DIVISION 15 – MECHANICAL

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1.1 GENERAL

A. These Design Criteria guidelines shall govern whenever discrepancies arise with the M-DCPS Master Specifications. The A/E shall be responsible for coordinating and revising the Master Specifications to suit the project needs in accordance with these guidelines to ensure no discrepancies exist. It shall be the intent of the construction documents, including the edited project specifications, to meet or exceed the requirements of the M-DCPS Design Criteria in quality and durability and within the project’s budgetary constraints. Deviations from the M-DCPS Design Criteria and Master Specifications, except for minor editing to suit a specific project requirement, shall be brought up in writing to the attention of M-DCPS for approval.

B. Consider environmental hazards, safety, recycling, and limiting the use and handling of hazardous materials in the selection of materials, equipment, and installation.

C. Chilled water piping serving HVAC systems equipment and other piping shall not be located over wood floored stages, gymnasiums, telecommunication rooms, or other similar spaces vulnerable to damage from condensation or leaks unless accepted by M-DCPS on a per condition basis using special insulation or auxiliary condensation drainage pan systems.

D. Provide access for maintenance and replacement of equipment to minimize the removal of adjacent equipment or piping that would cause disruption to facility functions. Access to roof mounted equipment shall comply with FBC.

E. Provide platforms, guardrails, ladders and safety cages as necessary to service and maintain cooling tower equipment. The platform and guardrail on the cooling tower fan deck perimeter may be omitted when the cooling tower is designed by the manufacturer to be serviced from the inside and is equipped with a factory installed interior work platforms and permanent ladders. Verify compliance with OSHA requirements.

F. Specify that installers, service personnel, and contractors engaged in handling refrigerant shall meet Environmental Protection Agency (EPA) regulations regarding technician certification and recycling and recovery equipment.

G. Specify that any Contractor performing refrigerant handling operations is to provide at least 2 working days (48 hours) notice to the M-DCPS Project Manager and M-DCPS Facilities Operations, Maintenance, before starting any work involving refrigerants, to allow for M-DCPS to be present for observation of the work. The Contractor shall comply with applicable code requirements for removing and disposing of refrigerants.

H. HVAC systems shall be operational and maintain 75 + 2° F. and a constant 55 + 2 percent relative humidity for a period of at least 3 days (72 hours) before installation of specified interior finishes. These conditions shall be maintained at all times until interior finish installations are completed and accepted by M-DCPS. As specified, the Contractor shall record conditions at least every 4 hours and provide supplemental temporary air-
conditioning or dehumidification if HVAC is not operating at specified conditions. Exterior openings shall be kept closed during these periods by using temporary or permanent barriers. These requirements can also be found in Division 9, “Finishes,” and are only cited herein for reference.

I. Specify that the Contractor shall provide temporary construction air-filters for all air-handling units (AHU) during construction. In addition, the Contractor shall provide temporary air filters at all supply-air and return-air outlets before and during the installation of interior finishes. Filters shall be changed whenever filter bank static pressure exceeds manufacturer's recommendations.

1.2 GENERAL MECHANICAL REQUIREMENTS

A. Construction documents shall conform to requirements of the latest adopted edition, but not limited, to the following:
   1. Florida Building Code (FBC) - Building.
   3. Florida Building Code (FBC) - Plumbing.
   4. Florida Building Code (FBC) – Mechanical
   5. Florida Building Code (FBC) - Gas
   7. Chapter 64E-11 (Food Hygiene) of the Florida Administrative Code.
   9. Florida Department of Environmental Protection (DEP).
   10. Florida Department of Environmental Resources Management (DERM).
   11. Florida Department of Transportation (FDOT).
   12. United States Environmental Protection Agency (EPA).
   13. American Society of Civil Engineers (ASCE) 7 (revision specified by the FBC applicable to the project).

B. Design shall comply with nationally accepted engineering practices, both mandatory and recommended, including, but not limited, to the following:
   1. American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE).
   2. American Society of Plumbing Engineers (ASPE) Data Book.
   3. Sheet Metal and Air Conditioning Contractors’ National Association a (SMACNA).
   4. National Sanitation Foundation (NSF).
   5. American Water Works Association (AWWA).
   6. American Society of Sanitary Engineers (ASSE).
   8. Insulation Contractors Association of South Florida.
   9. Applicable published recommendations of nationally recognized manufacturers' Associations.

C. Discrepancies among the preceding requirements, brought in writing to the attention of M-DCPS, will be reviewed and clarified by M-DCPS Building Code Consultant (BCC).

D. A/E is responsible for obtaining the documents containing the preceding requirements.
E. Equipment, parts, assemblies, and installations shall be certified for safety and performance according to the standard of Underwriters Laboratories (UL), Air-conditioning, Heating and Refrigeration Institute (AHRI), Factory Mutual (FM) or other OSHA approved Nationally Recognized Testing Laboratories (NRTL). Uncertified submittals, equipment, and construction shall be rejected. Products shall have Notice of Acceptance (NOA) or Florida Product Approval where required.

F. Coordinate HVAC System electrical demands with Florida Power and Light (FPL) during design. M-DCPS may require written system descriptions or specifications before authorizing A/E to proceed with design. A/E may request available data from M-DCPS on existing M-DCPS systems for evaluation.

G. M-DCPS special requirements and experiences with various types of materials, equipment, and system installations have led to the procedures and practices noted in this Division. Use of new products, procedures, or installations shall be justified in writing to M-DCPS and such innovations shall be shown to have a proven track record in national, state or local installations.

H. Systems shall be easy to operate, maintain, and allow for expansion.

I. New schools and renovation projects shall receive energy management, fire and security monitoring systems compatible with and connected to M-DCPS Office of District Inspections, Operations and Emergency Management.

J. Except for regular sanitary waste, all other piping, including domestic hot and cold water, shall be visibly field identified by legend, flow arrows and color coding according to ANSI 13.1.

K. Provide for accessibility for maintenance and replacement required by plumbing and HVAC equipment minimizing removing adjacent equipment or piping at locations including, but not limited to the following:
   1. Mechanical equipment rooms.
   2. Boiler or domestic water heater rooms.
   3. Chiller rooms.
   4. Cooling towers.
   5. Air-handling equipment.
   6. Dust collectors.
   7. Air compressors.
   8. Piping and ductwork.
   10. Chases.
   11. Fire dampers.
   12. VAV boxes.
   13. Roof fans.
   15. Cleanouts.

L. M-DCPS supplied equipment shall be listed specifying installation by the Contractor or future installation by others in the construction documents. The construction documents shall
also show a Not-In Contract (NIC) equipment schedule with required utilities, sizes and capacities. The schedule shall be cross-referenced to the Architectural Drawings and other required disciplines.

M. Contractor installed M-DCPS-furnished equipment, and equipment furnished by the Contractor as indicated in the construction documents, shall be installed, and connected to the necessary systems in accordance with Code, manufacturer’s installation instructions, and M-DCPS requirements.

N. Provide for rough-in of necessary services for proper connection and operation of future or NIC equipment. Stub out floor and wall lines with rough-in flush to the walls and floors (except were conditions require otherwise) for future connections.

O. The A/E may contact the BCC’s plan reviewers during design and permit review:
1. Meetings requiring M-DCPS participation shall take place on M-DCPS property.
2. The A/E shall visit the site and verify the accuracy of exposed and visible existing conditions. M-DCPS shall be notified by the A/E through the M-DCPS Project Manager if apparent omissions or discrepancies are found.

P. Locate equipment in mechanical rooms within the building where feasible. Wherever possible, locate mechanical rooms adjacent to exterior walls and provide access from the exterior of the building. Do not provide access to mechanical rooms through instructional spaces or private offices.

Q. Questions regarding building code requirements shall be referred to M-DCPS BCC.

R. Edit out non-applicable sections and/or portions of sections of the M-DCPS Master Specification Guidelines to reflect the actual scope of work for the project.

S. The phase review by the BCC will be the basis for determining the adequacy of the documents submitted by the A/E for that phase. M-DCPS will withhold A/E’s payment if A/E has not replied to comments, not complied with the requirements noted in the M-DCPS Design Standards, program requirements, and previous design reviews, or has submitted insufficient design information to meet the phase submittal requirements.

T. The A/E shall be responsible for designing an efficient, safe, maintainable, and working facility meeting the requirements of the Florida Statutes and the Department of Professional Regulation.

U. Roof mounted equipment, shall be installed in accordance with FBC and M-DCPS requirements. Provide clearance greater than the code-required minimum when required by the equipment manufacturer’s specifications or M-DCPS Master Specification Guidelines.

V. Roof edge guards shall be provided at rooftop equipment that is closer than 10 feet from the edge of the roof. Whenever possible, the roof top equipment should be placed more than 10 feet from the edge of the roof to avoid the use of edge guards. When edge guards are provided, they shall be designed in accordance with FBC Mechanical and Building. A/E shall specify that edge guards be anchored to the building fascia instead of through the roof membrane, whenever possible.
1.3 MECHANICAL SUBMITTAL PHASING REQUIREMENTS

A. Comply with the following document and submittal requirements:
   1. Program Phase – Mechanical submittal for existing facility renovations only.
      a. M-DCPS preprogramming shall be verified by A/E program phase submittal and include the following HVAC and plumbing system information:
         1) Scope of work.
         2) Preliminary construction cost estimates.
         3) Description of A/E’s recommended additional work scope and related probable costs not included in the M-DCPS preprogramming package.
   2. Phase I – Mechanical submittal, when requested by M-DCPS, shall contain the following:
      a. Submit an outline to include the following:
         1) Scope of work including revisions and identification of costs related to program requirements.
         2) Preliminary HVAC system description with identification of and qualifications for FPL incentives, if applicable.
         3) Identification of work in contract for the Contractor, M-DCPS and outside contractors and vendors.
         4) Description of connection points for gas, storm drainage, chilled water, sanitary and domestic water systems.
      b. Site plan drawings for Phase I shall include the following:
         1) Identification of existing, new or future buildings or additions.
         2) Construction, demolition or relocation status of portable classrooms.
         3) Approximate location of existing and proposed boilers, water chillers, cooling towers, storage tanks, pumps and other major plumbing and HVAC equipment.
         4) Proposed routing of major exterior lines for plumbing and HVAC systems.
      c. Floor plan drawings for Phase I shall include the following:
         1) Approximate location of air-handlers, chillers, pumps, boilers, tanks and other major plumbing and HVAC equipment.
         2) Plumbing fixture locations.
         3) Group toilet locations.
         4) Preliminary construction cost estimates with breakdowns covering central plant equipment, air-conditioning units, chilled water distribution, temperature controls, sanitary systems, domestic water systems, plumbing fixtures, domestic hot water heaters, expansion provisions and other major categories or items.
         5) Applicable FPL incentives for replacement or new installation of energy efficient HVAC equipment.
   3. Phase II – Mechanical submittal (35% completion) When a separate Phase II is not submitted, the Phase II requirements listed below shall be included in and submitted with the Phase III – 50% submission; however, when a Phase III – 50% submission is also omitted, the Phase II requirements listed below shall be included in and submitted with the Phase III – 100% submission:
      a. Completed Life Cycle Cost Analysis (LCCA), where required by Code or these Design Criteria. See Heating, Ventilating and Air-conditioning, this Division.
b. Drawings shall include the following in addition to Phase I requirements:
1) Revised drawings and a written response to each Phase I review comment.
2) Air-conditioning cooling and heating loads.
3) Domestic hot water estimated loads.
4) Type, size, capacity, efficiency ratings and location of air-handlers, routing and location of major interior piping for plumbing and HVAC equipment in equipment rooms noting ductwork and piping layouts.
5) Routing and location of major interior piping for plumbing and HVAC systems.
6) Duct layout at 1/8" scale floor plans with air quantities noted.
7) Double line duct layout showing supply air, return air, temperature sensors, smoke detectors, outside air, and exhaust systems including air quantities at 1/4" scale floor plans of typical and specific rooms or areas.
8) Double line duct layout showing piping, grilles, temperature sensors, diffusers, equipment, air quantities and sizes at 1/4" scale floor plans of typical and specific instructional spaces.
9) Double line layout of major ductwork with main runs and sizing completed.
10) Fire damper locations.
11) Typical and specific rooms or areas with locations of plumbing fixtures and sanitary and domestic lines sized and noted, on 1/4" scale floor plans.
12) Group toilets sanitary and domestic water line locations and sizes, on 1/4" scale floor plans.
13) Equipment room plans, elevations and sections identifying equipment and locations, on 1/4" scale plans.
14) Format of schedules for HVAC and plumbing equipment. Include efficiency ratings in the schedule.
15) Detailed construction cost estimates.
16) Preliminary schedule of events if required due to site complexity.

