and the evaporator coil(s) are located above the compressor(s), then loop suction lines(s) to top level of coil to prevent liquid slugging.

27. To prevent erratic operation of thermal expansion valve, provide a suction line trap next to evaporator coil suction outlet with expansion valve bulb located between coil and trap. Provide only in suction lines which are level leaving coil outlet or which rise on leaving coil outlet. Trap not required when evaporator coil outlet suction line drops to compressor or suction header immediately after expansion valve bulb.

28. Replace filter-drier after system has been adjusted and pressures are established.
23 25 00  HVAC Water Treatment

1. Chemical removal of oil film, organics and construction debris. Pre-cleaning provides for initial metal passivation which sets up for long term corrosion protection. This cleaning procedure applies to non-potable loops including glycol, chilled, hot, and open recirculating systems. All systems must be prepared prior to the introduction of the chemical cleaner.

2. Documents call for Chemical and Service Program for one year following date of Substantial Completion.

3. Perform leak test using three (3) times operation pressure (50 psig) nitrogen for a minimum of 24 hours and all joints soap tested.

4. Flush all systems, including mud from drop legs. Remove, clean and replace all strainers. All systems shall contain the highest quality of water available. This should take at least 24-48 hours depending on the flush rate and how dirty the system is. Flushing could take longer. End result should be water quality the same as the makeup water.

5. Determine the Volume of the system. This can be accomplished by calculating the area of the pipe \( \text{Area} = 3.14 * \text{(Pipe Diameter/2)}^2 \) times the length of pipe. This number is in Cubic Feet. Convert to gallons: 7 gallons=1CF. For larger systems, a more detailed volume can be done via a salt or dye study and calculated. Or through use of a water meter.

6. Add the chemical cleaner to the system. Amount is based on volume. The cleaning solution shall be formulated to remove light grease, cutting oils, loose mill scale, organics and extraneous construction debris. This will permit a uniform passivation film to form during the treatment phase. Cleaning also aids in the prevention of flash corrosion when the system is most vulnerable to corrosive attack. The cleaner shall not require external heat to ensure its effectiveness. Complete circulation must be achieved during the cleaning procedure. A minimum flow rate of 2 ft/sec. needs to be maintained to insure that the cleaning chemicals will work properly. All manual, electrical, air and thermostatic operated valves must be open. Recommend a minimum of 1-1/2" ball or gate valve is to be permanently installed in the low point of each system for the purpose of draining each system.

7. Recirculate the cleaner in the system for 24-48 hours. Open and drain mud legs and low points periodically during the cleaning process. After cleaning period, call Nalco contact to sample water and complete testing protocol and documentation.

8. Flush or Drain the system completely paying particular attention to mud from drop legs and all low points. Refill the system with clean water and check all strainers. Recirculate and drain again if needed. Refill the system and treat with corrosion inhibitor. The length of time between the completion of the cleaning procedure and addition of the corrosion inhibitor shall not exceed twenty-four (24) hours if possible. After flushing period, call Nalco contact to sample water and complete testing protocol and documentation. The flush water should be within 10% quality standard of the makeup water.
9. Add the recommended amount of closed loop corrosion inhibitor and biocide shock treatment. After treatment, call Water Treatment Company to sample water and confirm residuals of chemistry are at desired levels. Water Treatment Company will produce report documentation which will be provided to the end user who will ok work before any valves are opened to the existing main chilled loop system.

23 31 00 – Metal Ductwork

1. Provide complete duct systems as indicated. Systems shall include, but not be limited to, the following: outside air, exhaust air, and air conditioning supply and return air duct systems.

2. Items Included: This section generally includes, but is not limited to, the following major items:

   a. Low Pressure sheet metal ductwork.
   b. High Pressure sheet metal ductwork, round and rectangular (Single Wall).
   c. Low pressure flexible ducts.
   d. High pressure flexible ducts.
   e. Air distribution devices.
   f. Terminal units.
   g. Duct system accessories.
   h. Insulation.

3. Refer to other sections which may describe additional sound attenuation measures which may relate to this section.

4. SHOP DRAWINGS (MANDATORY): Include complete data on all prefabricated duct and fittings; duct sealing materials; duct joining and seaming methods; and all other items. Submit for approval completely detailed shop drawings of supply and return ductwork from any or each air handling unit through its transitions, bends and elbows until such ducts are extended beyond the air handling unit equipment area and/or congested areas; these shop drawings will not be required unless specifically called for elsewhere or unless significant deviation from the Drawings is necessitated by the equipment provided.

5. Provide partial plans for mechanical equipment rooms at a minimum ¼" per foot scale.

6. Provide all ductwork and components thereof in accord with manufacturer's recommendations. All ductwork dimensions shall indicate nominal free clearance internal dimensions which do not include insulation thickness.
7. Low Pressure Ductwork: Any and all ductwork conveying air or other gases at velocities less than 2500 fpm and static pressure less than 2.0 inches wg. This ductwork may also be referred to in these specifications as "Low Velocity Ductwork". SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Second Edition, 1995, shall govern construction of this ductwork unless otherwise specified.

8. High Pressure Ductwork: Any and all ductwork conveying air or other gases at velocities equal to or greater than 2500 fpm or static pressure equal to or greater than 2.0 inches wg. This ductwork may also be referred to in these specifications as "High Velocity Ductwork" or "Medium Pressure Ductwork", but shall be considered, in either terminology, to fall within pressure/velocity class (PV/C designation) 3 to 10. SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Second Edition, 1995, shall govern construction of this ductwork unless otherwise specified.

9. PRESSURE/VELOCITY CLASSIFICATIONS - Pressure and velocity classifications (hereinafter called "P/VC") for ducts are defined as follows:
   a. Positive
   b. SMACNA Static or SMACNA Maximum
   c. P/VC Pressure Pressure Negative Seal Velocity
   d. Design Class Rating Pressure Class (fpm) High 10" + A 2000 up
      e. 6 Medium 6" + A 2000 up
      f. 4 Medium 4" + A 4000 dn
      g. 3 Medium 3" + or - B 4000 dn
      h. 2 Low 2" + or - C 2500 dn
      i. 1 Low 1" + or - C 2500 dn
      j. ½ Low 1/2" + or - C 2000 dn

10. Materials shall comply with current SMACNA standards. Acceptable manufacturers are
    a. Ductmate Industries, Inc.
    b. Engel Industries.
    c. Nexus.
    d. Ward.
    e. Lock former.
11. ASTM: Unless otherwise specified, ASTM material specifications applicable are:

   a. Material Type ASTM Number
   b. Galvanized steel G90 A525
   c. Stainless steel 304,304 A240
   d. Cold rolled steel 20-28 ga. A366
   e. Cold rolled steel 18 ga. A619
   f. Aluminum 3003 H-14 B609

12. Special Materials, Gauges and Construction:

   a. Special Materials: Where special duct material other than galvanized steel is required, such duct material (e.g., fiberglass, stainless steel, plastic such as polyvinylchloride, etc.) shall be specifically indicated.

   b. Gauges: Gauges indicated in this section are for galvanized steel. Where greater or lesser gauges are specifically indicated for a sheet metal material other than galvanized steel, provide the indicated gauge. Comply with the SMACNA construction standard covering the required material if no gauge is given.

   c. Construction: Comply with indicated special requirements (i.e., such as welding, soldering, etc.) where application requires.

13. LOW PRESSURE SHEET METAL DUCTWORK

   a. Prime quality forty-eight inch wide re-square tight coat galvanized steel - conforming to the requirements of ASTM A-525 and/or A-527 as applicable to the intended use.

   b. Construction:

      i. Construct to comply with the pressure/velocity classification(s) indicated.

      ii. Use rectangular or round as indicated on drawings.

      iii. Reinforcing, Cross Breaking, Seams, Joints: Be in accord with latest SMACNA construction standard for low pressure sheet metal duct.

      iv. Gauge: As required by SMACNA for the dimensions and pressure/velocity classification involved.

   c. Insulation: Rectangular rigid sheet metal ductwork: As specified in the Insulation section of Division 23.

14. Round rigid sheet metal ductwork: Where low pressure round ductwork is designated as
15. double-walled construction, provide factory fabricated double-wall ductwork as specified for high pressure round acoustically lined sound attenuating duct (i.e., factory fabricated double wall duct with perforated inner wall).

16. HIGH PRESSURE DUCTWORK, ROUND AND FLAT-OVAL

   a. Comply with current SMACNA standards.

   b. Factory fabricated portions shall be made by McGill Airflow, LLC, Semco or equal.

   c. Straight Conduit: Galvanized steel unless otherwise indicated for a specific application.

      i. Seam construction: Spiral lock-seam (SMACNA Type RL-1) allowed for all Pressure/velocity classifications. Longitudinal grooved seam (SMACNA Type RL-5) allowed only up to pressure/velocity classification P/VC-3.

   d. Fittings:

      i. Material: Same as connecting duct system.

      ii. Configuration: Standard design as manufactured by United McGill, Semco or equal.

      iii. Elbows: General: All mitered elbows must be vanned. Round: 5-inch diameter and larger shall be five-section construction; less than 5- inches diameter shall be die-formed. Flat-oval: Five-section construction. Hard turn oval elbows shall have vanes as follows:

         1. Equivalent diameters Number of Vanes
         2. 10" through 14" 3
         3. 15" through 19" 4
         4. 20" through 60" 5
         5. Over 60" 12" spacing

   e. Vanes: Be minimum 20 gauge and limited to 24 inches of unsupported length. The leading edge of all vanes in duct exceeding 20 inch size will be hemmed with a 1/2 inch fold back.

   f. Divided Flow Fittings: All divided flow configurations are to be furnished as separate fittings. Tap covers welded into spiral duct sections are not acceptable. All tees, crosses and laterals up to an including 12" diameter tap size, will have a minimum 3/8" radius rounded entrance into the tap, produced by machining, press forming, or hand grinding to a smooth entrance. The entrance will be free of projections, weld buildups, burrs or irregularities. All fittings will have continuous welds along all seams.

   g. Tees and Crosses: All tees and crosses shall be the spun conical type with branch entrances through 12" size, to be rounded laminar flow as noted above.
h. Connections: Connections of conduit to fittings shall be made with a synthetic rubber sealing compound conforming to NFPA 90A as to flame spread and smoke developed ratings and mechanically fastened with drive or twist screws, and all joints tested in accordance with test procedure described hereinafter. Raychem TDB duct sealing bands may be used in lieu of the sealing compound. Connection between conduit and terminals shall be made with a maximum of 48” of flexible duct. Run-out connections shall be assembled in same manner as conduit and fittings.

i. Gauge: Minimum gauge as follows (gauges are for round and flat-oval duct with spiral lock seam construction unless otherwise indicated):

   i. Round duct (galvanized steel):
      1. Diameter Alternate
      2. (Inches) Gauge Gauge(2)
      3. 3 thru 8 26 24
      4. 9 thru 14 26 24
      5. 15 thru 26 22 20
      6. 27 thru 36 22 20
      7. 37 thru 50 20 20
      8. 51 thru 60 18 18
      9. 61 thru 84 18(1) 16
         a. Must be 16 ga. when static pressure is negative.

         b. NO ROUND OR SQUARE SNAP-LOCK DUCT IS ALLOWED.

j. Only factory reinforced spiral duct shall be allowed on low pressure ductwork and only for short connections to supply and return diffusers or fan vents. All Ductwork seams to be taped and mastic sealed completely.

k. Flat-oval duct (galvanized steel):
   i. Major
   ii. Dimension
   iii. (Inches) Gauge
      1. 0 thru 24 24
      2. thru 36 22
      3. 37 thru 48 22
   iv. 49 thru 60 20
   v. 61 thru 70 20
   vi. 71 and up 18

l. Fittings:
   i. Round duct: Same as duct unless otherwise recommended by manufacturer.

   ii. Flat-oval duct:
      1. Major
      2. Dimension
      3. (Inches) Gauge
4. 0 to 24 20
5. 25 to 36 20
6. 36 to 48 18
7. 49 to 60 18
8. 61 to 70 16
9. 71 and up 16

17. HIGH PRESSURE DUCTWORK, RECTANGULAR - Airtight and structurally stable at maximum system operating pressure. Any welding shall be continuous and corrosion resistant. Galvanized sheet steel unless otherwise indicated for a specific application. Reinforced and supported to neither cause nor convey any objectionable vibrations. Be in accordance with latest SMACNA construction standard for high pressure ductwork. Turning Vanes: Adequate rigidity and strength to be completely flutter-proof. Airfoil, permanently fixed type constructed of galvanized steel of aluminum with sound attenuating fiberglass inner liner with open protective metal facing. Quantity in each elbow in accordance with manufacturer's recommendations. Airsan Acoustiturn as made by Air Filter Corporation.

18. High pressure duct relief and access doors

a. Provide suitable size for access to heaters, dampers and other equipment installed in duct, and at other points indicated on drawings. Size shall be as listed by paragraph above and compatible with duct size but not smaller than 8"x12". Doors shall be 24 US gauge galvanized steel hinged to a 24 gauge galvanized mounting frame and for insulated duct shall be double panel construction with 1/2 inch rigid insulation material between metal panels. Doors shall be United Sheet Metal Type AR or an approved equal.

19. Low pressure flexible ducts

a. The inclusion of flexible ducts in this specification shall not be construed as approval of use on the project unless specifically shown on the Drawings.

b. Where used, provide in factory finished lengths not in excess of lengths required to make kink-free connections with minimum air pressure drop.

c. Insulated flexible ducts: Flexible duct shall be factory-fabricated pre-insulated type with seamless vapor barrier. Duct shall bear UL 181 Class 1 Air Duct label and shall comply with NFPA 90A and 90B. Fiberglass insulation nominal 1" thickness with thermal conductance of 0.23 BTU/hr-ft²-°F maximum at 75°F mean temperature. Flexible duct shall have an operating range of minus 0.5" w.g. to plus 2" w.g. Core shall be continuous and consist of aluminized mylar laminated to corrosion resistant steel wire helix. Vapor barrier perm rating shall be 0.17 maximum per ASTM E96-A. Maximum working velocity shall be 4000 FPM. Flexible duct shall be Genflex SLR-25, Clevaflex Type KQ, Wire Mold type WG, Flexmaster Type 5B, or approved equal.

d. Round branch take-off fittings for flexible duct:
i. Round duct branch take-off fitting shall be made of galvanized sheet metal designed for twist-in installation and to assure minimum air loss at the take-off. The fittings shall be of the conical converging type to reduce the pressure drop through the fittings. Provide a raised bead on the throat of the fitting to assure a tight positive connection. Products shall be Flexmaster Model CB-DE-BO3 or approved equal.

ii. Provide each fitting with the following:
   1. Lockable quadrant damper.
   2. 45-degree extractor scoop.
   3. Insulation guard where used with internally lined ductwork.

iii. Provide these "spin-in" type fittings at all connections between rigid sheet metal duct and flexible duct at the upstream end of the flexible duct.