4. Phase III – Mechanical submittals (50% stand-up review and at 100% construction documents):
   a. Complete set of mechanical specifications.
   b. Complete detailed and itemized construction cost estimate according to contract requirements, including any applicable incentives from FPL for energy efficient equipment.
   c. Drawings shall include the following, in addition to Phase I and II requirements:
      1) Revised drawings and a written response to each Phase II review comment.
      2) Complete mechanical drawings, coordinated with plans and specifications of structural, architectural, electrical, and civil disciplines, laboratory equipment supplier, kitchen equipment supplier and not-in-contact equipment, to eliminate errors, conflicts, and omissions.
      3) Mechanical and electrical coordination shall include the following:
         a) Equipment capacities, voltages and phasing.
         b) Wiring diagrams and control sequence narrative.
         c) Additional materials and equipment furnished and installed by specific trades.
         d) Plumbing and HVAC controls.
         e) Completed motor control component diagrams noting factory, and field wiring.
f) Completed temperature control component diagrams, noting specific contractors’ responsibilities.

4) Complete HVAC air distribution system and equipment, including valving, instrumentation, controls, temperature sensors, smoke detectors, humidistats, and other associated components.

5) Complete plumbing and HVAC piping system component diagrams including details of control and coil valving, strainers, thermometers, pressure gages with pressure snubbers, shut-off cocks and other associated components.

6) Complete control diagrams for kitchen ventilation system including components.

d. Drawings, details, and schedules, including, but not limited to:

1) HVAC schedules with reference flag notation to be used in equipment rooms for identification.

2) Plumbing schedules.

3) Complete fan schedules including area served by type of fan, wheel, arrangement, cubic feet per minute (CFM), static pressures in inches water gauge (w.g.), maximum allowable brake horsepower, speed, voltage, phase and sone ratings.

4) Roof curbs, flashing details, platforms, hanging and support methods, vibration isolators, housekeeping pads and other equipment mounting and tie-downs details.

5) Duct and piping roof penetration details.

6) Ductwork flags indicating SMACNA pressure change construction classifications.

7) Indicate insulation requirements at fringe areas to indicate interior, exterior, exposed, or concealed.

8) Fire damper and fire/smoke damper mounting details.

9) Coil connections, water treatment, air compressor controls, expansion tanks, duct fittings, branch take-outs, splitters, lab equipment and other equipment or installation details required for clarity.

10) Vertical or horizontal duct, pipe, and insulation supports.

11) Architectural life safety plan indicating fire rated walls coordinated with mechanical and fire protection drawings.

12) Fire protection system layout if required including hydraulic calculations according to NFPA.

1.4 GENERAL PLUMBING REQUIREMENTS

A. Plumbing Systems:

1. Plumbing drawings shall contain the following systems, extending to 5 feet beyond the building perimeter:
   a. Domestic water.
   b. Sanitary building drainage.
   c. Storm drainage, except gutters, scuppers and downspouts.
   d. Liquefied petroleum gases (LPG) or compressed natural gas (CNG).
   e. Fuel oil (only at existing facilities).
   f. Acid resistant piping and dilution tank.
   g. HVAC condensate piping.
h. Boilers and domestic hot water generators including boilers necessary for space heating.
i. Heating and domestic water heat exchangers and storage tanks.
j. Compressed air, excluding HVAC controls.
k. Steam and condensate return.
l. Swimming pools.
m. Chiller, equipment room riser diagram.
n. Miscellaneous systems and riser diagrams as requested by M-DCPS.

B. Plumbing Drawings:
1. Provide the following information in the following order:
   a. Site plan, legends, abbreviations, schedules and general notes.
   b. Floor plans at a minimum 1/8” scale.
   c. 1/4” or larger scale drawings including, but not limited to, the following congested areas:
      1) Group toilets.
      2) Group showers.
      3) Laboratories.
      4) Kitchens.
      5) Equipment rooms
   d. Section and details.
   e. Sanitary riser diagrams.
   f. Domestic water riser diagrams.
   g. Storm drainage riser diagrams.
   h. Gas riser diagrams.
   i. Acid riser diagrams.
   j. Compressed air riser diagrams.
   k. Swimming pool equipment riser diagram.
   l. Solar energy system riser diagram.
   m. Chiller equipment room riser diagram.
   n. Miscellaneous riser diagrams as requested by M-DCPS.

2. Plumbing drawings shall have sheet sizes, column lines, and floor plan scales similar to the architectural drawings, minimum 1/8” equals 1 foot. Include the following:
   a. Graphic scale, numerical scale, north arrow and lettering size legible for record drawings.
   b. Existing, new, and future construction located and identified.
   c. Finished National American Vertical Datum of 1988 (NAVD 88) elevations of existing and new construction to include finish floors, walks, roadways and landscaped or play areas where required.
   d. Plumbing legend and abbreviations.
   e. Correct project title and M-DCPS project number.
   f. Locate and provide sizing and loads, including fixture units, materials maximum and minimum pressures, slopes and inverts at the building exit, obstructions or other lines, and points of connection within property lines for the following:
      1) Sewer, drainage, gas, fuel oil, fire and water lines.
      2) Chilled water and heating lines.
      3) Wells, manholes, tanks, catch basins, soakage pits, French drains, septic tanks and drain fields.
g. Each manhole shall have the inlet and outlet invert elevations noted.
h. Distance separation noted between building foundations and parallel pressure, sewer, or drainage lines to avoid pressure gradients and undermining conditions.
i. Drawings and specifications shall assign sole responsibility to the Contractor:
   1) For locating buried pipes and duct banks, with hand trenching as necessary.
   2) To repair damage caused by the Contractor at the Contractor’s expense.
j. Include extension of utilities to grassed areas to provide for future building connections. Provide line termination with a cap or plug in valve boxes or valves at pressure lines if future construction is scheduled.
k. Note on the site plan “CONTRACTOR SHALL VERIFY DEPTHS AND LOCATIONS OF CONNECTION POINTS TO EXISTING PRESSURE LINES AND DRAINAGE LINES BEFORE STARTING WORK”.
l. Indicate minimum and maximum operating pressures where applicable.
m. At line connections and appropriate intervals, identify slopes and loads as existing, capacity available, future and maximum allowable. Loads shall be noted as follows:
   1) Fixture units at supply lines and fixture units at sewer lines. Square footage of the roof and paved areas for storm drainage lines.
   2) Tonnage on HVAC condensate lines.
   3) Type, pressure, material and cubic feet per hour of gas lines.
n. Locate, size and identify on-site domestic water lines, fire lines and facility water meters.

3. Plumbing floor plans shall include the following:
   a. Plumbing connections of fixtures and equipment to the appropriate system.
   b. Fixture and equipment identification by the common name abbreviation, as shown in examples below or another designation consistent with plumbing fixture schedule (P-1, P-2, etc.), on risers, details, and other drawing locations:

   Examples:

   WC-1 Water closet
   WC-2 Water closet, ADA accessible
   UR-1 Urinal
   UR-2 Urinal, ADA accessible
   L-1 Lavatory, wall hung
   L-2 Lavatory, counter top
   L-3 Lavatory, ADA accessible
   L-4 Lavatory with hot water
   SH-1 Shower, individual, ADA accessible
   SH-2 Shower, group, head only
   SK-1 Sink, stainless steel
   SK-2 Sink, enameled cast iron
   ARSK-1 Acid resistant sink
   EWC-1 Electric water cooler
   EWC-2 Electric water cooler, Hi-Lo ADA accessible
   PLSK-1 Plaster sink
   FD-1 Floor drain at finished areas
   FD-2 Floor drain at equipment rooms
c. Routings shall generally parallel building walls. Standardized symbols and text shall locate and identify lines rises, drops, valves, cleanouts and other related items.
d. Locate plumbing lines in finished areas in chases. Lines routed in stud partitions shall be coordinated with electrical and other trades to ensure adequate fit. Block walls shall not be cut or channelled to install vertical or horizontal lines.
e. No gas, water or drainage piping shall be routed through electrical or telecommunication rooms.
f. Note elevations on floor plans of:
   1) Sanitary lines above ceilings.
   2) Domestic water lines being fed from below.
   3) Aboveground horizontal lines 3 inches and larger.
g. Plumbing lines at obstructions, offsets at HVAC ducts, allowable beam penetrations, and limited or congested areas shall be detailed separately or shown on 1/4" per foot minimum scale drawings.
h. Pressure lines, gravity lines, or systems grouped for compatibility at congested areas may be shown on separate drawings. Reference separated systems to a specific drawing.
i. Coordinate the storm drainage system for roofing membrane material, roof assembly thickness, and gutter and downspout sizes, and locations.
jk. Evaluate the need for insulation for condensation protection for rainwater leaders, domestic cold water lines, or other similar systems.
k. Reference line continuation at match lines or drawings of a different scale to a specific drawing.
l. Isometric drawings shall provide a north arrow and an ellipse at slab penetrations.
m. Identify utilities to NIC equipment to be installed by Contractor or for future installation by others.

C. Specific Room Plumbing Requirements:
   1. Toilet Rooms and Group Showers.
      a. Locate and identify plumbing fixtures, associated equipment, and lines. Reference line continuation to a specific drawing. Size main branches and note invert and fixture units on gravity lines.
      b. Plumbing fixture symbols shall be representative of the fixtures specified.
      c. Size chases to provide sufficient space for plumbing lines to cross behind floor mounted fixture carriers, if used, and to conceal carrier feet within finished walls. Provide 1 accessible loose-keyed hose bibb in each group toilet room
      d. Floors at ADA accessible individual toilet rooms and group toilet rooms shall slope 1/8" per foot down to at least 1 floor drain within the room located out of the path of travel:
         1) Specify floor drains with reseals.
         2) Reseals shall be fed by a water closet flush valve tailpiece.
         3) Resealers fed from lavatories sinks, water cooler or drinking fountain shall only be used where no suitable water closet is within 30 feet.
4) Trap primer valves and distribution units, when used, shall be installed in a mechanical space or in a conspicuous and readily accessible location. The mounted elevation of the trap primer valve above the finish floor shall be as recommended by its manufacturer for the length of run of the trap make-up line.

e. Provide accessibility to the disabled at group toilet rooms and single occupant toilet rooms according to FBC, Accessibility, carefully noting those requirements applicable to children.
   1) Each group toilet room serving students, the staff or the public shall have at least 1 ADA accessible stall with an ADA accessible toilet and an ADA accessible lavatory within the stall.
   2) Coordinate mounting height of grab bars with length of flush valve tail piece to avoid interference with valve operation.

f. Provide hot water to kitchen staff toilet rooms. Hot water shall not be supplied to public, student, or any other staff toilet rooms, unless otherwise specifically indicated in the Educational Specifications.

g. The use of multi-station wash fountains are not acceptable unless required by the Educational Specifications or approved on a per condition basis by M-DCPS Office of Facilities Design and Standards. Such units, when approved, shall be ADAAG compliant.

h. Lavatory valves shall be slow-acting and self-closing except for Kitchen/Serving areas.

i. Showers shall not be provided with individual shut-off controls, except as noted:
   1) Centralized water controls for showerheads shall be provided by combination thermostatic and pressure balancing mixing valves to provide a water temperature from 95° to 110° F. at showerheads.
   2) Shower rooms containing 30 or more showers shall be zoned for 1/3 and 2/3 of the available showers.
   3) Showers accessible to the disabled shall receive individual vandal resistant thermostatic and pressure balancing controls.
   4) Control valves shall comply with the applicable section of the FBC - Plumbing.

j. Maximum flow rate and water consumption of shower head shall be as per FBC - Plumbing.

k. Electric water coolers shall be provided adjacent to the vestibule entrance to student toilet rooms, but not within the toilet room:
   1) Locate additional coolers according to program requirements.
   2) Mounting heights shall be as noted herein unless otherwise dictated by the ADAAG or the FBC.
   3) Any arrangement where water falls back on the mouthpiece shall not be used.
   4) Provide for a “hi-lo” double configuration water fountain meeting the requirements of ADAAG or FBC (one water cooler accessible to individuals who use wheelchairs - with a spout not higher than 36” above finish floor (AFF) - next to another water cooler accessible to those who have difficulty bending or stooping - with a spout height from 38” to 43” AFF).

l. Fixture counts shall comply with FBC-Plumbing Code Section 403 – “Minimum Number of Plumbing Facilities:’’
1) “Potty Parity” fixture ratios are required at group toilets serving assembly occupancies for gatherings of 50 or more.
2) Assembly occupancies include, but are not limited to, gymnasiums, auditoriums, media centers, multi-purpose rooms, cafeterias and cafeteriums.
3) The fixture ratio of the number of water closets for women to the combined total of water closets and urinals for men shall be as per Section 403.
4) A/E shall consider locating the number of fixtures to meet the calculated need within each building and on each floor/wing. A/E shall review location and fixture counts with M-DCPS Facilities Design and Standards staff for approval during Schematic Design Phase.
5) Urinals shall be provided in boys group restrooms to the maximum quantity allowed by Code.

m. Fixture mounting heights shall be coordinated with all the requirements stated in this Division and shall be indicated in the interior elevations.

n. Shut-off valves, cleanouts, access panels and water hammer arrestors shall be identified on the drawings. Valves shall be located above ceilings and not inside walls or chases. Provide access to all devices requiring maintenance and replacement as recommended by manufacturer. Access and the locations of access panels shall be coordinated with architectural drawings.

2. Kitchens:
   a. General Requirements:
      1) Sanitary sewer lines, storm drains or waste lines shall not be placed above the ceiling of a kitchen, serving line or cafeteria seating areas.
      2) Provide a kitchen fixture and equipment schedule to indicate required services, line sizes, and one of the following:
         a) The specification division under which the item is to be furnished and installed.
         b) The item is M-DCPS supplied and installed by contractor.
         c) Rough-in only is required for future item.
      3) Limit facility hot water requirements to sinks at staff toilet rooms to 110° F. maximum according to FBC:
         a) Maintain a domestic water heater serving multiple fixtures at a temperature of approximately 140° F. Provide the fixtures with accessible thermostatic mixing valves to limit water temperatures to 110° F. maximum.
      4) Provide overhead domestic water service distribution:
         a) Water supply service drop to freestanding service lines or fixtures shall be from the nearest wall for the shortest possible under slab run.
         b) At underground runs where allowed, provide a minimum 1/2” soft temper Type “K” copper tubing, without joints, in a minimum 2-inch PVC sleeve with sealed ends.
         c) Run PVC sleeves at least 4 inches below floor slab.
         d) Exposed ceiling drops are not allowed.
      5) Food service area sinks shall have hot and cold water. Request and comply with current requirements of the M-DCPS Food and Nutrition and the following:
a) Provide food preparation hand washing lavatory with hot and cold water, gooseneck spout with aerator, and foot valve operators at each food preparation area, minimum of two lavatories per kitchen.

b) Provide services to fixtures included in the kitchen equipment package.

6) Provide a mop receptor and a can wash area, each with hot and cold water. Fittings shall have a threaded hose-end and hose:
   a) Coordinate provision and location of mop receptor and can wash with Educational Specifications.

7) Provide cooking exhaust hoods with UL Standard 300 listed wet chemical automatic fire suppression extinguishing systems with a mechanically activated gas shut off valve in the kitchen gas supply.
   a) Gas valve shall require manual reset.
   b) Manual or automatic activation of the fire suppression system shall shutdown kitchen main gas line, shutdown hoods(s) supply fan, de-energize under-hood electrical appliances, and activate general fire alarm system. (See Division 11 – Utility Distribution and Canopy Ventilating Systems, and Division 16 – Fire Alarm System for additional information)

8) Provide portable fire extinguishers as required by NFPA 10. Portable fire extinguishers shall comply with NFPA 96. (See Division 10 – Fire Extinguishers, for additional information)

b. Grease Interceptors:
   1) Locate interceptors as close as feasible to a kitchen exterior wall.
   2) All grease interceptor manhole lids shall be accessible, brought up to finished grade and set in a concrete slab.
   3) Waste lines normally receiving grease waste shall be routed through the interceptor.
   4) Individual interceptor capacity shall be at least 750 gallons.
   5) Maximum individual interceptor capacity shall not exceed 1,250 gallons.
   6) Provide multiple 1,250-gallon capacity interceptors in series for required capacities above 1,250 gallons.
   7) Interceptor sizing and construction shall comply with the FBC Plumbing.
   8) Inlet and outlet inverts shall be noted for each interceptor.
   9) Locate interceptors end to end to allow for straight-line piping.
   10) Slope lines into grease interceptors at 1/4” per foot.

c. Floor Drainage:
   1) Provide kitchen and related areas with floor drains having hinged gratings, sediment buckets, and reseals.
   2) Seal traps from waste lines of suitable fixtures with clear water discharge.
   3) Reseals, if used, shall be fed from a water closet flush valve tailpiece, an electric water cooler, or drinking fountain if available, not from a lavatory or sink.
   4) Locate reseals in mechanical or custodial rooms if a water closet, electric water cooler, or drinking fountain is not available within 30 feet.
   5) Locate and select floor drains and floor sink for easy dismantling and cleaning by the custodial staff.
6) Interiors of kitchen floor drains and floor sinks shall be stainless steel or coated with acid resistant enamel. Kitchen floor drains and floor sinks shall have a removable mesh lined sediment bucket.

7) Drain cover grates shall only be able to be installed with the sediment bucket in place.

8) Drains shall have a double strainer.

9) Kitchen floor drains shall be located in accessible areas:
   a) Near refrigerators, tilting or steam kettles, and large capacity sinks.
   b) In storage rooms, except dry storage.
   c) At low points of floor slopes and other programmed locations.

10) Kitchen trough, channel or trench drains shall be located between cooking equipment and production lines according to the Educational Specification requirements and as may be specified by the kitchen consultant.

11) Floor drains shall be in plain view and accessible for cleaning and maintenance.

12) Drips, drains and wastes from ice bins, ice machines or any other food service equipment shall be indirectly conveyed by air gaps to sanitary systems and received by floor drains equipped with grating-free funnels or flow sinks with partial grates.

13) Floor shall slope at 1/8" per foot down to drains.

14) Floor sinks shall only be used at triple compartment drains and other M-DCPS accepted locations.

d. Dumpster Pad Area:
   1) Provide hose bibb within 25 feet of pad.
   2) See Division 00, “General Requirements” for additional requirements.

3. Laboratories (Science, Art, Printing, Photography, Automotive, etc.):
   a. Locate and identify plumbing fixtures, hoods, sinks, associated equipment, and lines, including acid resistant lines.
      1) Reference line continuation to a specific drawing.
      2) Size main branches.
      3) Gravity lines shall note inverts and fixture units.
   b. Provide a lab fixture and equipment schedule to indicate required services, line sizes, and one of the following:
      1) The specification division under which the item is to be furnished and installed.
      2) The item is M-DCPS supplied and installed by contractor.
      3) Rough-in only is required for future item.
   c. Provide acid resistant piping systems at science and photography labs. See Drainage Waste and Vent Systems, this Division.
   d. Acid waste shall be routed through a neutralizing tank installed outside the building inside an underground concrete vault filled with pea gravel to a level just below the tank inlet and outlet pipes. The tank cover shall be bolted and provided with an access door for visual inspection of the limestone level and tank interior without the need to remove the tank cover. The tank shall be filled with 1 to 3 inch diameter limestone chips having a calcium carbonate content of 90% or greater.
   e. Lines to cabinet fixtures or equipment shall be located in chases or partitions. Limit lines in cabinets to connection lengths required to make connections from
chases or partitions. If partitions are not available, provide chases from the ceiling behind cabinets at appropriate intervals for plumbing vents, gas and water lines.

f. Island vents are not allowed. Safewaste island sinks and sinks located at instructor’s desks to a 3-inch floor drain in the apron space. Coordinate the drain and desk locations on drawings. Extend a 3-inch drain line to a vented line as allowed by the FBC - Plumbing.

g. Provide a standpipe stopper with overflow at instructor’s desks and other non-student sinks where designated by the Educational Specifications.

h. Hot water shall not be provided at student accessible lavatories or sinks unless otherwise indicated in the Educational Specifications.

i. Science Lab Faucets shall be as specified in Division 11 of the Design Criteria.

j. Gas cocks shall be scheduled and have a serrated tip, color coding and lettered identification. Backsplash mounted wall-cocks are preferred to turret cocks.

k. Gas, compressed air, or water service available to students shall be provided with clearly labeled master emergency shut-offs:
   1) Use manual valves (preferred) or normally closed solenoid valves operated by a switch. A manual valve shall be provided for maintenance where a solenoid valve is required by the application.
   2) Manual valves shall have 1/4-turn shut-off handles.
   3) Valves or switches shall be accessible and located where required by Code.
   4) Each of the services serving the laboratory or classroom space shall be provided with an isolation valve for maintenance.

l. Rooms where students or school personnel may handle materials or chemicals potentially dangerous to human tissue shall be provided with the following without any flow restrictions:
   1) A drench hose at the instructor’s demo table.
   2) A dousing shower and an eyewash for emergency use. Locate the shower and eyewash away from egress routes and in a non-curbed area. Provide a floor drain with a primed trap in the immediate area.

m. See Domestic Water, this division, for supply to drench hoses, emergency showers, and eyewashes.

n. Art lab and art class sinks shall receive plaster interceptors at sinks designated by program requirements:
   1) Interceptors shall be cast iron, under counter, and have 2-inch inlets and outlets with unions, a removable top, a nonmetallic strainer and an acid resistant enamel interior.
   2) Provide access to the interceptor and cut the cabinet bottom to receive and set the interceptor on the floor to gain maximum top access. Interceptor shall be outside the “approach” envelope at ADA designed sinks.

o. Photography lab sinks, where required by the Educational Specifications shall be provided with an exposed cartridge filter, throttling valves, vacuum breakers, and a spray hose capable of reaching all points of the developing table:
   1) Faucet, throttling valve, hose outlet, and vacuum breaker shall be downstream of thermostatic valves and cartridge filter.
   2) Photography lab sinks shall not be provided with chillers for additional cold-water use.