20. High pressure flexible ducts

   a. Meet all requirements for low pressure flexible ducts except be recommended by manufacturer for high pressure application. All duct systems shall be free of noise, chatter, vibration and pulsation under all conditions of operation. Remove, replace or reinforce as directed by the Architect/Engineer if necessary to correct such conditions.

21. All horizontal ductwork on this project shall be supported from the existing structure located directly above the horizontal fire-rated ceiling assembly that is connected to the structure. All duct hangers and supports shall be carefully coordinated to remove the required portions of the fire-rated assembly and repaired to maintain the existing rating at the completion of the hanger installations.

22. If field conditions are determined to exist which would limit the guarantee of air delivery or system performance, due notice in writing shall be submitted to the Architect/Engineer of such conditions prior to starting fabrication.

23. Properly support and align ductwork. Ducts to be free of sag and bulge. Hang ductwork below concrete floors or roof deck with hangers set prior to pouring concrete, or from self-drilling screw anchors. GUN POWDER SET ANCHORS ARE NOT PERMITTED.

24. Where it is necessary that ducts be divided due to pipes or other obstructions which must pass through these ducts, the Contractor shall, at locations as noted or directed, provide air-stream deflectors in the duct and the duct shall be increased in size to maintain equivalent area around deflectors. Such changes shall be in accord with standard SMACNA details and shall be shown on Contractor's As-Built Drawings.

25. Interior of ductwork(sheet metal plenums visible through registers, grilles, or diffusers shall be painted flat black.)
26. Do not route ductwork through transformer vaults and electrical equipment spaces and enclosures.

27. Construct all ductwork and accessories in accord with the latest indicated editions of applicable SMACNA construction standards. Sheet Metal and Air Conditioning Contractors' National Association.

28. Streamline all ductwork to the full extent practical and equip with proper and adequate devices to assure proper balance and quiet draftless distribution of indicated air quantities.

29. Protect all ductwork and system accessories from damage during construction until Architect/Engineer's final acceptance of project.

30. Prior to ductwork fabrication, verify if all ductwork as dimensioned and generally shown will satisfactorily fit allocated spaces. Take precautions to avoid space interferences with beams, columns, joists, pipes, lights, conduit, other ducts, equipment, etc. Notify Architect/Engineer if any spatial conflicts exist, and then obtain Architect/Engineer's approval of necessary routing. Make any such necessary revisions which are minor at no additional cost.

31. Carefully correlate all duct connections to air handling units and fans to provide proper connections, elbows and bends which minimize noise and pressure drop.

32. Provide all curved elbows with radius ratios of not less than 1.5 unless otherwise shown or approved by Architect/Engineer. Provide all mitered elbows with turning vanes.

33. Properly suspend all ductwork so that no objectionable conditions result (such as vibration, sagging, etc.).

34. Coordinate any and all dimensions at interfaces of dissimilar type of ductwork and at interfaces of ductwork with equipment so that proper overlaps, interfaces, etc., of insulation and continuity of vapor barriers are maintained.

35. If necessary where ducts interface and have different types of insulation, provide transitions so that internal free-clear dimensions of duct remain unchanged.

36. Install horizontal low pressure ductwork at a level which maximizes length of any vertical, rectangular or round rigid duct connections to rectangular diffuser necks; however, such vertical duct connections are not required to be over 24 inches in length.

37. Make connections from any low pressure ductwork to terminal units (fan terminal units, variable volume boxes, etc.) with appropriate lengths of flexible duct unless other type of connection is indicated.

38. Install all flexible round duct without kinks or similar obstructions so that pressure drop is minimized. Cut and remove excess lengths as necessary.

39. Install horizontal rigid ductwork as high as practical above suspended ceilings so that movable light fixtures may be relocated without interference to meet any future partition relocation requirements.
40. Insulated Duct: Where ducts will be insulated, make provision for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. A metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be finished shall be mounted on duct.

41. Low pressure sheet metal ducts
   a. If width or height of rectangular duct exceeds 12 inches, cross break or roll a cross bead in panels to increase stiffness; otherwise, use two gages heavier steel.
   b. Provide corner closures. Longitudinal seams and transverse joints shall be flat and smooth inside. Make slip joints in direction of air flow. See governing SMACNA manual for transition requirements.
   c. Fabricate offsets, turns and elbows with centerline radius equal to 1-1/2 times diameter when possible. No mitered offsets will be allowed. Provide double thickness turning vanes to assist in smooth flow of air in square elbows or elbows with centerline radius less than duct width or diameter.

42. High pressure ductwork - In addition to other requirements, this ductwork shall be as follows:
   a. Any welds shall be continuous and corrosion resistant.
   b. Reinforced and supported to cause and/or to convey no objectionable vibrations.
   c. All seams and joints permanently sealed and joined in strict accordance with the manufacturer's recommendations.
   d. Conical Tees: Make all branch duct take-offs and all connections to flexible duct supplying air to terminal units with conical tees.

43. Low pressure flexible ducts
   a. Flexible ducts shall not be used unless specifically indicated on drawings.
   b. If flexible duct is indicated for use on this project, it must comply with the following requirements.
      i. The extent of the use of flexible ductwork shall be limited to that shown on the drawings.
      ii. Connect flexible ductwork to collars on rigid ductwork and diffuser collars and terminal devices with stainless steel worm gear driven type locking clamps. Stainless steel ductwork shall be secured with stainless steel bands and clamps only. **Plastic Cable or “ZIP” Ties are not permitted to connect ductwork.**
c. Flexible duct installation shall be per SMACNA Flexible Duct Installation Standards, and manufacturers latest printed instructions, whichever is stricter. In addition the following shall apply:

i. Flexible duct between rigid duct and diffusers shall be a **MAXIMUM of 6 feet** in length and shall be fully extended with a maximum equivalent of (2) 90 degree bends (no bend shall be made with centerline radius of less than one duct diameter). No additional flexible duct shall be provided for future terminal device relocation unless otherwise specified.

ii. Flexible duct shall be supported at ends and at each 90 degree bend. Maximum permissible sag is 1/2 inch per foot of spacing between supports.

iii. Hanger or saddle material in contact with the flexible duct shall be of sufficient width to prevent any restriction of the internal diameter of the duct when the weight of the supported section rests on the hanger or saddle material. In no case will the material contacting the flexible duct be less than 1 inch wide. Narrower hanger material may be used in conjunction with a sheet metal saddle which meets the foregoing specifications. This saddle must be formed to cover one-half the circumference of the outside diameter of the flexible duct and must be rolled to fit neatly around the lower half of the duct's outer circumference.

iv. Factory installed suspension systems integral to the flexible duct are an acceptable alternative hanging method when manufacturers recommended procedures are followed.

v. Hangers shall be adequately attached to the building structure (not pipe, conduit, etc.).

vi. To prevent tearing of vapor barrier, do not support entire weight of flexible duct on any one hanger during installation. Avoid contact of flexible duct with sharp edges of hanger material. Damage to vapor barrier may be repaired with approved tape. If internal core is penetrated, replace flexible duct or treat as a connection.

d. Terminal devices connected by flexible duct shall be supported independently of the flexible duct.

44. High pressure flexible ducts - Meet all the requirements for low pressure flexible ducts.

45. Miscellaneous duct system components - Spin-In Take-Off Fittings: Install around duct branch takeoff fittings according to manufacturer’s installation instruction. Additionally seal fitting to rectangular duct with a thin bead of mastic sealant.

46. Hangers and supports

a. General: Comply with latest applicable SMACNA construction standard. Where sprayed fireproofing occurs, install hangers before application of such treatment and withhold installation of ducts until after application.
b. Supports: Vertical risers and other duct runs where the method of support specified above is not applicable shall be supported by substantial angle brackets designed to meet field conditions and installed to allow for duct expansion.

c. Fasteners: Secure hangers to steel beams or metal deck with beam clamps or drop through connections from the metal or concrete deck.

47. Changes in shape or dimension

a. Where duct size or shape is changed to effect a change in area, the following shall apply:

   i. Where the area at the end of the transformation results in an increase in area over that at the beginning, the slope of the transformation shall not exceed one inch in seven inches.

   ii. Where the area at the end of the transformation results in a decrease in area from that at the beginning, the slope of the transformation may be one inch in four inches, but one inch in seven inches is preferable, space permitting.

   iii. The angle of transformation at connections to heating coils or other equipment shall not exceed thirty degrees from a line parallel to the air flow on the entering side of the equipment, nor fifteen degrees on the leaving side. The angle of approach may be increased to suit limited space conditions when the transformation is provided with vanes approved by the Architect/Engineer.

48. Changes in direction

a. Changes in direction shall be basically as indicated on the drawings and the following shall apply:

   i. Supply duct turns of ninety degrees in low pressure duct shall be made with mitered elbows fitted with closely spaced turning vanes designed for maintaining a constant velocity through the elbow.

   ii. Return and exhaust duct turns of ninety degrees in low pressure duct shall be made with mitered elbows, as specified hereinbefore for supply ducts, unless radius elbows are indicated in which case they shall be constructed with a turning radius one and one-half (1-1/2) times the width (with width considered as the dimension in the plane of the turn) as measured to the duct centerline.

   iii. Tees in low pressure duct shall conform to the design requirements specified hereinbefore for elbows.

   iv. Branch take-offs in low pressure supply duct shall be made with extractors or splitter dampers, as indicated, in square take-offs.
v. In high pressure duct, branch take-offs and connections to flexible duct supplying air to terminal units shall be made with conical taps.

49. Improper materials or configuration - If ductwork materials or ductwork configurations are installed which do not meet these specifications, Contractor shall remove such ductwork and replace with materials or configurations which are acceptable. Any delay in job progress will be the responsibility of the Contractor.

50. Other requirements

a. Insulated Duct: Where ducts will be insulated, make provision for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. A metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be finished shall be mounted on duct.

b. Control Devices: Properly install all control related devices which are part of the duct systems. See Section(s) describing control systems.

51. Sealing of ducts

a. Duct seal classes are as follows:

i. Seal class "A": Seal all transverse joints, longitudinal seams and duct wall penetrations. Use for P/VC-4 (4" w.g.) and greater unless otherwise indicated.

ii. Seal class "B": Seal all transverse joints and longitudinal seams. Use for P/VC-3 (3" w.g.) unless otherwise indicated.

iii. Seal class "C": Seal all transverse joints. Use for P/VC-2 (2" w.g.) and lower unless otherwise indicated.

b. Where sealing is required it shall mean the following:

i. The use of adhesives, gaskets, tape systems or combinations thereof to close openings in the surface of the ductwork and field-erected plenums and casings through which air leakage would occur.

ii. The prudent selection and application of sealing methods by fabricators and installers, giving due consideration to the designated pressure class, pressure mode (positive or negative), chemical compatibility of the closure system, potential movement of mating parts, workmanship, amount and type of handling; cleanliness of surfaces, product shelf life, curing time and manufacturer-identified exposure limitations;

iii. That these provisions are applicable to duct connections to equipment and to apparatus but are not for equipment and apparatus;
iv. That where distinctions between seams and joints are made herein, a seam is defined as joining of two longitudinally (in the direction of air-flow) oriented edges of duct surface material occurring between two joints. Helical (spiral) lock seams are exempt from sealant requirements. All other duct surface connections made on the perimeter are deemed to be joints. Joints are inclusive of but not limited to girth joints; branch and sub branch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum and casing abutments to building structures; that sealing requirements herein do not contain provisions to:

1. Resist chemical attack.
2. Be dielectrically isolated.
3. Be waterproof, weatherproof or ultraviolet ray resistant.
4. Withstand temperatures higher than 120oF or lower than 40oF.
5. Contain atomic radiation or serve in other safety-related construction.
6. Be electrically grounded
7. Maintain leakage integrity at pressures in excess of the duct classification herein.
8. Be underground below the water table.
10. Withstand continuous vibration visible to the naked eye.
11. Be totally leak-free within an encapsulating vapor barrier.
12. Create closure in portions of the building structure used as ducts, e.g., ceiling plenums, shafts, pressurized compartments.

v. The requirements to seal apply to both positive pressure and negative pressure of operation.

vi. Externally insulated ducts located outside of buildings shall be sealed prior to being insulated as though they were inside. If metal surfaces of ducts located on the exterior of buildings are exposed to weather, they shall receive exterior duct sealant. An exterior duct sealant is defined as a sealant that is marketed specifically as forming a positive air and water tight seal, bonding well to the metal involved, remaining flexible with metal movement and having a service temperature range of -30oF to 175oF. If exposed to direct sunlight it shall also be ultraviolet ray and ozone resistant or shall, after curing, be painted with a compatible coating that provides such resistance. The term sealant herein is not limited to materials of adhesive or mastic nature but is inclusive of tapes and combinations of open weave fabric strips and mastics.

c. Materials and applications for sealing ducts:

i. Complete product data on all materials used for sealing ducts must be submitted for approval prior to any duct fabrication.

ii. All sealants must be specifically recommended by their manufacturer for the purpose of sealing ducts.
iii. Liquid Sealant: Use only for slip type joints where sealant is to fill small space between overlapping pieces of metal. Do not use where metal clearances exceed 1/32-inch. Sealant must be specifically manufactured for the purpose of sealing ducts.

iv. Mastics: Use in lieu of liquid sealant at Contractor's option. Use as a fillet, in grooves and between flanges. Do not use oil base caulking or glazing compounds.

v. Gaskets: Use soft elastomer butyl or neoprene rubber or extruded forms of sealants in flanged joints in addition to mastic.

vi. Tape is not allowed on ducts.

52. Combination of mastic and embedded fabric: Use mastic/mesh/mastic as a sealant where pressure/velocity classification is equal to and exceeds P/VC-3 and where any spaces between metal surfaces at transverse joints or longitudinal seams or duct wall penetrations exceeds 1/16-inch. Apply glove coat of mastic, then embed a continuous or overlapping strip of not less than 4-inch wide 10 x 10 fiberglass cloth into the mastic, then apply a final glove coat of mastic over the glass cloth.

53. Surface preparation: Surfaces to receive sealant should be adequately clean (free from oil, dust, dirt, rust, moisture, ice crystals and other substances that inhibit or prevent bonding). Use solvent and/or apply a face primer if necessary to obtain adequately clean surface for adhesion.

54. LEAKAGE TESTING:

   a. Test the following duct systems:
      i. All rigid ducts which are directly connected to air moving device (air handling unit, exhaust fan, supply fan or similar air moving equipment).
      ii. All rigid ducts which are part of a supply, return, outside and/or exhaust air system.

   b. Duct systems shall be constructed so that leakage does not exceed 5.00% of the air quantity handled by the respective fan.

   c. Allowable Leakage: Leakage shall be measured during leakage test at a test pressure which is equal to the pressure/velocity classification of the duct system (e.g., a P/VC-2 duct shall be tested at 0.5 in. w.g.s.p., a P/VC-1/2 duct at 0.5 in. w.g.s.p., etc.).