4. Equipment Rooms:
a. Locate and identify equipment and lines with standard symbols or text denoting rises, drops, valves, instrumentation, cleanouts and other appurtenances. Note inverts or elevations at crossovers, obstructions and aboveground horizontal lines 3 inches and larger.
b. Provide access and clearance to allow equipment removal and maintenance according to the manufacturer’s recommendations without removing adjacent equipment or piping.
c. Fasten equipment to a 4-inch high minimum housekeeping concrete pads. Extend the pad at least 6 inches from the equipment outline. Vibration isolation requirements may require larger pads.
d. Provide vibration isolation at moving equipment and as required to meet the acoustical requirements of adjacent spaces.
e. Provide piping support at equipment to relieve equipment from stresses.
f. Provide valving and disconnect flanges or unions at equipment to accommodate disconnections and repairs.
g. Provide pressure gages, temperature gages, flow meters and other devices as required for proper equipment and systems monitoring.
h. In equipment rooms, provide frame protected drawings and schedules identifying valve tag numbers and equipment labels to show capacities, accessories, and options:
   1) Equipment labels shall correspond to identified breakers or disconnects unless located so purpose is evident.
   2) Identify and label equipment by name or number to correspond to construction documents.
   3) Equipment cabinets shall receive engraved plastic name plates and provide appropriately sized and legible brass tags on equipment without cabinets as specified.
i. Do not use centralized equipment for space heating.
j. A single centralized domestic hot water system is not necessary if loads are remote from each other.
k. Boilers:
   1) Boilers shall comply with the latest FBC adopted edition of the Boiler Safety Act.
   2) Boiler room design shall comply with FBC.
   3) See Fuels this division for energy sources.
l. Hot Water Systems:
   1) Unless otherwise specified by M-DCPS Design Standards, tankless water heaters, minimum of 9 KW, shall be used at all locations requiring hot water service, except at kitchens, food preparation areas, and Physical Education showers. Prior written approval, from M-DCPS Facilities Design and Standards, is required for the use of storage tank water heater at all other locations.
   2) When a storage tank hot water system is required, hot water shall be provided using a commercial grade, high efficiency, quick recovery, LP or natural gas-fired storage type water heater. The use of a commercial type electric water heater is acceptable if gas service is not available.
3) Mount water heaters on a 6 inch concrete housekeeping pad with chamfered edges. Pad dimensions shall extend a nominal 4 inches beyond the heater’s footprint.

4) Water heaters located on upper floors or mounted on a shelf shall be provided with a secondary pan with a 1 inch drain. Both the pan drain and the 3/4 inch P&T heater relief line shall be made of copper and run separately into a mop sink or floor drain provided with an appropriate splash guard for the protection of personnel.

5) If a gas fired water heaters with capacities over 60,000 BTUH is provided, it shall be housed in a dedicated one hour fire-rated room located on the building perimeter and equipped with an exterior door.

6) Since chemical sanitizing is used for manual washing in M-DCPS kitchens, A/E shall base calculations and set controls for domestic hot water requirements to not exceed 110° F. at usage point.

7) Provide domestic hot water recirculation systems at kitchens and other high hot water demand systems if the developed length of piping runs exceed 100 feet.

8) Maintain a domestic water heater serving multiple fixtures at a minimum temperature of approximately 140° F. to prevent bacteria/virus growth. Provide the fixtures with accessible thermostatic mixing valves to limit water temperatures to 110° F. at usage point.

9) Water heaters shall be sized for a 70° F incoming temperature. An expansion tank and heat traps shall be provided on the CW and the HW lines, if they are not already integral with the water heater, as required by the FBC – Plumbing.

10) When sizing hot water requirements for showers use 5 minutes per shower for the water consumption rate.

11) Design shall minimize dead legs to reduce water stagnation. Hot water temperature shall be maintained through the use of a recirculation system where required by the FBC - Plumbing, Section 607 and/or these Guidelines. Recirculation system shall turn off automatically when the hot water system is not in operation.

12) Provide riser diagrams and details for all systems. Show flow rates, temperature difference, valving and instrumentation. Flow diagrams shall be coordinated with detail drawings.

13) Minimum insulation thickness for domestic hot water mains shall be as required by the BFC, but not less than 1-inch thick. Where exposed in wet locations, insulation shall be protected or be resistant to water damage up to a height of 3 feet above the floor. Hot water branches may be bare if allowed by the Florida Energy Code.

14) Tankless water heaters serving custodial closets shall be installed close to but not directly over the mop sink, at a height that allows the installation and access to the mop rack located over the mop sink.

D. Domestic Water:

1. Service shall be extended underground from a water meter next to the property line to an adjacent reduced pressure backflow preventer, located within a fenced enclosure, and enter at an appropriate building mechanical equipment room or chase for overhead distribution.
a. The 20 feet of exterior underground water service prior to entering any building shall be ASTM A-64 polybitumastic covered type “K” copper pipe, for electrical grounding provisions. Coordinate with Civil requirements for piping beyond building line.

b. Domestic water service shall enter the building at an above slab location at an exterior wall. Continue the use of copper piping from underground to a distance of 5 feet above the first floor ceiling once inside the building.

c. Piping shall not be embedded in concrete slabs.

d. Piping shall not be installed below interior slabs on fill, except to floor drain reseals, demo desks, and other program required locations with island sinks. Use type “K” copper without any joints, coated with ASTM A-64 polybitumastic and sleeved under slabs. Coordinate the water distribution routing to limit under slab distances.

e. Domestic water piping located above accessible corridor ceilings and over 2 inches in diameter shall be CPVC, Schedule 40, with CPVC fittings. Piping above inaccessible ceilings and in chases, regardless of size, shall be copper.

2. Provide a duplex domestic water pump pressure booster system only if available street pressure and oversize piping are insufficient to serve the plumbing fixture requirements.

3. Prior to the completion of the mechanical design the A/E shall make a formal request to the Project Manager to test the water source to be used for all water-cooled air conditioning systems and advise the A/E to include a water softener system in the cooling tower condenser water design, sized for 2% of the condenser water flow if desired. The water softener system shall be operational prior to the start-up of the condenser water system start. See Water Treatment section in this Division.

4. Water meter selection shall be based on a 5 to 8 psig pressure drop at peak design flows and not maximum capacity, regardless of pressure drop.

5. Provide a Water and Sewer Department (WASD) sub-water meter and a reduced pressure backflow preventer at all cooling towers.

6. Establish water demand utilizing Hunter’s Curve counting fixtures with flush valves and adding other fixed loads such as group showers, cooling tower make-up, and food preparation areas.

7. Size metal water line mains for a maximum velocity of 7 feet per second (fps). PVC and CPVC lines shall be sized for a maximum velocity of 5 fps. Soft water branches and branches with a pH less than 6.9 shall be sized for a maximum velocity of 4 fps.

8. Piping size shall be determined to accommodate pressure drops instead of velocity requirements at remote fixtures.

9. Peak design flow minimum pressure requirements at flush valve operated fixtures shall be according to fixture manufacturers’ recommendations.

10. Locate an exterior master shut-off underground in a lockable valve box near each building served.

   a. The distribution system shall contain shut-off valves for each floor, wing, or appropriate zone.
   b. Valves shall be installed immediately adjacent to main or branch junctions.
   c. Major fixture groupings shall be valved.
   d. Locate toilet room valves above the nearest ceiling with lay-in-tile or access panel in a hard ceiling.
e. Aboveground valves shall be full ported ball valves with renewable seats for 2-1/2" and smaller. Use iron body bronze mounted outside stem and yoke gate valves for valves greater than 2-1/2".

f. Use full ported ball valves with renewable seats for hot water system balancing and FBC required emergency 1/4-turn shut-offs.

g. Do not install valves in toilet room wall valve boxes or behind wall access panels.

h. Provide services stops at each fixture.

i. Equipment not receiving service stops shall be provided with valves.

j. All valves shall be accessible.

11. Emergency Water Supply:

a. Water supplies for drench hoses at instructors’ demo tables, emergency showers, and eyewashes shall be from a source not prone to inadvertent shutoff.

1) Emergency water supplies shall connect upstream of both the instructor’s room master control and the branch shutoff valve feeding the room.

2) The emergency water supply to each area or room shall be equipped with a single, rising stem branch shutoff valve, chained and locked in the open position, labeled “EMERGENCY WATER SUPPLY”.

3) The emergency water supply shall not have additional valving or stops downstream of the locked and labeled valve.

4) Minimum supply size to an emergency shower shall be 1 inch.

b. Provide a dousing shower and an eyewash for emergency use at water treatment areas for chillers and other areas according to OSHA.

12. Provide properly sized water hammer arresters to eliminate water hammer in cold and hot water lines.

13. Exterior hose bibbs shall be 3/4", loose keyed, flanged, chrome plated, independently valved, vacuum breaker equipped, and at the building perimeter or courtyards at intervals not to exceed 150 feet.

14. See Toilet Rooms and Group Showers in this division and program requirements for additional hose bibb requirements.

15. Underground exterior domestic water lines provided under this Division shall be as follows:

a. PVC with push-on joints for 3" diameter lines and larger. Provide thrust blocks for push-on-joints.

b. PVC with socket welded joints for 2-1/2" diameter lines or less.

c. Determine proper PVC type for intended use from Florida Building Code (FBC) – Plumbing, Chapter 6 with their respective governing ASTM or other standards.

d. Plumbing lines shall be buried a minimum of 18 inches for lines 2-1/2" or less and a minimum of 24 inches for lines 3 inches and larger or as maybe required by loading or sod conditions.

e. Install lines with 6 inches of clean sand below and at sides of pipe and with a minimum of 12 inches of clean and backfill over pipe.

f. PVC supply line velocities shall not exceed 5 fps.

g. PVC lines shall have 2" wide metallic detection tape buried between 4 - 6 inches below finish grade.

16. Aboveground domestic water lines shall be type “L” copper for 4" diameter lines or less. Lines with larger than 4" diameters and lines of galvanized steel shall be avoided unless for absolutely necessary mains and only when accepted by M-DCPS on a per condition basis.
17. Domestic water system shall contain lead-free components. Lead-free solder, containing silver for easy flow, shall comply with Federal Specifications for potable water systems.

18. The plumbing contractor shall provide written certification of a completed lead free domestic water system from the point of service complying with governing codes and regulations.

19. Domestic hot water shall be limited at the point of use to 110°F maximum by use of fail-safe thermostatic valves.

20. Provide hot water at the following locations:
   a. Kitchens, food preparation areas, can wash areas, laundry centers, showers, custodial sinks, clinics, kitchen staff toilet rooms and staff lounge sinks, according to FBC and at other locations required by the educational program.
   b. Hot water shall not be supplied to individual or group public, student or any other staff toilet rooms, except as required by code or as may be required by the Educational Specifications.

21. Reduced pressure backflow preventers shall protect the domestic water system from cross contamination.

22. Dielectric unions and isolated flanges shall protect the domestic water system from dissimilar metal electrolysis.

E. Drainage, Waste, And Vent Systems:
   1. Sanitary System:
      a. Provide a gravity system to convey wastes through a sewer network to the available public sanitary sewer system or a DERM approved disposal system.
      b. See Division 2 – Sanitary Sewer System for additional requirements.
      c. Building drain piping shall comply with the following:
         1) 3” diameter lines or larger shall be sized for 1/8” per foot minimum slope.
         2) Lines less than 3” diameter shall be sloped at 1/4” per foot minimum.
         3) 1/16” per foot slope shall only be used for lines 8” or larger.
         4) Cleanouts shall be full sized up to 4 inches and at intervals not to exceed 100 feet.
         5) Provide concrete protection doughnuts for cleanouts in landscaped areas.
      d. Above and underground building drain lines may be PVC or CPVC used in accordance with the Florida Building Code (FBC) – Plumbing, and meeting the applicable governing ASTM or other standards.
      e. Underground exterior sanitary lines provided under this division shall be as follows:
         1) PVC with push-on joints for 3” diameter lines and larger.
         2) PVC with socket welded joints for 2-1/2” diameter lines or less.
         3) Determine proper PVC type for intended use from FBC - Plumbing, meeting their respective governing ASTM or other standards.
         4) Plumbing lines shall be buried a minimum of 18 inches for lines 2-1/2” or less and a minimum of 24” for lines 3” inches and larger.
         5) Install lines with 6 inches of clean sand below and at sides of pipe and with a minimum of 12 inches of clean backfill over pipe.
         6) PVC lines shall have 2 inch wide metallic detection tape buried between 4” - 6” below finish grade.
f. Use wet venting, circuit venting, loop venting, and combination waste/vent systems, as allowed by the FBC – Plumbing, to reduce piping and fittings.
g. Minimum size of a soil line connection to a water closet shall be 4 inches.
h. Provide an acid resistant piping system for science and photography labs separate from sanitary waste and vent lines until neutralized by marble chips, limestone, or other forms of calcium carbonate chips, all sized between 2 to 3 inches. Acid resistant piping systems shall comply with the following:
   1) Provide a single underground neutralization tank where possible. Under-counter tanks are not allowed.
   2) Provide venting for neutralization tanks and connect to the building’s acid resistant vent system.
   3) High silica cast iron piping is allowed for use at any location. Connection to a different aboveground piping material shall be made at least 6 inches above slab. High silica cast iron piping shall have mechanical coupling joints properly tightened to manufacturer’s specifications or bells and spigots with acid resistant packing.
   4) Borosilicate glass piping is only allowed for aboveground use. Borosilicate glass shall have mechanical coupling joints.
   5) Thermoplastic piping is allowed for use at any location. Include metallic detection tape for burial. Thermoplastic pipe shall be flame retardant polypropylene with adequate rack support and installed with fusible seal fittings.
   6) Connection of the acid resistant and sanitary systems shall be outside the building. Acid resistant piping shall continue from the neutralization up to the connection to the sanitary system.
   7) See Science, Art, and Photography Labs for plaster interceptors.
   i. See Kitchen in this division for grease interceptors.
   j. Provide floor drains with reseals unless receiving safewastes. All floor drains, with the exception of those provided in the kitchen, shall be provided with trap primers. Floor drains in mechanical rooms shall be primed.
   k. See Kitchens and Toilet Rooms and Group Showers for additional floor drain requirements.

2. Septic Tank Abandonment:
a. In accordance with the State of Florida Department of Health Chapt 64E-6, whenever the use of an onsite sewage treatment and disposal system is discontinued following connection to a sanitary sewer, following condemnation or demolition or removal or destruction, of a building or property, or discontinuing the use of a septic tank and replacement with another septic tank, the system shall be abandoned within 90 days and any further use of the system for any purpose shall be prohibited.
b. A septic tank need not be abandoned if the Department of Environmental Protection or its designee approves the use of the retention tank where the tank is to become an integral part of a sanitary sewer system or storm water management system.
c. To abandon an onsite sewage treatment and disposal system, specify that the following actions shall be taken in the order listed:
   1) M-DCPS shall apply for a permit from the Department of Environmental Protection to abandon the existing onsite sewage system.
2) Upon receipt of the permit:
   a) The tank shall be pumped out.
   b) The bottom of the tank shall be opened or ruptured, or entire tank collapsed so as to prevent the tank from retaining water.
   c) The tank shall be filled with clean sand or other suitable material, and completely covered with soil.
   d) The area disturbed or damaged in the course of the work shall be patched, restored, graded, sodded or paved as needed.

3. Storm Drain System:
   a. Drainage calculations shall be based on the rainfall rates FBC – Plumbing.
   b. Roof drainage, including downspouts, shall be connected to a storm drain system complying with the FBC – Plumbing, using a rainfall rate of 5 inches per hour.
      1) Use Schedule 80 PVC pipe assemblies for sections of downspout that are less than 9 feet above finish grade. At the base of each downspout provide a cleanout using a Schedule 80 PVC “Test Tee” installed parallel to the wall.
      2) Install underground lines with 6 inches of clean sand below and at sides of pipe and with a minimum of 12 inches of clean backfill over pipe.
      3) PVC lines shall have 2 inch wide metallic detection tape buried between 4''-6'' below finish grade.
   c. Interior roof drains, where used, shall be provided with under-deck clamps, drainage flanges and cast iron domes and shall be able to adjust height to account for roof insulation thickness. In critical areas, drain piping shall be wrapped with insulation for noise attenuation.
   d. Storm drain systems shall end at soakage pits or exfiltration trenches. Disposal wells may be used if chlorine and salinity levels are allowable. Verify system requirements based on percolation tests and extent of construction and incorporate under Division 2.
   6) Downspouts shall connect to the storm drainage systems. Downspouts ending aboveground require M-DCPS acceptance on a per condition basis, and when approved, shall end at a 45-degree angle and have a concrete splash block.
   c. See Division 2 – Civil, for additional storm drainage requirements.
   d. See Design Criteria, Division 7 for roof design requirements.

4. Condensate Drainage System:
   a. Provide all AHU’s traps (with cleanouts) sized for the static pressures used.
   b. PVC piping is allowed.
   c. Condensate system shall be independently routed and discharged to a catch basin or a properly sized drywell.
   d. Condensate drains for rooftop units shall be properly pitched and supported. Roof supports shall be attached to the roof deck and flashed.
   e. Insulate lines with 1 inch Armaflex. Insulation on condensate drains exposed to weather shall be provided with two coats of elastomeric paint.

F. Plumbing Fixtures:
   1. Plumbing fixtures shall be enameled cast iron except for fixture types available only in vitreous china. Enameled steel fixtures are not allowed. Plumbing fixture flows are to be in accordance with the requirements of the FBC - Plumbing.
   2. Water Closets:
a. Use wall mounted water closets only in replacement projects of existing wall mounted units when using existing drainage connections. Use floor mounted water closets in new projects and for the replacement of existing floor-mounted water closets.
b. Provide elongated siphon jets having a low flow manual flush valve activation, a 1-1/2" top spud, complying with ASME and ANSI standards.
c. Water closet seats shall be commercial quality, solid plastic, open front, coverless, and have stainless steel check hinges. Self-sustaining hinges shall not be used. Color shall be black.

3. Urinals:
   a. Provide siphon jet wall hung urinals with a low-flow manual valve activation and a 3/4" top spud.
   b. Urinals shall have an integral trap and visible standing water.
   c. Provide floor mounted fixture carriers with mechanical attachment.
   d. Connect each urinal to a 1" water supply, to a wall where it may be reduced to 3/4" to feed the flush valve, and a 2" sanitary waste line.
   e. The use of waterless urinals is not allowed.

4. Sinks/Lavatories:
   a. Sink and lavatory faucets shall be equipped with aerators, unless otherwise noted maximum flow shall not exceed the flow rates allowed by the FBC - Plumbing.
   b. Wall hung and counter mounted lavatories shall be enameled cast iron with 4 inch center holes, 1-1/2" grid drain, offset for lavatories accessible to the disabled, slow acting self-closing valves, and chrome plated “P” trap, extension to wall, and a escutcheon cover.
   c. Wall hung lavatories shall be a minimum size of 20” L x 18” W with a 4-inch high backsplash.
   d. Provide floor mounted concealed arm carriers for wall-hung lavatories.
   e. Counter mounted lavatories shall be self-rimming sized according to the Educational Specifications. Do not use in student or public toilet rooms.
   f. Lavatory fittings with mixing valves shall not be used, except at lavatories supplied with hot water.
   g. A cabinet mounted sink equipped with hot and cold water shall be provided in the clinic with wrist blade handles and a gooseneck spout.
   h. The classroom service sinks where programmed for elementary classrooms shall be equipped with a non-refrigerated drinking fountain fitting, located according to program requirements; the sink shall be 25” L x 17” W of a depth as required for accessibility, 18 gage stainless steel, single compartment, self-rimming, and supplied with cold water only:
      1) Provide a single handle gooseneck faucet with aerator and limited swing to avoid water damage to the cabinet surfaces, and the drinking fountain fitting. Bubblers or any arrangement where water falls back on the mouthpiece shall not be used for the drinking fountain fitting.
   i. Where double sinks are provided, provide a limited swing gooseneck faucet unless otherwise specified in the educational program.
   j. All custodial closets shall be provided with a 24" x 24" floor mounted sink. Provide the fitting at the wall above the floor sink with hot and cold water, shank stops, a vacuum breaker, a 30- inch long hose, and bucket hook. Do not use wall-mounted sinks except for replacement at existing custodial closets.
k. Minimum waste outlet size for service sinks shall be 3” diameter.
l. Provide a combination hand held eyewash drench hose connected to the sink faucet at each custodial closet.
m. Size photography lab developing sinks according to program requirements.

5. Electric Water Coolers/Drinking Fountains:
a. Electric water coolers shall be provided at corridors, large group areas, and at other locations according to the educational program requirements, ADAAG and the FBC. Provide for a “hi-lo” double configuration accessible to the disabled meeting the requirements of FBC (one water cooler accessible to individuals who use wheelchairs -with a spout not higher than 36” AFF- next to another water cooler accessible to those who have difficulty bending or stooping, with a spout height from 38” to 43” AFF).
b. Electric water coolers shall be wall hung at alcoves if necessary to maintain egress width requirements or not intrude upon traffic circulation. Provide side clearances for ventilation and comply with accessibility requirements.
c. Water coolers at exterior locations shall have weatherized fully stainless steel construction, secured remote chillers, vandal resistant components, and other security measures.
d. Locate electric water coolers next to group toilets, in administration areas, cafeterias, and other large assembly areas. Do not locate inside toilet rooms.
e. Drinking fountains and water coolers shall be safewasted to floor drains, if within 30 feet. Dry wells may be used for remote locations.
f. Stand-alone drinking fountains at remote locations not suitable for the provision of a remote chiller shall be of the pedestal type, stainless steel construction with internal bottom water and drainage connections and vandal resistant components.

6. See program requirements and this division for Toilet Rooms and Group Showers, Kitchens, and Science, Art & Photography Labs for additional fixture requirements.

7. See Science, Art and Photography Labs for emergency showers and eyewash facilities.

8. Unless otherwise dictated by the ADAAG, use the following fixture heights above finish floor for the grade levels shown:

<table>
<thead>
<tr>
<th>FIXTURE</th>
<th>Pre-K &amp; K</th>
<th>1-3</th>
<th>4-5</th>
<th>6-7</th>
<th>8</th>
<th>9-12 &amp; Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet seat</td>
<td>14”-15”</td>
<td>14”-15”</td>
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<tr>
<td>Access. toilet seat *</td>
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<td>14”-15”</td>
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<td>-</td>
<td>-</td>
<td>17”</td>
<td>17”</td>
<td>17”</td>
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</tr>
<tr>
<td>Lavatory rim</td>
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<td>25”</td>
<td>27”-28”</td>
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* Provide student group restrooms located at Middle Schools (grades 6th thru 8th) and K-8 Centers (grades 4th thru 8th), accessibility in accordance with Architectural and Transportation Barriers Compliance Board (Access Board) and the Florida Accessibility Code for Building Construction.
** Maximum height above finish floor.