55. Test Procedure: Test at time of duct installation and prior to installation of any field applied insulation and prior to any concealment in chases or similar enclosures. Duct openings (both entry openings and outlet openings) shall be capped or sealed by taping or banding a flexible plastic sheet over each opening prior to pressurizing duct.

   a. The plastic sheet shall be of adequate strength and thickness to withstand the test pressures. Use other method of sealing duct openings providing objective of test is obtained and if method of sealing is approved by Architect/Engineer.
b. Use a fan having a minimum capacity of 300-cfm or 5% of the particular duct system design capacity, whichever is greater and which is capable of producing a duct test pressure of 150% of the duct test pressure.

c. Test fan shall be connected to a flow measuring assembly consisting of straightening vanes and an orifice plate mounted in a straight tube with appropriately located pressure taps. Orifice assembly shall be accurately calibrated with its own calibration curve.

d. Pressures shall be measured with U-tube manometers and corresponding flow rates obtained from the orifice performance curve.

e. Connect test fan and orifice flow measuring assembly to the duct to be tested with section of flexible duct.

f. Test for audible leaks as follows:
   i. Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
   ii. Start the blower with its control damper closed (some small blowers popularly used for testing ducts may damage the duct because they can develop pressures up to 25 inches (W.G.).
   iii. Gradually open the inlet damper until the duct pressure reaches 50% in excess of designed duct operating pressure.
   iv. Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealing has been repaired if and where necessary.
   v. After all audible leaks have been sealed, the leakage should be measured with the orifice section of the test apparatus as follows: Start blower and open damper until pressure in duct reaches 25% in excess of designed duct operating pressure.

56. Duct types shall be as follows:
   a. Supply/Discharge Ductwork from VAV AHU’s to the inlet of each VAV terminal unit - High/Medium pressure ductwork/Seal Class A.
   b. Supply Ductwork downstream/discharge side of the VAV terminal units - Low pressure ductwork/Seal Class C.
   c. Return and Relief Air Ductwork – Low pressure ductwork/Seal Class C.
   d. Toilet and Ventilation Exhaust Ductwork – Low pressure ductwork/Seal Class C.
   e. O/A Ductwork – Low pressure ductwork/Seal Class C.
23 33 00  Air Duct Accessories

1. Provide all necessary duct system accessories to assure proper balance, quiet and draftless distribution and conveyance, and minimization of turbulence, noise and pressure drop for all supply return, exhaust and ventilation air quantities indicated.

2. Coordinate all items affecting the duct systems including but not limited to the following items: air handling units, exhaust fans, supply fans, sound attenuators, duct mounted coils, access panels air distribution devices, fire dampers, outside air louvers, hoods, filters, roof curbs, structural framing, roof construction, roofing, and the work of all trades to insure an orderly and timely progression of the work.

3. SHOP DRAWINGS - Include complete data on: access doors; flexible connectors; manual volume dampers including operating hardware; extractors; turning vanes; automatic shutters and all other items.

4. Provide all components in accordance with manufacturer's recommendations.

5. All ductwork dimensions indicated which may affect items of this section are nominal free clearance internal dimensions which do not include insulation thickness.

6. "SMACNA" means "Sheet Metal and Air Conditioning Contractors National Association, Inc."

7. Products listed in this Section are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements by the following manufacturers are acceptable:
   a. Vent fabrics
   b. Barber-Colman
   c. Tuttle & Bailey
   d. Dura-Dyne
   e. Airsan
   f. Titus
   g. Anemostat
   h. Young
   i. Metalaire
   j. United McGill
8. Flexible duct connections - Provided where air handlers, fans and blowers connect to their ductwork. At least 4 inches long. Connected on each side to metal (either metal ductwork, air handling apparatus, or heavy gauge steel sleeves). For use in high and/or low pressure duct systems. Vent fabrics, Inc., "Ventglas Metaledge", or equivalent.

9. Splitters - Provide for adjustment of air volume to their respective branches, where indicated. Constructed of at least the same gauge galvanized steel as the duct wherein they are used, and in no instance be less than twenty-two (22) US gauge. Use in low pressure duct systems only. Be adequately sized to close off air to applicable branches. Rigidly attached to pivot rod and operating linkage. Install on raised insulated base when used in internally insulated ductwork. Splitter blades; formed in two thicknesses of metal so that entering edge presents rounded nose to air flow; length no less than one and one half times the width of the smaller branch served or twelve inches, whichever is larger. Hardware used for the construction, assembly, and operation of splitter dampers shall be as follows:
   
   a. Operators for exposed splitters and those located above "lay-in" or accessible ceiling shall be Ventlok #690 splitter damper assembly.
   
   b. Operators for concealed splitters shall be Ventlok #691 with #680 miter and #677 concealed regulator.

10. Low pressure metal turning vanes - Provide in all elbows, bends and tees of all low velocity supply air ducts whether or not shown in detail; provide in all elbows, bends and tees of all other low velocity ducts where portions of such ducts convey air at greater than 700 fpm average velocity. Adequate rigidity and strength to be completely flutter proof; properly designed; permanently fixed type. Aluminum, or steel with acid/solvent chemical corrosion resistant coating, or galvanized steel. Air foil type in all mitered elbows, mitered bends and tees. Air foil type must be manufactured by Titus, Tuttle & Bailey, Anemostat, Waterloo, Metalaire, Barber-Colman or other approved manufacturer. Be Barber-Colman "Airturns", Tuttle and Bailey "Ducturns", or Dura-Dyne "VR" with 24 gauge rails and hollow vanes, or equivalent.

11. High pressure turning vanes - Provide high pressure turning vanes in elbows, bends and tees of high pressure systems. Material and installation shall be in accordance with SMACNA Standards.

12. Extractors
   
   a. Provide at rectangular branch duct take-offs.
   
   b. Use in low pressure duct systems only.
   
   c. Properly designed to deflect, proportion and direct the indicated air quantities to the branch duct and/or to the registers, grilles or other outlets without causing objectionable noise or pressure drop.
   
   d. Multi-vaned and adjustable.
e. Aluminum, or steel with acid/solvent chemical corrosion resistant coating, or galvanized steel.

f. Provided with devices for adjusting and securing the position of these deflectors; these devices shall allow adjustment of the deflectors from outside the completed ductwork without necessity for puncturing or otherwise penetrating ductwork and/or its vapor barrier.

g. Made by Titus, Tuttle and Bailey, Metalaire, Anemostat, Waterloo, Barber-Colman, or equivalent.

h. Be similar to Titus Model AG-45 or AG-225 Volume Extractor, Tuttle & Bailey Type VCL or VLK Vectrol, Waterloo Type DTM or DT2M Extractor, Anemostat "DTB" or "DTA" or Young Regulator "890" or 890A", or equivalent.


a. These dampers are to be other than those specified as being integral with each register, diffuser and other air outlet or inlet.

b. Provided where indicated in the complete air distribution system(s) (including ductwork, return air plenums, etc.) to allow complete balancing of the air supply, return, ventilation and exhaust system(s).

c. Opposed blade type.

d. 8" maximum blade width.

e. Made of galvanized steel, stainless steel with acid/solvent chemical resistant coating (for fume hood exhaust systems), or steel with a sprayed or dipped aluminum rust resistant finish; flutter proof.

f. Provided so that all damper adjustment can be made from outside the completed ductwork without necessity for puncturing or otherwise penetrating the ductwork and/or its vapor barrier.

g. Fully adjustable and with locking device.

h. Manufactured by Titus, Tuttle & Bailey, Anemostat, Waterloo, Metalaire, Greenheck or equivalent.

i. Provided at a point in the ductwork which is a sufficient distance upstream from an outlet (or downstream from an inlet) to attenuate objectionable noise due to damper throttling and to preclude adverse effects on the distribution device.

j. Based upon location of the duct in which the damper is to be installed, provide the following types:

   i. Dampers in ducts which are exposed or located above "lay-in" or "accessible ceilings": Young Regulator Company Model 817 or equivalent.
ii. Dampers in ducts concealed above plaster ceilings or behind dry wall construction: Young Regulator Company Model 817A or equivalent.

k. Use in low pressure duct system only.

14. Low pressure duct access doors

a. Provided for: each manual and motorized damper; fire damper; smoke damper; electric duct heater; and where access is otherwise necessary.

b. Factory prefabricated double wall insulated type of 24 US gauge galvanized steel (of same or thicker gauge than ductwork panel in which installed, whichever is greater).

c. Minimum size shall be as large as is compatible with duct size but in no case less than the following (provide larger sizes if necessary to permit proper access operation): Max. Duct Dimensions Access Door Size

i. 11" and less 12" x 12"

ii. 12" through 16" 12" x 16"

iii. 17" and over 16" x 24"

d. Doors shall be provided with and operated adjustable tension catches and shall be completely gasketed around their perimeters. Doors shall be Ventlok "Access Doors". Install in accordance with manufacturers recommendations using Ventlok #360 sealant or equivalent.

15. Test openings - Furnish and install gasketed capped test openings for test equipment (pitot tubes, etc.) on the entering and leaving sides of air handling unit and other air handling equipment and heating coils. Test openings shall be Ventlok #699-2 or equivalent.

16. Prefabricated duct connections - At Contractor's option, prefabricated duct connections as manufactured by Ductmate (or approved equal system) may be used in locations and applications for which the duct connection system is recommended. Use of these connections must meet or exceed specified duct construction quality as related to structural rigidity, pressure, accessibility and other such requirements.

17. Construct and install all accessories in accordance with the latest indicated editions of applicable SMACNA construction standards.

18. Provide all mitered elbows with turning vanes.

19. Install all duct system accessories in accordance with manufacturer's recommendations.

20. All accessories installed in double-walled ductwork shall match the material and insulation requirements for double-walled ductwork.
23 33 14  Duct-Mounting Access Doors

1. Take adequate precautions to insure that installed dampers/operators are protected from damage during construction.

2. Fire dampers shall comply with Underwriters Laboratories (UL) Standard 555 and bear the UL test label.

3. The sheet metal installer, in conjunction with the metal stud installer and drywall installer, shall fabricate a mock-up of each type of fire damper installation in a one-hour fire wall. The mock-ups shall contain all required framing, retaining angles, sleeves, caulking, drywall and other appurtenances as shown on the details and/or the manufacturer’s installation instructions. After fabrication the mock-ups shall be approved by the Architect/Engineer.

4. The mock-ups shall remain on the project premises to be used for reference and training purposes.

5. Provide dampers which are to be installed in a horizontal plane with spring closing mechanisms.

6. Curtain-type fire dampers
   a. Fire dampers shall be constructed with casings of 11 gauge galvanized steel with bonded red acrylic enamel finish interlocking type damper blade assembly, and fusible link rated at 160-165°F unless noted otherwise on the drawings. Provide factory furnished duct installation sleeve. Sleeve shall be minimum 16 gauge for dampers up to 36” wide x 24” high and 14 gauge for sizes exceeding 36” x 24”. Dampers shall be Style “B”, 100% full duct opening, and bear 1-1/2 hour UL label.

7. Multi-blade type fire dampers
   a. Provide multi-blade type spring-driven fire dampers in types and sizes indicated, with casing constructed of 10 gauge galvanized steel with bonded red acrylic enamel finish, fusible link 160-165°F (71-74°C), unless otherwise indicated, and matching factory furnished installation sleeve.
   b. Acceptable manufacturers are: Nailor Hart, Ruskin, Louvers and Dampers, American Warming & Ventilating, Prefco and Air Balancing, Inc., Safe Air, Greenheck or equivalent.

8. Provide access doors to facilitate re-linking of fire and fire/smoke dampers.

9. See installation details on plans.

10. Adhere strictly to damper manufacturer’s instructions.
11. Install multi-blade type fire dampers in ducts at grilles and registers if and where indicated on drawings.

12. Install curtain type fire dampers where indicated on drawings at locations other than grilles and registers.

### 23 33 19 - Sound Attenuators

1. Provide factory fabricated sound attenuators of the types, sizes, and acoustical and airflow characteristics indicated.

2. Shop drawings - Refer to requirements of Section entitled "General Mechanical Provisions". Include complete data on: dimensions, airside pressure losses, dynamic insertion losses, regenerated sound level (i.e. self-noise or airflow generated noise), performance certification, performance test method, and materials of construction.

3. Manufacturer - Products listed in this Section or on the plans are based on specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:
   a. Rink Division of Krueger/Phillips Industries.
   b. Commercial Acoustics.
   c. Transonics.
   d. Industrial Noise Control, Inc.
   e. Titus.
   f. United McGill Corporation.
   g. Ruskin Sound Control.
   h. Industrial Acoustics Company. *(Basis of Design)*

4. Outer casings - The outer casings of the attenuators shall be constructed of not less than 22 gauge galvanized steel with seams lock formed and mastic filled, or shall be continuously welded.

5. Partitions - The interior partitions of the attenuators shall be constructed of not less than 24 gauge galvanized perforated steel.

6. Filler materials - The silencer filler material shall be inorganic mineral glass fiber of a density sufficient to obtain the specified acoustic performance and shall be packed at not less than five percent (5%) compression to prevent the formation of voids due to vibration or settling. The material shall be inert, vermin and moisture proof, and shall comply with the flame spread and smoke developed ratings of NFPA 90A.

7. Performance - Acoustic and aerodynamic performance shall be tested and certified in accordance with ASTM E477-84 Standard Method of Testing Duct Liner Material and Prefabricated Silencers for Acoustical and Airflow Performance. Airflow pressure drops shall be tested in accordance with AMCA Standards. The performance indicated is not a
band-by-band listing of the silencer scheduled, but reflects actual minimum attenuation (in decibels) for the indicated octave bands at the design conditions.

8. General: Refer to manufacturer's instructions and the requirements of Section entitled "Ductwork" for installation and supporting requirements.

9. Where multiple sound attenuators are assembled, by either the manufacturer or the installer, into attenuator banks, the individual attenuators shall be securely fastened together using galvanized steel bands, straps, structural angles and/or welds, as recommended by the manufacturer. All joints between the assembled attenuators shall be sealed to prevent air leakage as recommended by the manufacturer.

10. Coordinate with sizes of ducts to be connected to attenuators. Provide duct transitions to match sizes of attenuators and attenuator banks if duct sizes differ from sizes of attenuators and attenuator banks furnished.

23 34 00 HVAC Fans

1. Provide Interlocks with respective AHU to automatically shut down lab exhaust fans.

2. Provide all power supply and exhaust roof ventilators of size, capacity, and electrical characteristics indicated/scheduled on the drawings or as otherwise indicated. Fan design mounting shall meet the Miami-Dade requirement for 140 MPH wind resistance without the need for cabling tie downs, etc. Submit manufacturer’s data indicating conformance with this requirement.

3. SHOP DRAWINGS - Refer to the requirements of Section entitled "General Mechanical Provisions". Include complete data on: fan external static pressure, fan rpm, motor rpm, fan tip speed, fan size, fan performance tables or curves showing all possible operating selection points for each fan size (including rating certification), fan brake horse-power, motor horsepower and electrical characteristics, sound level, curb adapter, and fan accessories. The data shall take the form of engineering data sheets, clearly depicting specification compliance, and a complete schedule worked up by fan number.