G. Fire Protection:
1. Fire sprinkler systems, when required, shall be wet pipe and hydraulically designed for the occupancy designated by NFPA 13 for the space use. Comply with NFPA-13, NFPA-101 and FBC fire protection requirements.
2. Construction documents shall be prepared and sealed by a mechanical engineer with a documented 10 years of fire protection experience or a fire protection engineer. Florida registration is required.
3. Provide 6 foot high chain link fencing around the fire protection system backflow preventer when it is installed in an area accessible to the public or students.
4. Install fire department connection at a clear, accessible location and without interference from nearby objects such as buildings, fences, posts or other fire department connections. Locate fire department connection at the minimum distance from structures required by NFPA or the Fire Department.
5. Provide an indicating valve with tamper switch at the water entrance and a flow switch. An alarm check valve may be required at the connection to the water supply depending on fluctuating pressure conditions to prevent surges and false alarms. Provide alarm check valve complete with retard chamber. Provide an electric driven bell adjacent to the water entrance or fire pump location.
6. Provide at each floor an accepted water flow detector alarm device connected to activate the building fire alarm system.
7. Classroom, dining and office areas shall be designed to meet the requirements for Light Hazard occupancy. The kitchen, its associated service area and flammable and equipment storage rooms shall be designed as an Ordinary Hazard Group I occupancy. Stages, where required to be protected by the FBC, shall be designed as an Ordinary Hazard Group II area.
8. No water or drainage piping shall be routed through electrical, elevator machine or telecommunication rooms. Sprinkler piping serving such spaces shall be a dedicated branch terminating therein.
9. Provide quick response heads throughout with the appropriate temperature classification. In finished areas sprinkler heads shall be fully recessed type.
10. The use of steel flexible hoses for connecting sprinkler heads is not allowed.
11. Upon completion of the fire sprinkler system, provide M-DCPS appropriate extra heads and a cabinet as specified by NFPA-13. When used, provide an equal number of concealed type fire sprinkler heads and concealed cover plates.
12. Stages shall comply with FBC and NFPA-101 classifications of stages, and platforms. The automatic sprinkler system shall be designed to operate with the available fire test water flow and pressure.
13. NPFA 14 requires the standpipes protecting the stage to operate at pressures that require a fire pump. If the school does not have a pump, one shall be provided. In lieu of the pump, the approvals of the AHJ and local Fire Department will be required for the Fire Department to provide the necessary standpipe flow and pressure through the Fire Department Connection (FDC) when necessary. In such a case a placard will be provided at the FDC stating the flow and pressure required for the operation of the standpipe.
14. Provide fire-hose cabinets with a UL listed semiautomatic hose rack with a 100-foot hose and plastic nozzle at stage sides if required by the FBC. Include pressure reducing valve or orifice to angle supply as necessary to reduce pressure below 100 PSIG.

15. Six sprinkler heads may be connected to the domestic water supply for an isolated hazardous area in an un-sprinkled building, when complying with NFPA.

16. Provide woodworking shops, and paint spray booths with fire protection and alarms to comply with FBC and NFPA.

17. UL Standard 300 listed wet chemical fire suppression systems shall be provided at cooking exhaust hoods. See Kitchens, this Division, and section on Utility Distribution and Canopy Ventilating Systems in Division 11.

18. The use of chlorinated polyvinyl chloride (CPVC) piping in fire sprinkler systems is NOT allowed.

19. Paint all above ground exposed fire sprinkler piping, fittings and valves as specified in Division 9. Exposed fire sprinkler piping located within mechanical rooms, electrical rooms, rooms with high humidity or rooms that are not air-conditioned, shall be painted with a minimum 10 Mil rust proof fire protection red paint. Exposed fire sprinkler piping located in occupied spaces that have no finished ceiling shall be painted to match the adjacent color schemes, and shall be minimally identified as required by ANSI/ASME A13.1. Sprinkler piping located concealed above a ceiling space which is located over an air-conditioned space shall not be painted. Under no circumstance shall sprinkler heads or cover plates be painted. If required, the finish of sprinkler heads and or covers must be factory furnished as required by their listings.

H. Fuels And Energy Sources:

1. Use natural gas for emergency electric generators in schools not designated as Enhanced Hurricane Protection Areas (EHPA). Diesel fuel oil is not accepted by M-DCPS for new construction except at facilities designated as EHPAs. See Division 16 for emergency power systems. Consider liquefied petroleum gases (LPG) or compressed natural gas (CNG) if natural gas service is unreliable or unavailable in the area.

2. Natural gas, when used, shall provide boilers, kitchen equipment, water heaters, laboratory outlets, and emergency generators with manufacturers’ recommended operating pressures.

3. All natural gas services to an individual school site shall be provided by means of one (1) common gas meter. Any exception must first be approved in writing by M-DCPS Office of District Inspections, Operations and Emergency Management.

4. The gas meter shall be located above grade, and whenever possible, within the service yard:
   a. Provide concrete filled bollards to protect gas meter, regulator gas tanks and entrance piping against traffic hazards.
   b. Provide fencing for exterior regulators and valves.
   c. Valves shall be lockable.

5. Gas lines shall not be installed underground below interior slabs except for short runs not exceeding fifteen (15) feet without joints. Such lines shall be installed in sealed metal sleeving vented to the exterior. Pipe sleeve shall be at least two and a half to three pipe sizes larger than the carrier pipe, but not less than 2 inches for a 3/4 inch gas line.
Use wrought iron, cast iron, or steel pipe for underground sleeves for aboveground gas venting. PVC is not allowed for sleeves or gas venting.

6. Gas piping shall not be embedded in concrete slabs or in slab raceways.

7. Egress corridors and stairwells and surrounding wall and ceiling construction shall not contain gas or flammable liquid piping or valves.

8. Low-pressure gas distribution shall be used inside buildings and sized to provide the recommended operating pressures.

9. Gas pressure regulators at each major piece of equipment shall be provided by the equipment manufacturer or Contractor. Regulator locations shall be noted on construction documents and have relief vent piping to exterior when required.

10. When required by the FBC provide normally closed, electrically operated gas valves with manual reset to shut off the fuel supply. Connect such valves to the fire alarm system; other gas services that do not require to automatically shut off need not be provided with the electrically operated valve or otherwise connected to the fire alarm system. Electrical shut-off valves for gas service shall be located in an exterior location and protected from the weather, traffic, and vandalism. Valves protecting piping serving or going through student occupied spaces shall close upon activation of the fire alarm system. Valves associated with the gas service to the kitchen shall not be activated by the fire alarm system, but by a mechanically activated valve operated by the kitchen hood’s fire protection system.

11. See Science, Art and Photography Labs, this Division, for additional gas shut-off valve requirements at student locations.

12. Fuel tanks shall be aboveground, double walled, protected with concrete filled bollards at new facilities. Comply with NFPA 58 for locations. Comply with M-DCPS and FBC requirements at Enhanced Hurricane Protection Areas (EHPA):
   a. Facilities requiring the replacement or relocation of fuel tanks, shall receive aboveground fuel tanks.
   b. New underground or relocated underground fuel oil tanks are not allowed.
   c. Fuel oil tanks shall comply with Miami-Dade County 24-12, Florida DER. Code 17-61, and all other applicable codes. See Division 15.
   d. Coordinate with the latest M-DCPS Safety, Environment, and Hazards Management guidelines for aboveground tanks installations.
   e. Locate fuel tanks as far as possible from student occupied areas.
   f. Aboveground fuel oil lines shall be painted.

13. See Division 16 for emergency power.

I. Compressed Air:
   1. Air compressors required for shop and paint areas shall be located in a mechanical equipment room.
   2. See Equipment Rooms, this division, for mounting and vibration isolation.
   3. Compressors shall be tank mounted and sized to accommodate student loads, tools, or other diverse requirements. Compressor capacity shall be designated as having “x” CFM at “y” psig.
   4. Compressors 3 HP and larger shall be two stage. Water-cooled or electric dryer operation shall not be provided. Provide forced air after-cooler where required to maintain discharge temperatures within the allowed limits of the system components.
   5. Provide the compressor airline with a regulator equipped with a globe valve bypass and a centrifugal filter water separator of at least 75% efficiency. Combination filter...
regulators are not allowed. Additional air outlet regulators are not required. Provide instrumentation.

6. Automatic water traps with shut-off valves and piped drains shall be provided at the following locations:
   a. Air line exiting from the air compressor.
   b. Compressor storage tank.
   c. First air riser from the compressor and risers over 1 story in height.
   d. End of the main line branch.
   e. Provide a petcock at the bottom of piping riser/drops without an automatic water trap, and at the bottom of each air outlet.

7. Water trap drain lines of different pressures shall not be combined except in infrequently used systems.

8. Provide 1 inch in 40 feet slope down in the airflow direction of airlines and avoid water collection pockets. Reverse slopes are not allowed. Air branch lines shall be taken from only the top of the main line.

1.5 HEATING, VENTILATING, AND AIR-CONDITIONING

A. General:
   1. Design conditions shall be:
      a. In the absence of specific design criteria not found in this document, the recommendations found in the “Educational Facilities” Chapter of the ASHRAE HVAC Applications Handbook shall be followed.
      b. Cooling indoor design conditions: 75 Fdb/50% relative humidity.
      c. Heating indoor design conditions: 68 Fdb/40% relative humidity.
      d. Summer outdoor design conditions except for cooling towers and air-cooled condensers: 91 Fdb/79 Fwb.
         1) Cooling tower outside design conditions: 91 Fdb/80 Fwb.
         2) Air-cooled condenser outside design conditions: 95 Fdb.
      e. Winter outdoor design conditions: 48 Fdb.
   2. Load calculations and design of the building envelope, lighting, air-conditioning, heating, and ventilation systems shall comply with, but not be limited to:
      c. An accepted life cycle cost analysis (LCCA).
      d. ASHRAE Design Standards.
      e. Air-conditioning, Heating and Refrigeration Institute (AHRI) guidelines.
      f. Sheet Metal and air-conditioning Contractors National Association, Inc. (SMACNA).
   3. Only EER shall be considered for the selection of equipment, SEER is not acceptable.

B. Life Cycle Cost Analysis (LCCA):
   1. Life cycle cost analysis shall be provided for educational facilities with new HVAC systems with a capacity of 30 tons or greater.
   2. Computer programs acceptable for life cycle cost studies shall comply with the following:
      a. Be commercially available, third party software.
      b. Use latest ASHRAE procedures Use hourly calculations based on ASHRAE weather date for Miami International Airport.
c. Calculate annual energy consumption and annual energy costs based on current FPL rates.
d. Provide software features to model systems needed to complete LCCA Data Sheets 1, 2, and 3. See Design Criteria Appendix for blank forms.
e. Include improvements in equipment efficiency and systems for which incentives are offered by Florida Power and Light in their “Business Heating Ventilation and Air-Conditioning Program Standards.” For the purpose of the FPL incentives, any increase in system cost associated with the implementation of a given improvement shall prove to have a payback period, in the form of the cost of the energy saved, of four years.

3. The following, but not limited to, programs for small computers are acceptable, if suitable:
   a. Carrier HAP.
   b. Trane Trace.
   c. Building Energy Analysis by Elite Software.
   d. MICRO-DOE 2 by Acrosoft, Inc.

4. Financial Analysis:
   a. Life cycle costs shall be based on a 25 year term using cost escalation factors of inflation and interest rates in formulas listed in latest ASHRAE Handbook – HVAC Applications, Chapter – Owning and Operating Costs.
   b. Use M-DCPS provided current maintenance contracted costs for chillers, pumps, and cooling tower maintenance.
   c. The air-conditioning system with the lowest life cycle cost or another system within 4% of the lowest life cycle cost shall be submitted to M-DCPS for final approval.
   d. Analysis shall include applicable FPL incentives as discussed above, design incentives, or other rebate programs for replacements or new installations using energy efficient equipment or systems if applicable.

5. Submittals:
   a. The submittal shall include the following:
      1) Description of the project as new, remodeling, or an addition.
      2) If an on-site central chilled water system exists.
      3) Printouts of required computer program inputs including building data, equipment, hours of use and rates of energy.
      4) LCCA Data Sheets 1, 2, and 3. See Design Criteria Appendix for blank forms.
      5) Computer printouts of energy consumption and energy costs by month and total for a year.
      6) Comparisons of different mechanical systems or schemes including central chilled water systems, a thermal storage system, and DX, water-cooled, or air-cooled systems.
   b. The life cycle cost analysis shall include:
      1) Water-cooled versus use of air-cooled chillers or condensers of 200 tons or more.
      2) Heat recovery of chillers for domestic hot water at kitchens, showers and heated swimming pools or wading pools.
      3) Demand control ventilation for spaces or systems not otherwise required by the Florida Energy Code.
      4) Constant volume air systems versus variable air volume systems.
5) Refrigerants, if HFC 134a, or HFC 410-A are not used:
   a) Escalation of costs of other refrigerants due to recovery expenses and shortages.
   b) Equipment conversion costs of CFC-12 to HFC-134A, and/or HCFC-22 to HFC-410A.
   c) Increased energy costs of operations and increased future replacement cost after conversion to new refrigerants.

c. See Cooling Sources, this Division, for chillers and condensers.

C. HVAC System Selection:
   1. General Requirements:
      a. HVAC shall be provided to all instructional spaces, staff occupied spaces and additional areas as required by M-DCPS Design Criteria and the Educational Specification for each project.
      b. When HVAC Systems are provided, an EMS compatible with M-DCPS central control shall be provided.
      c. HVAC distribution systems shall be zoned to permit closing off of building areas when their use is not required.
      d. HVAC systems shall be simple, easy to operate and maintain, use established design principles, and be constructed of standard and proven materials. The energy efficiency ratio (EER) of HVAC equipment installed shall be the greater of minimum values stated in the FBC. Before installation, provide M-DCPS the manufacturer’s literature verifying EER rating compliance which shall be required as part of the shop drawing submittal.
      e. Electric motors for AHUs, pumps, fans and cooling towers that are 1-horsepower or larger, shall be high efficiency per Florida Energy conservation code (FBC). Motors shall be NEMA standard design, with grease lubricated bearings, wound for the specified voltage, have a minimum power factor of 0.85 at 100% load and a minimum efficiency of 91% at full load. Provide motor starters with H-O-A switches.
      f. Selection of one of the following systems shall be determined by LCCA and FBC with M-DCPS approval within parameters according to this division:
         1) Unitary systems: Packages for single zone, factory assembled, self-contained or split systems serving single or multiple spaces.
         2) Central systems: Cooling from a central source providing control zones and serving multiple instructional spaces.
      g. All exterior mechanical appliances and equipment that are exposed to wind, including package units, condensing units, fans, equipment casings, rooftop units, hold-downs, curbs, etc., (whether integral or loose), shall be designed and installed to resist wind pressures in accordance with the FBC wind load zone designated for the project. Provide calculations signed and sealed by a Florida registered professional engineer to the BCC establishing wind velocity pressure values for the specific project in accordance with ASCE-7 adopted by the FBC applicable to the project.
      h. Discharge condensate drains to dry wells or a storm drain system. PVC piping as specified for drainage may be used. Provide cleanouts and long radius elbows.
      i. The following, systems and components shall be used:
1) VAV systems shall use variable frequency drive fans. Variable inlet vanes are not allowed.

2) Provide a VAV system, with individual temperature control, for each classroom and instructional space.

3) In new additions projects, the use of individual classroom DX Package Units shall be considered for cost reduction purposes. However, final decision to use this type of HVAC system requires prior written approval from M-DCPS Facilities Design and Standard.

4) Provide single zone units for Administration areas that are 4,500 total square feet or less.

5) Provide VAV system for Administration areas that are greater than 4,500 total square feet.

6) Provide single zone units for Gymnasiums, Cafeterias/Cafeteriums, Auditoriums, Media Centers, and any other large assembly areas.

7) Chilled water air handling units in areas requiring single zone units shall be provided with variable frequency drives.

8) Whenever single zone DX units are provided, over 5 Tons capacity, use full face, intertwined evaporator coils, variable speed fans and variable speed or digital scroll compressors. Split coil by row if necessary to take advantage of compressor unloading.

9) Whenever electric duct heaters are provided, locate them inside mechanical rooms whenever possible, and downstream of smoke detector and upstream of temperature sensor.
   a) In multi-zone systems, provide heater at each zone.
   b) In VAV systems provide heater at each VAV box as required.
   c) In single zone systems provide heater at main supply duct.

10) Water-cooled central plants with individual chillers of more than 200 tons shall consist of 2 rotary screw or centrifugal type chillers. Centrifugal chillers may be oiled or oil-free magnetic bearing type:
   a) Size each chiller for approximately 50% of calculated peak cooling load on a primary loop except for economical installations.
   b) At M-DCPS designated economical installations, limited to 200 Tons and less, the use of a single chiller sized at 100% of the load with multiple independently circuited refrigerant lines, and compressors with individual factory installed breakers may be approved.
   c) Chiller type shall be according to Cooling Sources in this Division.

j. The use of VAV Systems in combination with direct expansion (DX) units is allowed only if the DX blower assembly contains a variable frequency drive, and the condenser side of the DX unit has multiple compressors were the lead compressor is either variable speed or digital scroll.

k. Fan coil units and VAV diffusers are not allowed.

l. Unit ventilators:
   1) Unit ventilators may only be used as follows:
      a) In areas requiring 24 hour/7day HVAC as indicated in this Division.
      b) For replacement of existing fan coil/unit ventilator units in remodeling projects.
      c) In other special and very limited conditions with prior written approved from M-DCPS Facilities Design and Standards.
2) Each cooling coil shall be provided with a properly insulated steel drain pan that extends under all un-insulated valves and piping which are subject to condensation.

3) The sound generated when producing the specified CFM shall not exceed the requirements stated in M-DCPS Master Specification for Unit Ventilators. Maximum face velocity shall be 250 CFM.

4) Chilled water coil shall have a factory installed 3-way valve and two (2) shut-off valves on the chilled water lines, one for the supply and one for the return.

5) Chilled water isolation valves shall be provided at each supply and return chilled water branch line. Isolation valves shall be provided per zone, floor, or building.

6) Unit ventilators shall be provided with Demand Control Ventilation (DCV), in order to reduce cost of operating the HVAC system in accordance with ASHRAE/ANSI Standard 62.1. An outside air motorized damper and a CO2 sensor shall be provided for this system. The outside air motorized damper shall be in the close position during the unit off cycle.

8) For DX unit ventilators the condensing unit shall be a minimum of 16 SEER and the compressor shall be either two stage or variable speed.

9) Unit ventilator shall be provided with a variable speed fan and humidity control.

m. Contractor shall verify that components and systems are operational. Test and balance services will be provided by an M-DCPS contracted firm.

n. Fiberglass materials used for insulation or sound reduction shall not be exposed to the airstreams of ducts, outlets, air-handlers, VAV boxes, sound traps or other HVAC equipment or components. Mylar is not allowed in contact with the airstream, even if protected by sheet metal with round openings.

o. In smaller AC units such as unit ventilators and other similar equipment, the use of single wall construction is approved if foamed plastic insulation is substituted for fiberglass in all areas that come in contact with the air stream.

p. The A/E shall specify that all air handling unit motors with variable speed drives shall be installed with 3-phase overload monitors for protection of the drive and motor with an automatic restart feature, such as ICM 450 or approved equal. The 3-phase monitor must monitor the main voltage and control voltage. The phase monitor shall trip due to phase loss, phase imbalance, under voltage and over voltage. The phase monitor safety cut off shall cut power to the main control transformer secondary in the drive. This will drop power to all controls and devices. They shall be set to auto-restart when the power returns, corrected within the parameters. The phase monitor shall automatically reset the secondary power of the control transformer and the speed drive will automatically restart.

2. Specific Requirements:
   a. Air-condition kitchens, kitchen offices, food storage areas, general food preparation areas, and other spaces according to the requirements stated in this Division:
      1) Odor-filled return air from cafeterias, home economics, and other similar spaces shall not be mixed with and re-supplied to other limited spaces or areas unless accepted odor filtration systems are used.
   b. Cooking kitchen hood ventilation and exhaust:
1) Provide a low-volume conditioned make-up type kitchen exhaust hood system.

2) Kitchen hood design shall extend 6 inches minimum beyond grease and fume generating equipment and have fluorescent lighting with solid lens covers to maintain kitchen illumination requirements.

3) Hood shall be 18 gauge, Type 304 stainless steel. Exposed stainless steel shall have No. 4 finish. Galvanized, mild steel, or 400 series stainless steel is not allowed.

4) Design for low air velocities to minimize noise and to comply with ASHRAE Applications Handbook.

5) Hood system shall be listed by a NRTL approved by OSHA, and designed to comply with NFPA 96 and be NSF labeled.

c. Provide full width fly-fan air curtains with automatic door opening operation at each exterior door of food service areas and dining rooms. Locate according to manufacturer’s recommendations for dust and insect control:
   1) Provide weather resistant coatings and construction.
   2) Provide a keyed cutoff switch. Push button switches are not allowed.

d. Maintain indoor air quality (IAQ) at instructional spaces, home economics, darkrooms, shops, graphics, and science laboratories during experiments, dissections, and other odor producing activities with the use of additional ventilation, filtration or exhaust:
   1) Return air from odor producing areas shall not be combined with return air from non-odor producing areas unless supply air is filtered using an M-DCPS accepted IAQ filter system.
   2) Hoods required for these areas, except for home economics, shall be designed according to SMACNA and industry standards.
   3) Provide supplemental make-up air type fume hoods according to program requirements.
   4) Provide one exhaust fan and one supply fan for each fume hood.
   5) Laboratory fume hood exhaust system shall be stainless steel.
   6) Provide an emergency exhaust system at rooms with laboratory fume hoods to comply with FBC. Emergency exhaust system may be galvanized steel.
      a) Emergency exhaust system shall consist of a supply air fan and an exhaust fan, located as to sweep the room. Both fan openings shall be provided with premium low leakage motorized louvers. The system shall be all interlocked.
      b) When emergency exhaust fans are turned on, the fume hood exhaust fan shall remain in operation and the fume hood supply fan shall automatically shut down.
      c) Include the laboratory hood exhaust fans in the air change rate calculation when the emergency exhaust fan is turned on and the laboratory hood supply air fans automatically shut down.

e. Provide mechanical ventilation or mechanical exhaust at custodial closets with service sinks and at storage rooms. Provide 1 CFM minimum per square foot mechanical ventilation for these rooms. Make up air to janitor's closet equal to 100 CFM or less, may use a 3/4" door undercut if fire/smoke rating permits. Coordinate with Architect.
f. Provide thermostatically control exhaust fans in all satellite wiring closets serving the telecommunication system and in non-conditioned mechanical rooms.