4. Certified performance - AMCA certified as to both sound and performance ratings.

5. Manufacturers - Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:

   a. Greenheck Fan and Ventilator Corp. (Basis of Design)
   b. Loren Cook Company.
   c. Penn Ventilator Company.

6. Fan assembly - Fan Hood, Housing, and Base: Weatherproof and constructed of heavy gauge aluminum.

7. Motor and drive: supported by a structural frame independent of hood, housing, and curb adapter.

9. Drive Assembly: Motor and drive assembly located out of exhaust/supply air stream, cushioned mounted on multi-directional neoprene vibration isolators and positively ventilated. Direct or belt drive type as indicated.

10. Other requirements
   a. Provide factory-wired non-fusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection unless otherwise noted on the drawings.
   
   b. Provide matching factory insulated curbs to fit base of roof ventilator, 14” height minimum or as indicated on drawing, and type to suit roof construction. Kitchen ventilation hood exhaust fans shall be up-blast type and shall include all accessories to meet UL762 requirements.
   
   c. Provide removable bird screens, ½” mesh, 16 ga. aluminum or brass wire unless noted on the drawings.
   
   d. Provide gravity-actuated back-draft damper.
   
   e. Isolate the entire rotating assembly and motor of each fan to prevent the transmission of vibration into the structure. The hood covering the fan motor and drive shall be hinged and provided with an approved locking device to fasten hood in closed and open position.
   
   f. Provide fan motors suitable for VFD control where indicated on the drawings.
   
   g. Provide curb adapters for placement on the existing roof curbs unless the new fan bases fit the exact dimensions of the existing curbs.
   
   h. Mount fan and back-draft damper in strict accordance with manufacturer’s instructions. Coordinate with existing roof curb dimensions and size curb adapters as required based upon field measurements.

11. Wiring - Ensure that fans are wired properly, with correct motor rotation, and positive electrical motor grounding.

12. Duct connections - Connect inlet ducts (where required) to roof curb inlet flanges using flexible connectors. Install connectors so that they are not in tension and are aligned with ductwork.

13. Test and balance - Operate all power roof ventilators, adjust drive speeds to achieve design air flow, record fan motor amperes and nameplate data, and perform other requirements as indicated in section describing testing and balancing.

14. Other requirements
   a. Remove shipping bolts and temporary supports within ventilators and exhaust fans. Adjust dampers for free operation.
b. Furnish to Owner, with receipt, 1 spare set of belts for each belt drive power ventilator and exhaust fans.

c. Provide curb adapters for placement on the existing roof curbs unless the new fan bases fit the exact dimensions of the existing curbs.

d. Provide necessary anchorage and supports to prevent vibration.

23 36 16 Terminal Units: VAV, Single Inlet, Electric Coil

1. Provide single inlet, variable air volume (VAV) terminal units of types, sizes and capacities indicated.

2. Shop drawings: Refer to Section entitled "General Mechanical Provisions". Include: complete performance data at the scheduled operating conditions; dimensions; performance data; pressure loses; descriptions; discharge and radiated sound power levels at the stated conditions.

3. Manufacturer: Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:

   a. Trane. *(Basis of Design)*
   b. Enviro-Tech
   c. Titus.
   d. Krueger.
   e. Metalaire.

4. Terminology: The word "box" or "terminal unit" used throughout this section without any modifying adjective shall mean the entire terminal unit assembly including all other accessories integral therewith, unless otherwise indicated. Terminal units may be referred to as "TU".

5. Noise criteria: Unless otherwise indicated on drawings, the following noise criteria comprise the basis upon which the selected terminal units must be rated in order to comply with the design limits for allowable NC levels:

   a. All sound power level decibels are referenced to 10 to the minus 12 watts.
   b. Room outlet NC sound pressure levels specified for these TUs are based on 10dB room absorption.

   c. Room radiated NC sound pressure levels specified for these TUs are based on 10dB room absorption plus 13 NC ceiling sound transmission loss.

   d. *The maximum allowable NC level in any occupied space (unless otherwise indicated) shall not exceed NC20 as a result of radiated or discharge noise from any terminal unit.*
e. NC levels which are generated by the terminal units on which noise criteria will be judged are those NC levels generated when the terminal unit is operating with an inlet static pressure of 1.0-inch w.g.

6. Selection: Terminal units shall be selected for maximum air discharge within the mid-range of the TU rating so that field adjustment of maximum indicated discharge air quantity may be made plus and minus 15%.

7. Leakage: Terminal units intended for full shut-off operation shall not have air leakage of more than 2% of nominal box capacity when inlet pressure is 6.0 inches w.g.

8. Pressure drop: Maximum allowable static pressure drop across the control box portion of any terminal unit (i.e., excluding any applicable companion sound attenuator or heating coil) shall not exceed 0.20 inches w.g. or the value(s) scheduled on drawings. Maximum allowable minimum operating pressure of the entire unit shall not exceed 0.50 inches w.g.

9. Terminal units: Control Unit: Double-wall, galvanized steel or aluminum casing; insulated between the outer and inner wall with 1-inch thick high density fiberglass insulation to prevent condensation (comply with NFPA 90A); acoustically treated to reduce noise level; air quantity indicator; access panel(s) for complete access to all parts of the assembly which may require service, maintenance and repair. The solid inner liner shall be constructed of 26-gage galvanized steel.

10. DDC controllers shall be Automated Logic, Inc. and shall be factory-mounted in each VAV terminal. Terminal manufacturer shall coordinate with Automated Logic.

11. Electric heating coil: General: Each terminal unit shall be provided with an integral, factory-mounted electric heating coil/control panel. Heating coils shall have all operating characteristics completely coordinated to function satisfactory as an integral part of the fan terminal unit. Capacities for each integral heater shall be as scheduled on the drawings. Provide integral disconnect on the door of the heating coil control panel.

12. Other Requirements:
   a. Meet all applicable requirements of the current NEC.
   b. UL listed including all built-in components.
   c. Coordinated with the specified requirements of the mechanical system control system.

13. Materials:
   a. Open coil type.
   b. Full fine break mercury contactors which will break all ungrounded conductors (note horizontal, vertical or oblique position of each heater assembly as shown on drawings).
   c. Transformer with primary fusing if control voltage is different from supply voltage.
   d. Over-current protection in accord with NEC requirements.
   e. Control terminals and power terminals.
f. Built-in or remote pressure type air flow switch. Install in series with automatic reset thermal cutout.

14. Wiring Diagrams: Provide complete wiring diagram furnished by the heating coil system manufacturer to the mechanical systems control manufacturer and the Electrical Contractor.

15. This wiring diagram shall completely indicate in full detail all electrical and control wiring requirements, terminal, etc. necessary to allow the control manufacturer and Electrical Contractor to completely coordinate their respective wiring portions of the heating coil system installation.

16. Control requirements: Pressure Independent Operation: Terminal units must operate independent of inlet pressure fluctuations in the main or branch duct system. Units must have controls which are factory installed, factory calibrated and factory tested to be pressure-independent. This pressure independent feature must be a standard catalogued feature or available and provided as a standard catalogued option.

17. Units shall maintain constant discharge flow for any given set-point with any variation in inlet static pressure between 0.2 inches w.g. and 6.0- inches w.g.

18. All terminal units must be factory set for design air flow and for minimum air flow. Adjustment: Unit must have capability for easy field adjustment of maximum and minimum air quantities by resetting of control mechanism(s) on terminal unit.

19. Operation: Discharge volume setting shall be controlled throughout indicated variable volume operating range as dictated by the controller which signals air flow requirements.

20. Controls integral with the terminal unit shall be provided by the terminal unit manufacturer. This includes damper motors and similar items.

21. Controls/Controllers must be completely compatible in all respects with the related components of the building temperature control system by Automated Logic.

22. Sensor: In addition to other requirements, the terminal unit shall have an inlet flow/pressure sensor which is designed to operate in conjunction with variable air volume exhaust hood control systems where applicable.

23. Coordinate location with all ducts, beams, joists, conduit, lights, piping, air distribution devices and other items in immediate vicinity of indicated locations. Make minor adjustments in exact locations shown to best fit available space.

24. Make all duct connections to and from boxes in as streamlined a manner as practical so that air pressure drop is minimized. Make such connections air tight at operating pressures encountered. Coordinate exact box location and inlet duct connection so that any straight diameters of inlet duct are provided as may be required by the terminal unit manufacturer for proper operation.

25. Locate terminals so that access for repair, maintenance and adjustment is easily facilitated without removal of other permanently located items which are in the immediate vicinity of
boxes (this excludes removable ceiling panels, removable air distribution devices attached to flexible ductwork and other similar items). **DO NOT INSTALL terminal units unless all clearance requirements are provided in the field.**

26. No terminal unit outlet (including companion sound attenuator, if needed) shall be nearer than 60-inches from the first flexible duct connection take-off to the first downstream air distribution device.

27. Coordinate controls to take into account reverse or direct acting thermostats, whether TU’s are normally open or normally closed, and similar interfacing.

### 23 37 13 - Air Distribution Devices

1. **Scope:** Provide all air distribution devices as indicated on the drawings and as specified herein for a complete and operable system.

2. Coordinate with work of the ceiling, drywall and plastering trades as required to insure an orderly progression of work and a first class finished system with respect to placement, alignment, finish, general fit and absence of conflict with lighting systems and fire protection systems.

3. Insulate air distribution devices to prevent condensation formation.

4. Acoustical: Noise produced at each diffuser, register, grille or other air distribution device shall not exceed a noise criteria level of NC 20 based on sound pressure levels in db re 0.002 microbars unless otherwise indicated. Coordinate air distribution devices, sound attenuation measures and equipment actually provided to insure that this design constraint is not exceeded by the system installed.
   a. **Exceptions:** Any particular rooms or areas which are normally occupied by other than maintenance staff or service staff and which may be noted on the drawings as requiring lower NC criteria.
   b. Pressure Drop: Pressure drop across any air distribution device shall not exceed 0.15 in wg static pressure unless otherwise indicated.

5. **SHOP DRAWINGS:** ALL AIR DISTRIBUTION DEVICES SHALL BE SUBMITTED IN A DETAILED AIR DEVICE SCHEDULE INDICATING THE SPECIFIC PERFORMANCE REQUIREMENTS FOR EACH AIR DEVICE. NO EXCEPTIONS. THE SCHEDULE SHALL INCLUDE THE DIMENSIONS, AIRFLOW, STATIC PRESSURE, NC LEVELS, AIR OUTLET VELOCITY AND ROOM LOCATION.

6. **MANUFACTURER:** Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:
   1. Titus.
   2. Metalaire.
7. Other requirements:
   a. All aluminum is to be extruded unless otherwise indicated.
   b. Appearance: Each air distribution device which has a portion thereof (frame, core, etc.) exposed to view in the finished area shall have a factory applied finish which matches and is compatible with the color of the surrounding surface on which the device is installed. Colors must be approved by Architect prior to device fabrication.
   c. All louvers, dampers and/or shutters shall be rated by their manufacturer in accord with AMCA Standard 500-74.
   d. Integral Components: All dampers, blank-off baffles and other companion devices which form an integral part of air distribution device shall be factory made items produced by the manufacturer of air distribution device.
   e. Louvers: Louvers may be specified in another division but for reference may also be indicated on mechanical drawings.
   f. Door Grilles: Door grilles may be specified in another division but for reference may also be indicated on mechanical drawings.
   g. All devices must each comply with the applicable portions of the Air Diffusion Council (ADC) Equipment Test Code 1062R4 "Certification, Rating and Test Manual", the Air Movement and Control Association, Inc. (AMCA) Standard 500 "Test Method for Louvers, Dampers and Shutters" and the "National Fire Protection Association" (NFPA) Standard 90A "Installation of Air Conditioning and Ventilating Systems".
   h. Provide ceiling and/or linear diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of diffuser.
   i. Diffusers, grilles and registers installed in fire rated ceiling, or floor/ceiling assemblies shall be constructed of steel.
   j. Mounting Screws: Where grilles, diffusers or registers are specified which require mounting screws visible from the face of the device these screws shall be furnished with the air distribution equipment and be finished at the factory to match the finish on the grille, diffuser or register in which they are to be used.

8. Location: Install air distribution devices where indicated and in accordance with manufacturer's recommendations. The location of ceiling supply, return and exhaust air devices as shown on the architectural reflected ceiling drawings shall take precedence over any other location shown.

9. Exposed Duct and Device Interiors: Duct interiors, air distribution device interiors and blank offs shall be painted with flat black enamel to eliminate light reflectance from the inside of the duct system.
10. Support: All ducts connected to air distribution devices shall be supported independently of the ceiling. Verify the ceiling grid type being furnished. Lay-in devices shall be supported from the structure above if the suspended ceiling grid is not designed to carry the weight of the device.

11. Surface Mounted Devices; Lay-In Ceiling: Unless otherwise indicated, locate units in center of acoustical ceiling modules.

12. Paint the interior of all return air grille plenum boxes flat black.

13. Rectangular Diffusers: Where diffusers are the lay-in type, they shall be supported by the inverted T-bar suspension system but all ducts connected thereto shall be supported independently of the ceiling as specified under Section entitled "Ductwork". Surface mounted diffusers shall be supported by the duct runouts or drops where sheet metal ducts are indicated and by separate hangers where flex runouts are indicated. All rectangular ceiling diffusers shall be installed with their lines parallel and perpendicular to the building line and properly aligned with the ceiling.

14. Sidewall Grilles and Registers: Mount securely to the duct system flanges using finish screws and in accordance with accepted good practice.

15. Ceiling mounted Exhaust and Return Registers/Grilles: Mount as specified hereinbefore for surface mounted ceiling diffusers except use finished screws provided and secure to duct and finished ceiling (or finished ceiling for non-ducted returns) in accordance with the manufacturer's instructions. Where required to provide adequate support for non-ducted registers or grilles, provide appropriate mounting frame for incorporation into the ceiling system.

16. Install all outlets and inlets as recommended by the manufacturer; in accordance with recognized industry practices; to insure that products serve intended functions.

17. Locate ceiling air outlets and inlets as indicated on the drawings. Unless otherwise indicated, locate units in center of acoustical ceiling modules. Install square and parallel with partitions, ceiling grid members, etc.

18. Spare Parts: Furnish to Owner, with receipt, 3 operating keys for each type of outlet and inlet that require them.

19. Do not install blank-offs under continuous linear diffuser distribution plenums. Distribution plenums shall cover only active portion of the diffuser.

20. Exposed ductwork:
   a. Diffuser: Duct mounted supply diffusers shall be provided with a collar of sufficient length to have the closed combination damper and equalizing grid, where required, flush with the interior surface of the duct.
   b. Sidewall Device: Duct mounted sidewall devices shall be provided with a collar of sufficient depth to allow the open opposed blade damper to be flush with the interior surface of the duct.
c. Insulation: The exterior of all supply devices shall be insulated with a minimum of 3/4 inch elastomeric or 1 inch fiberglass blanket with vapor seal. The vapor seal shall extend to the edge of the device.

21. Protection of work until final acceptance: Coordinate the installation of the air distribution equipment with related work and finishing of adjacent surfaces to prevent damage to the devices or adjacent finishes. Protect the finish of all air distribution equipment until final acceptance. Replace or repair to the Architect's satisfaction any damaged equipment.

23 40 00 HVAC Air Cleaning Devices

23 41 00 Air Filter Assemblies

1. Furnish and install complete air filter assemblies of the types, sizes and capacities indicated.

2. SHOP DRAWINGS: Include complete performance data at the scheduled operating conditions; dimensions; weights; performance curves; airside pressure losses; quantities; descriptions; and any other necessary information.

3. FILTERS: Shall pass applicable air quantities at velocities and pressure drops which are within manufacturer's recommended operating ranges and as specified and scheduled.
   a. Filter Manufacturers: Continental; American Air Filter; Cambridge; Farr; Flanders; Purafil; or equivalent.
   b. Filter Housing Apparatus Manufacturers: Same manufacturer as the applicable filters or same manufacturer as the air handling unit in which installed, whichever manufacturer is applicable.
   c. Air Handling Unit Filter Sections: Shall be of adequate size to accept specified filters. Air handling unit filter sections shall be factory made by air handling unit manufacturer or by filter manufacturer to be specifically compatible with applicable air handling unit.
   d. Fan Coil Units and ERV's: Integral part of fan coil unit or ERV assembly. Refer to the individual equipment specifications for filter requirements. Provide minimum pleated media filter of MERV 8, 2-inches thick.
   e. Access: Filter sections shall be designed for side service access unless otherwise indicated.
   f. Filters: Extended surface, pleated panel type; disposable; double-wall chipboard frame with diagonal support members; 2-inches thick; average efficiency no less than MERV 7 based on ASHRAE 52.2 test method; operate at an initial resistance of not more than 0.25-inches w.g.s.p. at 500 fpm face velocity.
   g. Design base: Camfil Farr AeroPleat IV; MERV-8 High Capacity Pleated Panel Filter.
   h. 
4. Pre-filters for air handling units: Filter Housing: Integral part of air handling unit assembly. (If not part of AHU assembly, provide external filter housing.)

5. Final-filters for air handling units:
   a. Filter Housing: Integral part of air handling unit assembly. (If not part of AHU assembly, provide external filter housing.)
   b. Filter: Air filters shall be high performance, extended area, deep-pleated, 12-inch thick, disposable type. They shall consist of a filter element, media retainer holding frame and sealer frame. The media shall be a wet-laid microfine glass fiber which is reinforced by a laminated synthetic backing. The filter shall have an average efficiency of MERV 14 per on ASHRAE Test Standard 52.2. The filter shall be listed by Underwriters' Laboratories as UL 900-Class 2.
   c. Design Base: Camfil Farr OptiPac; MERV-14, High-Efficiency.

6. Arrangement and Access: Arrange, install and make provisions for easy access to and removal and replacement of filters. Provide access doors and/or panels as necessary.

7. Coordination and Matching: Coordinate assembly components and properly match sizes and quantities of filters with related air moving systems (e.g., air handling units, fan coil units, filter banks) so that filter assemblies will operate in accord with operating conditions, sizes and capacities as listed in this section or as otherwise indicated.

8. Miscellaneous support steel and hardware: Provide as required to provide for adequate support and structural integrity of each filter bank. In no case shall supplementary supports be less than those indicated or recommended by the filter manufacturer in his standard installation instructions.


10. Original and spare filter sets: Provide an original filter set and two (2) spare filter sets for each unit having an air handling equipment filter assembly specified above. Upon initial start-up, each filter assembly shall be provided with a complete original filter set. Prior to or at the time of final test and balance, this original filter set shall be replaced with a complete new spare filter set. However, if at the time of final test and balance there is still useful operating life remaining in the initial filter set (i.e. the filters are still operating within their recommended pressure drop limits for the particular application), then the Contractor (if he is given written approval by the final test and balance agency) may give the spare filter sets to the Owner (at a place of the Owner's selection on the site) in lieu of replacing the original filters with the spare filters.
23 70 00 Central HVAC Equipment

1. Provide air handling units as indicated, including appurtenances, accessories and service connections. Air handling unit shall be selected for custom dimensioning to meet the clearances in each mechanical room.

2. Submittal: Include the following data:
   a. Manufacturer’s Literature.
   b. Performance Data: Provide the following information for each air handling unit:
      i. Coil capacity at design conditions including air entering and leaving temperatures.
      ii. Coil descriptions, rows and fins per inch, and face velocity.
      iii. Air flow and airside pressure loss at design conditions.
      iv. IF unit are Freon- Refrigerant charge and pressure at design conditions.
      v. Fan curve indicating design flow and brake-horsepower at scheduled static pressure, including drive losses.
      vi. Maintenance Instructions:
      vii. Manufacturer's printed instructions for the maintenance of each air handling unit.

3. All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with the paragraph entitled "Code Compliance" in Section 230100.

4. Comply: With the National Fire Protection Association (NFPA) Standards and other Codes and Standards as adopted by the Local Authority having Jurisdiction.
   a. NFPA: All materials and adhesives used shall conform to the requirements of NFPA 90A, 1999 Revision, and NFPA 255, 2000 Revision, with flame spread not exceeding 25 and smoke developed ratings not exceeding 50.

5. Performance: Supply fan performance shall be certified as complying with ARI Standard 430-89. Coil capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 410-91.

6. Warranty: Each air handling unit shall carry a full five-year parts & labor warranty.

7. Manufacturers: Equipment items listed in the schedule on the drawings are based on a specific manufacturer to establish the desired style, quality, performance, and type of equipment. Equal products, complying with the required installation shown on the plans and with these specifications, by the following manufacturers are acceptable:
a. Trane/Performance Air Handler (*Basis of Design*).

b. Carrier.

c. McQuay/Vision Air Handler.

8. Single Source: All air handling units shall be of the same manufacturer. All components in factory-furnished air handling units shall be factory-assembled and factory-tested prior to shipping.

9. Condensate Drain Pan: Each unit shall have an insulated, 20 gauge stainless steel, double wall, pitched drain pan for condensate drainage. Drain pan shall extend a minimum of six inches downstream of the coil face for inspection and access. The insulation shall be a minimum of 1 inch thick.

10. Sound Power Levels: Sound power levels in each band shall not exceed those indicated.

11. Fan Motor: Fan motors shall be an open drip proof ball bearing specifically designed for fan applications, unless otherwise indicated. Refer to paragraph entitled "ELECTRIC MOTOR" in Section 230200 for motor efficiency requirements. Unless specifically indicated otherwise air handling unit fan motors shall be selected as follows:

   a. Less than 5 HP; 135 percent of bHP

   b. 5 Hp through 25 HP; 125 percent of bHP

   c. Greater than 25 HP; 115 percent of bHP

   d. Trane – Performance Air Handler (*Basis of Design*).

12. General:

   a. Air handling unit shall be single path.

13. Unit Casing: Units shall be of the sectional, unitized, bolt-together construction with gasketing where modules are joined. Units shall have a separate fan section and coil section. All enclosure panels on the units shall be fabricated from minimum 18 gauge galvanized steel (G-90) which has been chemically cleaned, phosphatized *factory painted* with an enamel finish. Unit shall be supported on a continuous base rail assembly. *All air handling units shall be designed, manufactured, compartmentalized, shipped and installed in order to physically fit into the building. Coordinate maximum sectional dimensions.*

14. Access Doors: Hinged insulated access doors shall provide access to the mixing air section, the inlet and outlet of each coil, the drain pan, and both sides of the internal fan drive and filter section. Latches for doors shall be industrial cam-lock type. Removing bolted sections of the air handling unit casing is not acceptable.

15. Fans: Fans shall be single width, single inlet direct drive, plenum-type fans constructed in accordance with the American Fan Manufacturers’ Association Standards. Direct drive plenum fans shall have up to two, aluminum blade Class II fans as scheduled. Wheels
shall be aluminum plenum type fan type as scheduled. Fan blades shall be aluminum for corrosion protection. Fan shafts shall not pass through their first critical speed at any cataloged rpm.

16. Sound Power Levels: Sound power levels in each band shall not exceed those indicated.

17. Bearings: Fans shall be equipped with self-aligning, anti-friction pillow block ball type bearings with a minimum life of 100,000 hours.

18. Single Path: Air handling units shall be single-path type.

19. Solid, Double-Wall Construction: Units shall be double wall construction with minimum of 2 inch thickness, foam-injected (R-13) insulation. Insulation shall be continuous throughout the entire unit, including all panels, sections, spacers, seams and connections.

20. The insulation shall be sandwiched between a minimum 20 gauge galvanized solid interior wall and the 18 gauge exterior wall.

21. Variable Frequency Drive: Air handling unit fan motors controlled through a variable frequency drive shall comply with the requirement of paragraph entitled "VARIABLE FREQUENCY DRIVE" in Section 230925.

22. Coils: Coils shall be leak tested to 200 psig air pressure underwater and designed for 300 psig working pressure. The coils shall be continuous seamless copper tube with aluminum plate fins bonded by mechanical expansion of the tubes, unless otherwise indicated. Fin spacing shall not exceed 12 per inch. Frames shall be constructed of minimum 16 gauge Type 304 stainless steel casing with copper headers brazed to tubes and threaded connections. AIR COILS SHALL BE PROVIDED WITH "FACTORY-APPLIED"

23. Electro-fin coating. Field applied or third party coatings are not acceptable. Unit coil shall be single or dual-circuited.

24. Filters: Filters section shall be flat type arrangement with individual gasketed rails to accept 2" thick pleated media pre-filter (30% efficiency/MERV-8) and a 12" thick pleated media (MERV-13) final filter section. Ship AHU’s with the initial start-up set of filters until the units are ready for actual test and balancing. At project close-out, provide Broward College personnel with a complete set of pre-filters (MERV-8) for all AHU’s with quantities necessary to provide one complete pre-filter change-out.

25. Controls: Temperature controls for the unit are provided by the DDC Control system contractor.

26. Clearance: Layout and carefully install units with sufficient clearances to permit proper maintenance. The space required shall be as recommended by the manufacturer including the space required for removal of the coil and for filter maintenance.

27. Piping: Isolation valves and flanges or unions shall be so arranged that the removal of the coil piping shall provide unobstructed access for the removal of the coil.

28. Fins: Straighten fins for each coil, using a fin comb, prior to final acceptance. Coils having tubes with excessive broken fins shall be replaced at no additional cost to the Owner.
29. Dampers: All air handling units with a direct unconditioned outside air connection shall be provided with a motorized opposed blade damper and a manual volume damper in the outside air duct. Refer to the control sequence for additional control requirements.

30. Vibration isolation: All fans shall be internally isolated and shall be free of vibration and shall not produce excessive noise. Refer to Section 23 05 48, vibration isolation equipment.

31. Isolators shall be sized for a minimum static deflection of 2 inches.

32. Duct Connections: Internal fan drive units shall be provided with flexible duct connection inside the unit and in the supply and return duct connections as required to prevent transmission of vibration into the duct system. Refer to paragraph entitled "DUCT SYSTEM ACCESSORIES" in Section 23 33 00.

33. Piping Connections: Provide P-trap(s) in the condensate pan(s) drain connection. Each coil shall be independently piped to the nearest condensate/floor drain terminating with an air gap.

34. Coil connections shall be selected for right/left hand as required.

35. Equipment support: Install each unit on a 6-inch galvanized steel channels/lightweight I-Beam the full perimeter of the unit.
26 00 00 ELECTRICAL

26 00 00 Electrical Design and General

1. Design Approach: Incorporate life-cycle considerations and a holistic approach with respect to energy conservation, properly proportioned demand load considerations, emergency power requirements, and power quality needs. Avoid over-designing of systems.

2. Related Work: All Electrical work to be performed shall be reflected in Division-16 specifications and/or on the Electrical Drawings. Any required electrical work related to other Divisions of the specifications shall be shown on the Electrical Drawings and specified in Division-16.

3. Existing Drawings: Drawings of existing facilities and underground utilities or systems may not be accurate and shall be considered as informational only. Architect/Engineer/CM shall verify field conditions (above ceiling, behind existing furniture, etc.).

4. Communications and Data Systems: The Architect/Engineer shall provide access points and outlets for these systems in the facility design. Coordinate communications and data systems design and communication duct bank design with the College Project Manager.

5. Ceiling Space: The design shall provide adequate space above corridor ceilings for electrical power, signaling, communications, data, and security systems installations.

6. Clear Space: The Architect/Engineer/CM/Electrical Contractor shall be responsible for determining locations and meeting any clear space and in-sight requirements for the installation of electrical equipment. Contract documents shall leave no question that clear space requirements can be met, especially at duct heater terminal cabinets and HVAC VAV boxes.

7. Branch Circuit Design: Where anticipated loads are comprised of a high proportion of equipment utilizing switched-mode power supplies, design in conformance to NEC.

8. Separate Neutrals: Specify separate neutrals on all circuits. Shared neutrals will not be acceptable.

9. Products: Equipment and materials of the same type of classification and use for the same purpose shall be products of the same manufacturer. ie. Motor controllers and disconnects shall be same manufacturer.

10. Classrooms, Conference Rooms and Instructional Spaces: Provide communications/data infrastructure consisting of lighting with motion detection sensors, emergency power, audiovisual, voice, data and electrical distribution.

   a. Audio-visual screens shall be electrically powered and controlled from AV console.

   b. Multi-media: Provide connectivity for a classroom multi-media podium.
c. Voice Evacuation System: Provide for public assembly areas such as lecture halls, auditoriums and libraries.

d. Laboratories: Provide electrical power to all lab tables from adjacent wall surfaces in instances where the laboratory. Ceiling drops for electrical power shall not be used under any circumstances without the BCPM written authorization.

11. Coordinated Short Circuit Current Calculations: The Architect/Engineer shall perform to determine the proper sizing of circuit breakers in accordance with NEC. Submit calculations to the College for review prior to final construction document submittal. Include calculations on the Electrical Drawings.

12. Voltage Drop Calculations: To meet NEC recommended minimum of 3 percent voltage drop, the Architect/Engineer shall specify the following:

   a. #12 Wire: 120V 20A circuit 0 to 50 feet to the farthest outlet; 277V 20A circuit 0 to 100 feet to the farthest outlet.

   b. #10 Wire: 120V 20A circuit 51 to 90 feet to the farthest outlet; 277V 20A circuit 101 to 200 feet to the farthest outlet.

   c. #8 Wire: 120V 20A circuit 91 to 140 feet to the farthest outlet; 277V 20A circuit 201 to 300 feet to the farthest outlet.

   d. Electrical design shall preclude any panel runs supplying these circuits from exceeding the maximum distances and associated wire sizes noted above.

13. Aluminum products and materials including, but not limited to, raceways, boxes, and fittings are not permitted for electrical work.

14. Quality Work: Contractor shall maintain the highest level of quality in the performance of the work. The execution of the work in the installation of electrical equipment shall be performed in a neat and workmanlike manner as required by the current edition of NFPA 70, National Electrical Code. The College and the Code authorities having jurisdiction will strictly enforce this requirement “Area practice” does not relieve the Contractor of the responsibility for conforming to the stated and shown Contract Document requirements.

15. Coordination: Contractor shall coordinate work specified in other Divisions of the specifications that require electrical installation with the requirements of Division 16 and the contract drawings to ensure all subcontractors involved work together to provide a complete, operational systems at no additional cost to the College.

16. Exterior Equipment: All exterior electrical equipment and related supports and fasteners shall be stainless steel. Grade of stainless steel to be specified by project and application. Minimum acceptable stainless steel grade 316.
26 00 50 Electrical and Communication Room Requirements

1. Space: Maximum allowable space shall be allotted to electrical and communications/data equipment rooms to provide ample clear space for the equipment provided and for future needs. Rooms shall be located to be serviced from an interior corridor.

   a. Rooms shall be a minimum of 10-feet by 12-feet; minimum size for closets shall be 8-feet by 10-feet. Provide a minimum of 50 percent additional wall space for future expansion. Non electrical utilities (ie. Water, HVAC, etc) are allowed to be in this space. HVAC required for the space shall be ducted outside the space.

   b. Communications/data equipment rooms are not to be calculated as part of the 6 percent space allocation for electrical and mechanical space under State Requirements for Educational Facilities.

   c. Communications/data equipment rooms are to be include in the net square foot area of the facility that is used to calculate the 6 percent space allocation for electrical and mechanical space.

2. Drawings:
   a. A/E Construction drawings shall contain enlarged floor plans at 1/2-inch scale of all electrical and communications/data equipment rooms and closets showing the location of all equipment in these spaces. Plan view and elevations of each wall shall be provided. Including, but not limited to, all equipment, pull boxes, junction boxes, grounding systems and exposed conduits.

   b. The Electrical Contractor shall provide, prior to construction, shop drawings for approval by the Electrical Engineer and BCPM, containing enlarged floor plans at 1/2-inch scale of all electrical and communications/data equipment rooms and closets showing the location of all approved equipment in these spaces. Plan view and elevations of each wall shall be provided. Including, but not limited to, all equipment, pull boxes, junction boxes, grounding systems and exposed conduits.

3. Air-conditioning and Ventilation: Provide all telephone equipment and communications/data equipment rooms and closets with 24-hour air-conditioning. Provide all electrical rooms and closets with air-conditioning unless provided with positive outside air ventilation. Primary HVAC from central station and backup and after hours with a dedicated space AC system. AC system or ductwork shall not be located within the space. AC system shall be controlled through the Building EMS.


5. Lighting: Provide battery power emergency lighting.

6. Doors: All electrical and communications/data equipment room doors shall swing out.

7. Raceways: Terminate immediately adjacent to the cable trays or backboards. All conduit type raceways, including through the floor stubs, shall terminate in an insulated throat, lay-in lug bonding bushing (RAC01213, or equivalent).
8. Data/Communication Outlets: Provide one in each electrical distribution room.

9. Housekeeping Pads: Provide for all floor-mounted electrical equipment; minimum 4-inches high, 3000 psi concrete with no greater than a 2-inch lip chamfered edge around the equipment.

**26 0519.23 Manufactured Wiring Assemblies**

1. Sequencing: All surface-mounted wiring devices shall be installed only after finish painting is completed.

2. Transient Voltage Surge Protection (TVSS): Provide for all outdoor lighting poles, incoming mains, sub-panels, computer circuits, fire alarm systems, and other sensitive equipment or systems. Refer to Section 16285 for specific TVSS requirements.

3. Boxes: No aluminum metal boxes, extensions or mud rings will be acceptable.

4. Outlet box extension rings will not be permitted.

5. "Handy" Boxes, 180 boxes, or gangable/non-gangable 2-inch wide ("cut-in") switch boxes will not be permitted.

6. Box Height: Minimum receptacle box mounting height shall be 18 inches and switch height 46 inches on center. All finish device height shall be uniform within wall run. No operable switch to be installed above 48 inches.

7. Receptacles: General-duty Simplex or Duplex receptacles shall be 2-pole, 3-wire rated at 125 volts and 20 amps, equipped with green hexagonal equipment grounding screw, ground terminals and poles internally connected to the mounting yoke, with plated ears, back wiring, NEMA configuration 5-20R.

8. GFI: Ground fault interrupter, general-duty duplex receptacles shall be of the GFCI (ground fault circuit interrupter) grounding type, UL rated Class A, Group 1,20 amp rating, 120 volts, 60 Hz, with solid state ground fault sensing and signaling with 5-milliamperes ground fault trip level, NEMA 5-20.

9. Back-wired, feed-thru type, capable of protecting connected downstream receptacles on single circuit are only acceptable where used as a single unit not protecting any other downstream receptacles.

10. Snap Switches: Provide single pole or multi-pole heavy-duty, flush toggle, 20 amp, 120/277 volts AC, commercial grade.

11. Occupancy Sensing Switches: Provide 120/277V, 20 amp units that provide single pole or 3-way switching.

12. Interior Finish Plates: Provide smooth, white plastic wall plates.
13. Installation of Boxes: Where used to enclose flush devices, provide with the proper mud ring to ensure that the front-edge to finish, and side edge to plaster complies with NEC. The use of "goof rings" is unacceptable. One eighth (1/8)-inch maximum setback allowed in non-combustible material walls and flush in combustible material walls per NEC 370-20 & 21. Boxes to be fully mudded in.

a. Boxes of any type shall not be supported from ceiling support wires

b. Do not install back-to-back; install at least 12-inches apart

14. Installation of Receptacles: Vertical installation shall be with the ground pin down. Horizontal installation shall be with the neutral pin up.

26 05 26 Grounding

1. Grounding Buss: Copper, minimum ¼ x 4 x 12 with 25 percent spare capacity. Provide in the Electrical Main Distribution Room and in all other Electrical Distribution rooms and separate Communication/Data rooms.

2. Equipment Grounding Conductors:

a. Architect and Engineer to provide a complete design of all equipment grounding. Providing a grounding symbol and NEC reference only is not acceptable.

b. Equipment grounding conductors shall in no case, be run on the exterior of a raceway, on the building surface, or concealed in the building structure. All grounding conductors to be in conduit.

c. Termination: Terminate equipment grounding conductors in terminal bars, screws, or lugs expressly designed for the purpose.

3. Grounding Buss Installation: Mount 18-inches above the finish floor of the Electrical Main Distribution Room. Connect to the footer steel, building steel, to two (2) 3/4" diameter by 10 Basic foot long copper-clad driven ground rods, or to the cold water pipe with the proper size copper grounding electrode conductor.

a. Interconnect grounding buss to each Electrical Distribution room grounding buss with a tie conductor of the same size as the main grounding electrode conductor.

b. Connections: Connect the ground buss in each communications room with a minimum #3/0 copper conductor in 1-inch conduit.

4. Grounding Electrode Conductor. Run enclosed in rigid metallic conduit continuous from the service entrance grounding buss to the grounding electrode.

5. Connections and Terminations to the grounding electrode and grounding electrode conductor shall be made by exothermic welding.
26 05 29 Hangers and Supports for Electrical Systems

1. Performance Requirements: Design supporting devices capable of supporting combined weight of supported systems and components. Do not use cantilever supports.

2. Submittals: Provide shop drawings to the BCPM for approval prior to fabrication and erection of electrical supporting devices for exterior equipment.

3. General Material: Provide cold-formed steel with corrosion-resistant coating acceptable to authorities having jurisdiction. Use 316 stainless steel for outdoor and damp locations, U-channel system components.

4. Raceway and Cable Supports: Manufactured Clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

5. Pipe Sleeves: Stainless Steel or ASTM A53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

6. General Installation: Securely fasten electrical items and their supports to the building structure unless otherwise indicated.

7. Support Clamps for PVC Raceways: Use click-type clamp system.

8. Horizontal Raceways: Support individual raceways with separate pipe hangers or clamps. Arrange for grouping of parallel horizontal conduit runs to be supported together at the proper intervals on trapeze type hangers. No tie wire support acceptable.

9. Threaded Steel Hanger Rods: Use minimum 1/4-inch diameter for support of a single conduit up to a 2” conduit. Single conduits 2” and larger, minimum 5/16” diameter support rod.

10. Arrangement: Arrange supports in vertical runs so the weight of raceways and enclosed conductors are carried entirely by raceway supports, with no weight load on raceway terminals.

11. Metal Channel Racks: Install for mounting cabinets, panel boards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

12. Sleeves: Sleeves must be listed. Install for cable and raceway penetrations of concrete slabs and wall unless core drilled holes are used.
   a. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies.
   b. Install sleeves during erection of concrete and masonry walls.
13. Wall-Mounted Electrical Equipment: Install surface and wall-mounted equipment on Unistrut equivalent supports, installed approved wall backing or 3/4-inch exterior A-C grade or better plywood.

26 05 33 Raceways and Boxes for Electrical Systems

1. Locations, Types, and Sizes:
   a. All raceways above grade/slab in the building interior shall be metallic unless subject to damage. All systems for lighting, heat, power, or controls shall be installed in 3/4-inch trade size raceways with minimum 3/4-inch trade size.
   b. All branch circuit home runs shall be 3/4-inch minimum trade size containing not more than one four-wire multi-wire branch circuit plus an equipment grounding conductor (if required) and shall be clearly indicated as such on the Drawings.
   c. All raceways below grade or under slabs shall be a minimum of 3/4-inch trade size.

2. Aluminum: No aluminum raceways will be permitted.

3. Rigid Galvanized Steel Conduit (RGS): Use where conduit is exposed and subjected to the weather or potential physical damage (ie. mechanical areas, electrical areas, service areas, parking garages, etc).

4. Conduit: Provide rigid steel conduit, in, below, or through concrete floor slabs, vapor barriers, and in masonry or concrete walls. Protect conduit utilizing one of the following methods:
   a. Field-coated with two coats of bitumastic compound
   b. Additional outside factory coating of polyvinyl chloride, phenolic-resin-epoxy material, or other equally flexible and chemical resistant material

5. EMT (Electrical Metallic Tubing): May be used for all indoor work exposed or concealed above slab except where subject to physical damage or wet locations.

6. All fittings shall be steel or malleable iron without exception, conforming to ANSI C80.4. Where concealed, fittings may be set-screw type with insulated throat connectors having two (2) set screws in line at each tubing connection for sizes 1-1/4 to 2-inches, and two (2) set screws 45 degrees apart at each tubing connection for sizes 2-1/2 to 4inches.

7. Provide steel or malleable iron compression type, UL listed fittings for rain-tight applications, with insulated throat and casehardened locknuts.

8. The connection of power or communications outlets within permanently installed cabinets and casework shall be concealed and run in EMT.

9. Exposed Connections: Provide Liquidtight Flexible Metal Conduit, 24-inch maximum length in mechanical rooms, damp and wet locations, or where flexible connections are required.
10. Flexible Metal Raceways: Shall not be used to extend a raceway system, or for the connection of outlets within permanently installed cabinets or casework. Flexible metal raceways shall be steel (no aluminum will be permitted).

   a. May be used only where they will be concealed but dry and accessible

   b. May be used for the connection of recessed lighting fixtures where a maximum run of 6-feet will be permitted

   c. Connections to items requiring frequent maintenance

11. Fittings: Steel or malleable iron, UL listed when used for grounding. No die-cast or pot metal fittings will be permitted.

12. Cable Tray: Use of cable tray is not acceptable unless approved by the College. In those instances where the College has approved the use of cable tray, provide in continuous runs without gaps, field-fabricated fittings, or bends. Only manufactured fittings will be acceptable. Installed cable tray shall be easily accessible with a minimum of 2-feet clear on each side.

13. Surface-Mounted Raceways: Provide a fabricated trough or enclosure with a screw cover to house or enclose data cables, communications cables, and power raceways.

14. Locate to provide easy access for servicing or future expansion or modification of the enclosed systems

15. Provide grommets for power, data and communications cables at proper locations. Size shall be 1-3/4 inches or 2 inches as required.

16. Installation, General: There shall be no single bend exceeding 90 degrees in any conduit run.

17. Stub-Outs: Provide four (4) spare ¾ inch conduit stub-outs from each panel board and telephone board into the nearest accessible ceiling space. All spare conduits to terminate in a box. Spare to panel to be identified on the box.

18. Pull Wire: Provide a pull wire in all empty raceways. Pull wire shall be #14 TW, Thomas Industries Jet Line #232 Polyofin 200 lb. Test, or equivalent.

19. Raceways penetrating walls or floors through sleeves shall be sealed and fire-stopped. Refer to Section 07 8413, Fire and Smoke Protection, for additional requirements.

20. Conductors or circuits of differing voltages (i.e., 120/208VAC or 277/480VAC, or Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power Limited circuits, or circuits originating in different panel boards) shall not be installed or contained in the same conduit run.

21. Architectural Millwork and Furniture: Provide a trough or enclosure with a screw cover to house or enclose data cables, communications cables and power raceways.
22. Location: Provide easy access for servicing or future expansion or modification

23. Grommets: Provide 1-3/4 inch or 2 inch diameter units at proper locations for power, data and communications cables.

26 05 53 Identification of Electrical Systems

1. General: Tag all conductors and identify unused conduits in or at outlets, raceways, panels, pull boxes, switch boards, motor controllers, cabinets and similar items. Conductor tags shall be non-conductive or Brady-type markers.

2. Junction Boxes: All lighting and power junction boxes shall be identified by circuit and panel board number and color-coded (refer to section E below) in a permanent manner.

3. Other Devices: All disconnect switches, panel boards, motor starters, system controllers, fire alarm zones, transformers, power outlets (other than ordinary receptacles) shall be identified by installing a permanent plastic laminated engraved nameplate with appropriate designation.

4. Panel Board Directories: Typewritten indicating complete as-built circuit information, and protected by a plastic covering.

5. Load description including location or room number and use indicated for each circuit (as-built documentation shall show corrected information)

6. Panel power source including room number.

7. Provide a master power riser in the main electrical room.

8. Re type directory after additional work is performed in the panel.

9. Panel Schedules: All panel schedules shown on the Drawings and shall include the following:

   a. Load description including location or room number and use indicated for each circuit (as-built documentation shall show corrected information).

   b. Panel power source including room number.

   c. Panel type and capacity, individual load calculations, short circuit, conduit, wire size, grounding, neutrals and overcurrent protection.

10. Color-Coding: Identify all systems by painting the designated color-code on all junction boxes and covers using the following system:

   a. Normal Power - Black
   b. Telephone - Gray
   c. Normal Lighting - Blue
   d. Sound System - Light Blue
   e. Emergency Light/Power - Orange
   f. Energy Management - Pink
g. Fire Alarm - Red
h. ATC/AC Control System - Purple
i. Clock System - Green
j. Computer/Conditioned Power - Yellow
k. Data Systems - White
l. Security - Burgundy
m. MATV Systems - Brown

26 05 83 Wiring Connections

1. Neutrals: Separate neutrals are a requirement. Common neutrals shall not be used.

2. Wire Size: 120 volt/20 amp branch circuits supplying lighting, receptacles exceeding 100 feet from the overcurrent device to the connected device and all 277 volt/20 amp lighting circuits exceeding 150 feet from the overcurrent device to the first outlet shall be #10 AWG for the entire branch circuit. Circuits exceeding 200 feet to the first outlet shall be #8 AWG for the entire branch circuit. Verify voltage drop prior and after installation.

3. Grounding:
   a. Provide a copper equipment grounding conductor of the proper size in all power and lighting branch circuit and feeder raceways. This wire is in addition to conduits and other raceway ground paths.
   b. Minimum size of the equipment grounding conductor shall be #12 stranded copper.
   c. A10/32 green screw shall be used to ground all outlet boxes.
   d. Wire and Cable shall be annealed, coated stranded copper per ASTM B33 or ASTM B189 with conductivity or not less than 98 percent.

4. Provide Stranded Class B wire and cable per ASTM B8
   a. Bus, lugs, and terminal blocks shall be copper
   b. **Aluminum wire and cable will not be permitted.**

5. Conductor Insulation: UL Type THHN/THWN, or provide UL Type THW or XHHW as appropriate for locations where installed.

6. Color-Coding: Factory color insulation. Re-identification with paint, tape or other means is not permitted.
   a. Ground leads Green
   b. Neutral Conductors White (120/208V); Gray (277/480V)
   c. Phase A, B, C120/208V Black, Red, Blue
   d. Phase A, B, C 277/480V Brown, Orange, and Yellow

7. Conductors: Run in approved conduit system regardless of voltage or insulation.
8. Lugs: Use approved types on all stranded or solid conductors.

9. Bundling: Conductors located in branch circuit panel boards, cabinets, and control equipment shall be bundled neatly and securely using plastic cable tie-wraps. Tape is not permitted as a tying method.

   a. Wires: Not more than seven (7) wires, including the equipment grounding conductor, shall be installed in a conduit run except by written authorization from the BCPM.

I. Splices: Provide sleeves using hydraulic Hy-Press or approved methods for splices made in conductors #4 AWG and larger.

   1. No splicing will be permitted on fire alarm, clock, speaker, intercom, or TV systems wiring. All splicing on these types of systems shall be made in junction boxes on the proper termination strips.

   b. Compression terminals and splices shall be installed only with a controlled cycle crimping tool.

26 52 19 Emergency Power Systems

1. Purpose: Emergency generator power system shall be used for emergency and stand by loads exceeding 24 KVA or consider inverter alternate for less than 24 KVA. When generators are not provided, an external generator dock connection will be required.

2. Life Safety and Emergency Egress Lighting: Provide systems listed by Underwriters' Laboratories (UL) under UL 924. Specify additional battery pack lighting in electrical and generator rooms.

3. Salient Design Features: Provide for the following:

   a. Prime mover power plant shall preferably be a water-cooled natural gas/diesel hybrid unit if gas available at location.

   b. Voltage Output regulation shall be +/- 0.5% of nominal

4. Generator Windings: 2/3 pitch design to eliminate triplen harmonics on the voltage waveform and for the mitigation of excessive neutral currents when supplying non-linear loads.

5. Emergency AC Inverter System: Storage battery type for emergency loads from 2500 VA to 24 kVA, consisting of a 3-stage battery charger, a DC to AC static inverter with transfer relay circuit, a battery bank properly sized for load requirement, a solid state custom IC-controlled electronics system, and a central display panel. Other salient features are as follows:

   a. Electronics and Batteries: Provide fully enclosed in 16 gage, welded steel cabinetry of modular design that allows side-by-side or vertical stacking. When provided
stackable, cabinets must be capable of being stacked two high for each two unit stack and shall have a foot print no larger than 27-inches wide by 18-1/2 inches, and a maximum height of 92-inches when stacked.

6. Battery Charger 3-stage unit meeting UL 924 standards and having the following features:
   a. IC-controlled for continuous monitoring and full charge maintenance
   b. Temperature compensated, constant voltage type providing constant current, float, and equalization of charging modes
   c. Operating efficiency not less than 85%, with each mode of operation indicated by a 2-color LED on the unit’s central display panel

7. Output circuit fuse and thermal cutout on the charger transformer to insure fail-safe operation

8. AC Inverter System shall deliver single phase, sinusoidal emergency power free from high voltage surges or frequency drift and shall have the following features:
   a. Inverter Start-up: Capable of transferring 100% of the system’s rated capacity to the connected emergency load within one second of utility failure
   b. Output: Sinusoidal AC wave form with voltage regulation held to +10%, -5% variance from nominal (standard input/output voltages shall be 120/120 or 277/277 VAC, 60 Hz, single phase)
   c. Output Frequency Tolerance: 60 Hz+/-2%
   d. Total Harmonic Distortion: Less than 10%
   e. Inverter shall accommodate load power factors of 0.5 lead to 0.5 lag
   f. Operating Efficiency: Not less than 85%


10. Central Display Panel: Located on the front of the electronics cabinet having the following features:
    a. Service Alert Alarm section shall provide audio/visual alarms for the following:
    b. HI/LO Battery
    c. OUTPUT CIRCUIT BREAKER OPEN
    d. BATTERY CAPACITY/TRANSFER CIRCUIT
    e. THERMAL OVERLOAD
    f. ALARM SILENCE
11. Test Switch to initiate a 5-minute discharge/diagnostic cycle check of emergency operation

12. Systems Status Panel to provide the following:
   a. STATUS INDICATOR (to indicate charger operation)
   b. UNIT READY (indicates unit is ready for emergency operation)
   c. AC OUTPUT VOLTS: DC CHARGER CURRENT; DC INPUT VOLTS; AND OUTPUT FREQUENCY are to be indicated on a 3-figure LED digital display

13. Output Distribution Circuit Breakers: Provide an appropriate number in electronics cabinet
   a. 2-Year System Warranty
   b. Factory Start-Up
   c. Automatic Transfer Switch:
      i. Must be UL-1008 listed through 480 VAC.

14. Automatic Transfer Switch Drive Mechanism: Shall not be dependent upon springs, gravity, latches or counterweights, and shall be operated by a positive, unidirectional stroke, fully electrically energized drive mechanism that will prevent an accidental neutral position and assure contact transfer in 6-cycles or less.

15. Emergency Lighting: Provide each emergency fixture with battery backup ballast.

**26 36 00 Transformers**

1. K-Rated Transformers: Specify power conditioning equipment or devices, or other disturbance mitigation methods for systems supplying outlets for computer terminal or other sensitive equipment

2. Line-side Mitigation: Provide equipment such as Harmonic Traps for equipment utilizing 6 pulse and 12 pulse power supplies, all variable frequency drives, and appliances capable of generating harmonic frequency currents or voltages on their respective circuits of significant magnitude that would be harmful to the facility's electrical system.

3. Provide units with copper windings and electrostatic shielding.

4. Dry-Type Transformers: Provide "Energy Star", low impedance units with copper windings, amorphous iron or silicon steel core and type "HN insulation, 115 degrees C temperature rise above 40 degrees C ambient

5. Installation: All transformers shall be floor mounted with vibration isolation pads between the unit and the supporting structure secured to a 4-inch high concrete housekeeping pad.

6. Transformers rated at 30 KVA or less may be mounted on the wall.
7. Transformers shall not be hung from, or mounted to, overhead building structure.
26 05 72 Overcurrent Protective Device

1. Application: A listed TVSS device shall be provided for each building service entrance, distribution panel, sub-panel, and individual equipment including motor control center.

2. Purpose: The Transient Voltage Surge Suppression System (TVSS) shall be designed to protect all AC electrical circuits and connected equipment from the destructive, damaging and disruptive effects of lightning induced transients, normal utility load switching activities, and internally generated transients caused by the normal operation of connected equipment, as well as capacitive and inductive load switching that typically accounts for 80 percent of the transient activity at a given facility. Design in accordance with these requirements and those of the TVSS manufacturer.

3. Manufacturer: Basis of design for TVSS manufactured by ERICO and distributed by Omega Power Systems.

4. Standards Compliance: All TVSS components shall be designed, tested, manufactured, listed and installed in accordance with the applicable publications, resources, and standards.

26 24 19 Motors Controls

1. General: Provide combination across-the-line controller with the required motor circuit disconnect switch included, HOA switch, phase monitoring on all three phase starters for protection against phase loss or phase reversal, electronic overload protection, and no pilot light.

26 24 16 Panel Boards

1. Panel Board Schedules shall indicate details of size, capacity, number of poles, and number of circuits. Each branch circuit listed in the schedule shall have an indication of location of usage.

2. Location: Units shall not be located in corridors or public/staff areas except by special written authorization from the BCPM.

3. Selection: Where a major portion of the loads supplied by the panel board are non-linear, a non-linear type panel board shall be used. Use of Load Centers is not acceptable.

4. Fault Current Ratings shall be adequate to carry all available fault current.

5. Future Expansion: Reserve 20 percent of the dedicated circuit breakers provided as spares. Provide spares with complete bus connectors and supports for future breaker installation.

6. Buses: Panel board buses shall be copper or silver-plated copper only.

7. Fused Pullouts are not acceptable and shall not be used for any purpose.
8. Fused Disconnect Switches: Use only where specifically required by Code or equipment manufacturer.

9. Installation, General: Panel boards, circuit breaker enclosures, and cabinets shall be mounted not more than 6'-6" above the finish floor as measured to the top of the unit. Install so the center of the switch grip, or circuit breaker operating handle, will not be more than 6 feet above the finish floor when in its highest position.

26 40 00 Lighting Protection

1. General: The College's facilities are located in a geographical area that experiences the highest incidence of lightning strikes in the Nation. Therefore, all new facilities shall have a certified lightning protection system included in the design. College facilities to be renovated shall be provided with lightning protection if it is included in the Project scope of work.

2. Surge Suppression: Include a complete network of surge suppression outlets from the service to sensitive equipment outlets.

3. Early Streamer Emission (ESE) Lightning Protection: Basis of design shall be Lightning Preventer System as distributed by Omega Power Systems, Inc.

26 51 00 Interior Lighting

1. General: Lighting illumination values shall be in accordance with Florida Department of Education, Office of Educational Facilities, State Requirements for Educational Facilities (latest edition) and IEEE Standards. Basis of design for all fixtures shall be LED.

2. Illumination Certification: Provide computer-generated calculations prepared by the lighting fixture manufacturer certifying that lighting levels in foot candles and equivalent spherical illumination values comply with specified standards.

   a. Submit copies of the computer-generated calculations with the lighting fixture shop drawings.

   b. Provide normal and emergency point-by-point foot candle specific area plots for all functional areas (including site lighting, exterior lighting, and lighting for non-instructional areas) as part of shop drawing submittal

3. Maintenance: Lighting fixtures shall be so designed that there shall be no special equipment, tools, or methods needed for a worker to reach the fixture for the purpose of maintaining it, or to replace lamps.

4. Architectural Lighting and indirect lighting fixtures shall not be used or specified without written authorization from the BCPM.

5. Instructional Spaces: Provide low voltage control system for all light switching for classrooms, laboratories, and rooms used for instructional purposes, that will result in optimum light levels for the application of digital projection teaching systems.
a. Lighting control stations shall be located at each exit and at the front of the room at the instructor’s station.

b. Master occupancy sensor system shall over-ride all lighting to "off" when the room is unoccupied.


7. Recessed Fixtures: May be connected with flexible raceways not exceeding 6-feet in length made to a junction box in accessible concealed spaces above ceilings. No fixture to fixture connections will be permitted except where the fixtures are mounted end-to-end and mechanically connected together.

8. Anchorage: All lay-in type recessed fixtures shall be fastened to acoustical ceiling grid main T bars by four (4) approved clips, or by other Code approved method, located one at each corner.

9. Independently Support each lay-in fixture from the building structure, diagonally from two corners with minimum #12 AWG steel wire.

10. Fixture Support Bars spanning structural T-bar ceiling channels shall be required for surface-mounted fixtures. Support bars and fittings shall allow vertical and horizontal positioning of the fixture.

11. "Y" Grid Ceilings: Proper ceiling grid hangers shall be used for mounting or suspending light fixtures. The grid hanger shall be secured to the main support channels of the ceiling Lighting and have provisions for locking in place and acceptance of stem canopy fixtures or surface mounted fixtures.

12. Industrial Lighting: Provide 2’ or 4’ LED vapor tight fixtures in areas such as mechanic room, electrical rooms, and elevator machine room and elevator pit.

26 52 00 Emergency Lighting

1. Symbols: Provide exit sign symbols on the electrical power drawings as well as the electrical lighting drawings.

2. Exit Signs: Provide red LED having the following salient features:
   a. Precision die-cast aluminum or white plastic construction throughout
   b. Normal AC illumination shall be provide by digital design red LED lamp panels consuming 7 watts or less per face at 120 or 277 VAC
   c. Emergency illumination shall be achieved through a factory-installed, fully automatic, power pack providing 1-1/2 hours of emergency operation except where a separate building EM power system is used. Power pack components shall mount inside the fixture casing and include a solid-state battery charger, a maintenance-free nickel-cadmium battery, a charge indicator pilot light, and a test
switch. The charger shall be capable of recharging the battery within acceptable UL specified time standards.

d. Standard snap-out directional arrows

e. Comply with all UL 924 requirements

f. Provide cast aluminum or white plastic mounting canopies for end, ceiling, and wall mounted models

g. Dimensions shall be approximately 7-3/4 inches high by 10-1/2 inches wide by 2-1/4 inches deep.

h. Transformers shall be provided for universal 120/277 VAC Lighting
27 00 00  Communications

27 05 00  Common Work Results for Communications

1. Provide a complete structured cabling system (racks, outlets, patch panels, patch cords, wire management, media/cabling, testing, administration, commissioning, etc.).

27 11 00  Communications Equipment Room Labeling

1. Labeling shall comply with TIA/EIA-606-A and UL 969.

27 13 00  Communications Backbone Cabling

1. Materials shall be:
   a. Cable Supports: Support brackets, lacing bars, spools, J-hooks, and D-rings.
   b. Conduit and boxes. Flexible metal conduit is allowed when wall is fished.

2. Connectors: Simplex and duplex, Type SC connectors.

27 51 16  Public Address

1. Public address systems functions shall selectively connect any zone to any available signal channel, selectively amplifying inputs, all call, telephone paging, program-signal tone generation, and produce high-quality, noise- and distortion-free sound.

2. PA System shall utilize modular with solid-state components, with preamplifier, power amplifier, and transfer to standby amplifier. Other components:
   a. Microphones: Desk-stand, dynamic type with cardioid polar characteristics.
   b. Volume limiter/compressor.
   c. Control Console: Modular, with self-contained power and control unit.
   d. Equipment cabinet.
   e. Equipment rack with 20 percent spare capacity
   f. Telephone paging adapter.
   g. Tone generator for clock and program interface.
h. Monitor panel.
i. Loudspeakers: Cone and horn type.
j. Noise-operated gain controller.
k. Volume Attenuator Stations: Autotransformer type with paging priority.
l. Microphone outlets.
m. Headphone outlets for the hearing impaired.
n. Battery backup power unit.
o. Conductors and Cables: Jacketed, twisted pair and twisted multi pair copper conductors.
p. Use raceways. No loose wire permitted.
28 00 00  Electronic Safety and Security

28 10 00  Electronic Access Control and Intrusion Detection

   1. Refer to Appendix 28 01 for the Access Control Communication Matrix.

28 30 00  Fire Alarm

   1. System Description: Microprocessor controlled, intelligent reporting fire alarm system.

   2. System Performance: Fire alarm system shall be UL, FM and ISO9001 listed and provide
      the following:
      a. Alarm, Trouble and Supervisory Signals: Provide from all intelligent reporting
         devices encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC)
      b. Initiation Device Circuits (IDC): Provide as Class B wired circuits (NFPA Style B) as
         part of an addressable device connected to the SLC.
      c. Notification Appliance Circuits (NAC): Provide as Class B wired circuits (NFPA
         Style Y) as part of an addressable device connected by the SLC or a panel circuit
      d. Alarm Signals: Signals arriving at the main fire alarm control panel (FACP) shall not
         be lost following a primary power failure (or outage) until the alarm signal is
         processed and recorded

   3. System Functional Operation: When a fire alarm condition is detected and reported by one
      of the system initiating devices, the following functions shall immediately occur:
      a. System alarm LED on the FACP will flash
      b. Local piezo electric signal in the control panel will sound
      c. Display on the FACP will indicate all information associated with the fire alarm
         condition, including the type of alarm point and its location
      d. All system output programs assigned via control-by-event interlock programming to
         be activated by the particular point in alarm will be executed and the associated
         system outputs will be activated

   4. System Capacity and General Operation:
      a. Capable of expansion where required for future additions
      b. Include Form-C alarm and trouble relays rated at a minimum of 3.0 amps at 30
         VDC
c. Fire alarm control panel shall include a full-featured operator interface and back-lit 80 character LCD

d. Fully field programmable

5. Specific System Operations:

a. Point Disable

b. Point Read

c. System Status Reports

d. Water Flow Operation

e. Supervisory Operation

f. Signal Silence Operation

6. Warranty: Provide warranty for a 3-year period from date of acceptance by the College. Warranty shall cover defects of any kind and shall include all labor and materials. Notifier distributor must meet NESCO requirements for the warranty.

7. Project Construction Cost shall include as a separate price the cost of maintenance labor and materials for the fire alarm system during the first year of operation.

8. Installation Contractor shall be a Notifier distributor, a member of NESCO (Notifier Engineered Systems Company), and shall have NICET Level II certification, and a State of Florida Fire License. Installing technicians shall have Alarm Agent Certification or higher.

9. Wiring: Color-coded and identified with Brady tags or other suitable means of identification to provide ease of tracing for maintenance, trouble identification and correction purposes.

a. Color-coding shall be reflected on the required Record (As-Built) Drawings. Refer to Section 01790, Project Record Documents, for additional requirements.

b. Loop - Twisted Pair - Red outer sheath

c. Notification Appliances - Orange & Yellow (out); Purple & Violet (in)

d. Door Holder - Pink & White

e. AHU Shut Down - Blue & Gray

f. 24 Volt DC - Red & Black; Note: All wire shall be stranded

g. If FPL cable is used, color code shall be uniform throughout the system

h. Conduit: Minimum 3/4-inch conduit
10. Fire Alarm Control Panel (FACP): Completely microprocessor-based, analog, and addressable. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program. Basic operator controls shall include the following:

   a. Acknowledge Switch
   b. Alarm Silence Switch
   c. System Reset Switch
   d. Lamp Test

11. Central Microprocessor High-speed, state-of-the-art, able to communicate with, monitor and control all external interfaces; include an EPROM for system program storage, nonvolatile memory for building-specific program storage, a "watch dog" timer circuit to detect and report microprocessor failure, and ability to perform the following functions:

   a. Real-time Clock: To provide for time annotation of system displays, printer, and history file; time of day and date shall not be lost if system primary and secondary power fail.
   b. Control-by-Event Programs: Capable of containing and executing programs for specific action to be taken if alarm condition is detected by the system

12. Display: 80-character (minimum) back-lit LCD capable of providing light-emitting-diodes (LED's) for standard fire alarm indications; provide with a type keypad and multiple password levels

13. Signaling Line Circuits (SLC): Provide a minimum of one SLC that can provide power to, and communicate with, intelligent detectors (ionization, photoelectric, or thermal) and intelligent modules (monitor or control)

14. Power Supply: Modular expandable with over-current protection on all power circuits, an integral battery charger for 24 hours of standby using dual-rate charging techniques, and all circuits power-limited UL 864 requirements including ground fault detection.

15. Addressable Devices: Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel signaling line circuits. Detectors shall be ceiling-mounted types with separate twist-lock base with tamper-proof feature. Functions include the following:

   a. Smoke and Thermal Detectors to provide alarm and power/polling LED's
   b. FACP to permit detector sensitivity adjustment through field programming
   c. Testing whereby detectors will simulate an alarm condition and report that condition to the FACP
19. Batteries: Gel Cell type, 12 volt nominal (two required) with the capacity to power the fire alarm system for not less than 24 hours, plus 5-minutes of alarm upon a normal AC power failure.


21. Function: Upon activation of any alarm device, the annunciator will identify the exact location of the device.

22. Features: Provide one additional silence key switch as well as the following standard features:
   1. Built-in voltage regulator
   2. Reverse polarity protection
   3. Per point diode isolation
   4. Lamp test key switch

23. Wiring: Install wire in conduit or raceway.

24. Multiple Cables: Where three or more cables are contained within a single conduit, the filled cross-sectional area of the conduit shall not exceed 40 percent.

25. Cable Separation: Cable shall be separated from any open conductors of power or Class 1 circuits, and shall not be placed in any conduit, junction box, or raceway containing these conditions per NEC.

26. Fire Alarm Control Panel: Connect to a dedicated branch circuit, maximum 20 amps.

27. Signaling Line Circuits (SLC): Wire all SLC loops per NFPA 72, Style 4 (Class B)

28. System Testing: All testing shall be done in accordance with NFPA 72.
32 00 00 Exterior Improvements

1. Grates:
   a. All storm water outfalls shall have protection grates and horizontal energy dissipation pads per FDOT specifications.
   b. Provide Florida Accessibility Code for Building Construction compliant grates at all trench drains and inlets at areas of pedestrian traffic.

2. Vinyl Coated Chain Link Fence:
   a. Chain link fence shall be minimum 9GA galvanized fabric thickness at all locations.
   b. All posts shall be set in concrete bases.
   c. Tension wire in lieu of bottom rail shall be specified for all locations.
   d. Top and bottom selvage shall be knuckled/turned into the fabric.
   e. Provide minimum one gate 60” wide all locations for lawn mower.
   f. Galvanize fabric prior to weaving.
   g. The fence shall be green in color.

3. Composite Fence: Fence made out of 50% reclaimed wood fiber and 50% polyethylene. Basis of design is Trex Seclusions. Refer to Appendix 32 01.

4. Bacteriological Testing:
   a. In addition to bacteriological water testing that may be required by the Department of Health, a minimum of 2 bacteriological tests (at sink and at water fountain) for the interior of each floor and building.

5. Site Drainage Grading:
   a. The construction drawings shall clearly show (and have appropriate spot elevations) of finish grades in the areas of structures/buildings and shall be designed to shed surface runoff away from the structures/buildings. The A/E shall ensure that the finish floor elevations shall be a minimum of 8” above adjacent finish site grades to ensure positive runoff away from the structures/buildings. No water shall be designed to sheet flow over sidewalks from landscape areas or roofs.
b. Renovation projects shall be designed to make modifications to spaces and adjacent grades such that the above criteria are met. Swales and runoff collection systems shall be designed and clearly shown on the construction documents to ensure drainage away from all buildings.

c. Design for storm drainage away from buildings, parking areas and driveways. Consider flow of concentrated storm drainage, design to slow down velocity. Concentrated drainage across sidewalks shall not be allowed, nor will ponding be allowed. Discharge from roofs and canopies shall be directed away from buildings and walks or tied to an underground storm drainage system.

d. Take roof rain leaders to underground systems (when appropriate) utilizing a sleeve.

e. Install storm drainage collection devices with a positive outfall in all areas where water can be trapped, especially in closed basin such as between buildings, interior courtyards and other similar conditions.

f. All storm drainage pipe installed shall comply with the applicable water management agencies, material and construction specifications.

g. As built drawings, signed and sealed by a Florida registered surveyor, will be required upon completion of the retention basins and storm drainage system. Drawings shall include all invert and grate elevations of all storm pipe and structures.

6. Termite Protection:

   a. The general contractor will schedule a meeting, at the site, with the owner, architect and pest control operator to discuss procedures, chemicals and ratios of mix.

   b. Termiticide treatments shall not be applied at existing facilities during occupied hours.

   c. Termite protection chemicals shall be brought to the site in sealed containers and mixed on site with the Owner present.

   d. All applications are to be witnessed by the Owner. 24-hour notice shall be given to the Owner of scheduled treatments. Prior to application, the contractor will be responsible for calculating the square footage, lineal footage and any other dimensions needed to determine the proper ratios of mix being applied.

7. Athletic Fields:

   a. Baseball/Softball fields shall have a sand/clay ratio of 20/80 to 30/70 with surface additive.

   b. Provide a hose bib nearby for maintenance of clay.

   c. Hose bib installed in both dugouts.
d. Dugouts shall consist of aluminum canopy, chain link fencing and aluminum bench on concrete pad.

e. Provide drinking water fountains at athletic fields.

f. Athletic courts shall be asphalt.

g. Provide basketball goals on courts.

h. All exterior athletic courts shall have flexible base material specified.

i. Soil cement shall not be specified as a base material for any exterior athletic courts.

j. Courts fencing shall be vinyl, black or green-coated galvanized fabric.

k. Soccer fields and Tennis courts shall run north/south.

l. Tennis courts surfacing shall be Plexi-Pave or equal over asphalt.

8. Refer to Appendix 32 02 for details on the approved valve box cover.

32 10 00 Paving

1. Type FDOT S-1 asphalt shall be specified in all vehicular traffic areas. Consider the use of recycled asphalt whenever possible.

32 80 00 Irrigation

1. All PVC utilities and main irrigation lines shall have #10 GA copper tracer wire located directly above the line and terminate on a metal device accessible from the surface without excavation. In addition, plastic marker tape indicating the type of line shall be located no less than 2’ directly above the utility line. The tape and wire/terminations shall be inspected by the Owner prior to backfill. On main irrigation lines provide marking tape ½ ways between pipe and grade.

2. Irrigation systems shall be designed by the A/E and clearly detailed on the construction drawings. Irrigation systems designed by the installer shall not be allowed. Use Rainbird, Hunter or equivalent unless approved by the Owner.

3. Schedule 40 PVC pipe shall be specified for irrigation lines. All irrigation heads shall be pop-up type, regardless of application. Fixed head, stationary risers shall not be specified.

4. New Irrigation lines connected to re-use water lines shall be “purple” pipe PVC.

5. Existing irrigation lines connected to re-use water lines shall have purple sprinkler heads/caps.
6. All irrigation wells shall have as a basis of bid, 100 FT in depth.

7. Pump and controls design shall be selected for ease of maintenance.

8. Sprinkler systems shall be directed away from buildings and shall not spray on buildings to reduce the likelihood of moisture intrusion.

9. Architect / Engineer to submit a preliminary plan to be reviewed by the owner.

10. Existing systems should be evaluated and field inspected prior to new work being specified.

11. A pre-construction meeting should be scheduled including contractor, Architect/Engineer and owner.

12. At substantial an owner training session will be required.

13. An inspection of the system at the end of the warranty period should be performed.

14. Wipe clean all glue joints of excess adhesive.

15. The pipe edge should be tapered on PVC 2” and larger.

16. At substantial, demonstrate a control wire integrity test, assuring the minimum ohm requirements are satisfied.

17. When sodding next to pavement or sidewalk, always set/lay the top of the sod 1-inch maximum lower than the pavement finish grade. This will prevent sod from trapping water on the pavement or sidewalks. When tying into existing sodded areas, the top of sod elevation shall match existing sodded areas without wedge cut areas.

18. Sod the bottom and side slopes of a retention basin or swale to reduce erosion.

32 90 00 Landscape

1. Landscape Architect to provide plant schedule with mature height specifications with color photos for each type of planting at mature height. Spacing of planting material shall be based on mature / maintained height and spread.

2. All landscaping shall have root ball wraps cut back prior to planting.

3. A/E’s are encouraged to consider sodding throughout entire site. Use proper sod to match soil conditions.

4. All spaces between newly placed sod shall be filled in with organic material, rolled and fertilized as deemed necessary.

5. The Designer shall indicate the protection of all existing planting to remain or to be relocated.
6. All species should be native to or acclimated to South Florida and require low maintenance. When available to meet landscaping goals, select native plants whose mature sizes are appropriate to the locations planted. Warranty trees and shrubs through indicated maintenance period, and until final acceptance.

7. Warranty trees and shrubs for a period of one year after date of final acceptance against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Installer’s control.

8. Sodded areas should be easily accessible for mowing.

4. Whenever possible incorporate the removal of existing exotic species listed as category I or II by the FLEPPC.

5. Where feasible, reduce lawn areas by increasing xeriscaping with native plants and native ground covers.

7. Utilize integrated pest management to minimize the use of pesticides including insecticides, herbicides, and fungicides.

8. Fertilize sparingly using organic compost or low phosphate/phosphate-free fertilizer.

10. Maintain a grass-free area around trees to avoid damage by weed eaters.

11. Specify Melaleuca mulch when available and avoid mulches containing arsenic or dyes.

13. When designing the landscape plan for the project, review each Master Plan to assure it is consistent with native plant landscaping.

15. Design landscaping to enhance security. Plants of appropriate maintained or mature size will be selected to assure visibility and prevent obstruction of lighting and signage.

16. Maintain plant material away from equipment to meet equipment access requirements.

17. Design for matured tree canopies away from the building roof overhangs.

18. Avoid specifying material that will require hedge pruning.