g. Do not air-condition or heat toilet rooms if conditioned air can be exhausted through the room. Exhaust slightly less than conditioned make-up air requirements from adjacent areas. Odor laden air shall not move through adjacent areas en route to exhaust. Provide 2 CFM minimum per square foot mechanical ventilation for toilet rooms:
   1) Group toilet rooms shall have exhaust fans on continuously during occupancy periods. Provide exhaust fans with a keyed switch and interlock with EMS for shut down and air-handling unit for start-up.

h. Individual toilet rooms shall have exhaust fan operation for 10 minutes after turning off lights. Make up air to individual toilet rooms equal to 100 CFM or less, may use a 3/4” door undercut if fire/smoke rating permits.

i. Building shall be pressurized to maintain a 0.1” w.g. positive pressure.
   1) The total return air and exhaust air volume from a space and the building shall be 90% of the supply air volume.
   2) At each AHU schedule, show the amount of outside air and supply air.
   3) Provide air balance tables for corridors on the related floor plan sheets. Ensure corridors, especially first floor corridors are under positive pressure not less than 0.1” w.g.

j. HVAC piping or ducts shall not be located on top of walkway roofs or building roofs unless approved in writing by M-DCPS on a per condition basis.

k. Equipment not feasible or not within budget to be located within the building shall be installed at exterior ground floor locations.
   1) Condensing units installed at exterior ground floor locations shall receive a chain link roof and 8'-0” high minimum chain link perimeter fencing with lockable gates to deny unauthorized access. Pave the enclosed area and provide fencing clearances for equipment access and maintenance. See Division 2 for additional fencing requirements.
   2) Roof mounted equipment not intended for curb installation, shall be mounted on a structural framing system:
      a) Bottom of the framing system (clearance) shall be as accepted by FBC - Building, Chapter 15.
      b) In existing buildings, the replacement of existing rooftop equipment reusing existing support framing that does not provide the code specified clearances is permitted when the project budget does not allow for replacement of the non-compliant supports and only if they are structurally sound and capable of withstanding the required imposed loads, including wind.
      c) Minimum curb height shall be 12” above the level of the roof membrane.
      d) Pipes or supports intersecting and extending above the plane of the roof membrane shall have a sufficient length to be able to be flashed a minimum of 18”, as required by pipe size. All piping penetrations shall be perpendicular to the roofing membrane. Piping parallel to the roof membrane, including condensate drainage lines, shall be installed at least 16” above the roof membrane.
      e) Coordinate with Divisions 7 and 16. See Division 5 for equipment framing supports.
3) Roof mounted mechanical equipment including but not limited to exhaust fans, exhaust and intake goosenecks, louvers, etc., shall be identified and labeled to correspond to the construction documents.

l. Provide controls and proper installation at direct expansion units to prevent freezing of coils.

m. Equipment rooms where refrigerant is used shall comply with ASHRAE 15-2004 and provide the following:
   1) Refrigerant sensors within 50 feet of refrigerant systems.
   2) Equipment room alarm, audible 10 decibels (dB) above ambient noise.
   3) Forced mechanical ventilation for occupied and non-occupied conditions at chiller room.
   4) Purge and relief valves piped to exterior.
   5) Signage as required.
   6) Provide the required audio/visual alarm inside and outside of the chiller room.
   7) Refrigerant monitor shall override other controls and start fan on emergency exhaust mode.

n. Specify that the Contractor is to maintain a repair log of equipment before M-DCPS acceptance.

D. Heating Sources:
   1. Alternative heat sources shall be evaluated and decided by LCCA with M-DCPS approval.
      a. In remodeling projects, provide outside air intake with electric strip heaters where individual unit heaters are impractical or existing heaters are to be removed.
      b. The use of central boilers for space heating requires approval by M-DCPS Facilities Design and Standards on a per condition basis. Boiler inspection is required by the M-DCPS insurance company. Schedule with M-DCPS Risk Management before operation.

E. Cooling Sources: A/E shall comply with all design standards for cooling sources. Prior to beginning design, A/E shall meet with M-DCPS Division of Facilities Design and Standards to obtain the appropriate updated Division 15 Master Specification Guideline Sections.
   1. The following chiller and condenser combinations are to be used as basic guidelines cooling sources for the total system capacity:
      a. Up to 25 tons - Scroll DX air-cooled.
      b. 26 tons to 200 tons - Rotary scroll air-cooled chillers. **NOTE**: DX Packaged Units with capacity over 25 tons may be used on a per project basis only when pre-approved in writing by M-DCPS Facilities Design and Standards.
      c. 201 tons to 800 tons - Rotary screw or centrifugal, water-cooled chillers.
      d. 800 tons and above - Centrifugal water-cooled chillers.
   2. Nothing in the above suggested cooling sources and sizes shall be construed to require a single cooling plant for a school campus or given project. Multiple plants, or even individual units, may be used to serve a project, using the sources and sizes listed, if the related LCCA yields a lower cost for such a configuration. Similarly, alternative cooling sources may be evaluated in the LCCA and used provided that prior written approval has been obtained from M-DCPS Facilities Design and Standards.
   3. An existing central refrigeration plant shall be used for a cooling source if available for present or future use.
4. All chiller surfaces subject to condensation shall be field insulated with a minimum Armaflex insulation thickness of 1-1/2".
5. Provide one flow-measuring device per project. Provide taps at each chiller’s chilled water and condenser side, and if not independently piped, at each cooling tower’s condenser piping. Taps shall be provided with sufficiently large ball valve screwed fittings and caps to be able to introduce the flow measuring device without water spillage.
6. Provide each water cooled chiller with four liquid filled pressure gauges with pressure snubbers and gauge cocks graduated in feet of water. All pressure gauges shall be scaled to read at their midpoints. Maximum intervals shall not exceed 2 feet of water.
7. Combination electric heater and refrigeration packaged units may be used at small buildings on a per condition basis when pre-approved by M-DCPS Facilities Design and Standards.
8. Heat pumps shall be avoided, but may be used for small individual instructional spaces on a per condition basis when pre-approved by M-DCPS Facilities Design and Standards.
9. Multiple individual classroom DX units are not allowed to be used except in remodeling projects where similar units are present.
10. Packaged air-cooled water chillers with at least 4 compressors and independent refrigerant circuits shall be used for equipment less than 150 tons capacity. Each compressor shall be provided with individual factory installed breakers.
11. Manufactured packaged systems shall comply with the minimum efficiencies set forth in the Florida Energy Conservation Code.
12. Water-cooled systems shall be considered for systems over 200 tons. Investigate FPL incentive programs, and LCCA.
13. Upon activation of the fire alarm, AHUs and other system fans shall shut-down.

F. Design Considerations:
1. When central chilled water plants are selected, they shall be placed in an engineered driven location and not based on aesthetics alone.
   a. Provide a service door, lined up in front of each chiller.
   b. Doors shall allow for condenser and evaporator tube service.
   c. Door shall allow for replacement of chiller in one piece.
2. The central plant chilled water air-conditioning equipment shall be capable of operating at reduced loads for after-hour use.
3. The following spaces shall be designed, for after-hour use, to maintain the temperatures and relative humidity referenced below. Design shall incorporate use of the same AHUs while operating the central chiller plant at a reduced capacity. If the central plant’s chillers cannot be operated at the necessary reduced capacity, provide an independent refrigerant system with a secured local thermostat and humidity control device, or computerized start/stop/temperature controls with a digital display panel:
   a. Cafeteria/Cafetorium dining areas, 80 Fdb/55% RH.
   b. Auditoriums, stages, stage storage areas, and related spaces, 80 Fdb/55% RH.
   c. Gymnasiums and all related physical education spaces, 80 Fdb/55% RH.
   d. Administration area, 80 Fdb/55% RH. Provide sufficient cooling load to account for computers, printers, TV sets, copying machines, vending machines, microwaves, and other NIC items located in this area.
e. Band classrooms and Vocal music classrooms: Temperature and relative humidity at instrument storage, uniform storage and robe storage rooms shall not exceed 80°F/55% RH at all times, 24 hours/7 days.

f. Media Center: Temperature and relative humidity shall not exceed 80°F/55% RH at any time during off-hours, 24 hours/7 days.

g. Full Service Clinics, 75°F/55% RH.

4. Provide the following areas with a supplemental HVAC system capable of maintaining room temperature not to exceed 75°F, and relative humidity not to exceed 50%, 24 hours/7 days:

a. Kitchen Dry Storage Room.

b. Main Telecommunication Room: The design heat-load for the NIC equipment located in this room is approximately 20,000 BTU/hr. For each Project, the A/E shall coordinate with ITS personnel to confirm the heat load for the actual NIC equipment that will be designated for each of these spaces.

c. Satellite Wiring Closets: The design heat-load for the NIC equipment located in this room is approximately 5,000 BTU/hr. For each Project, the A/E shall coordinate with ITS personnel to confirm the heat load for the actual NIC equipment that will be designated for each of these spaces.

d. Security Camera System Control Room: The design heat-load for the NIC equipment located in this room is approximately 20,000 BTU/hr.

e. Media Director’s Office/Technical Processing Room: The design heat-load for the NIC equipment located in this room is approximately 8,000 BTU/hr.

f. Instructional TV (ITV) Distribution Center Room: The design heat-load for the NIC equipment located in this room is approximately 20,000 BTU/hr.

g. Instructional TV (ITV) Production Control Room: The design heat-load for the NIC equipment located in this room is approximately 20,000 BTU/hr.

h. CCTV Room: The design heat-load for the NIC equipment located in this room is approximately 12,000 BTU/hr.

5. Provide HVAC to the main electrical switchgear room, electrical closets, telecommunication wiring closets and AHU mechanical rooms.

6. Provide HVAC to the elevator machine room to ensure that the ambient temperature and humidity is maintained in the range specified by the elevator equipment manufacturer. Under no circumstance shall the temperature of this room go below 55°F or higher than 90°F., and the relative humidity exceed 75%. When the operation of the elevator is required by Code to be connected to emergency power, the air conditioning system servicing the elevator machine room shall also be connected to the emergency power. This may be accomplished by means of an air conditioning “ductless” split unit.

7. Childcare centers shall be individually and separately zoned.

8. Full Service Clinics shall be provided with MERV 12 filtration and negative relative pressure at all examination rooms and patient bed areas.

9. Each instructional space shall receive temperature sensors to monitor and independently control air-conditioning. When approved by M-DCPS, adjacent offices housing teaching staff may receive a single zone control at the most representative room temperature location. Locate temperature sensors in return air ductwork to be accessible from the return air grille in the space.

G. Indoor Air Quality (IAQ) And Outside Air Requirements:
1. Outdoor air ventilation for appropriate indoor air quality shall be according to ASHRAE 62.1.

2. Provide Outdoor supply air according to ASHRAE 62.1.

3. At auditoriums, media centers and gymnasiums and other spaces as required by the Florida Energy Code, provide demand control ventilation to reduce outside air quantities and energy usage.
   a. Provide automatic controls using carbon dioxide measuring, and/or localized motion detectors, for adjusting outside air quantities.
   b. In retrofit projects, where EMS systems are not available, provide manual overrides with timers to be easily accessible and in a secured location.
   c. System shall maintain temperatures and relative-humidity within M-DCPS required design conditions throughout the range of outside air variation.

4. Select the lowest cost system based on a LCCA and M-DCPS approval to maintain appropriate indoor air quality by one of the two following options. Exceptions would be based on the “Odor Considerations” section in this Division:
   a. Option 1: Providing an adequate amount of outside air per occupant as applicable, with the following:
      1) Air-handling units shall have:
         a) A dedicated outside air-cooling coil with a minimum of 6 rows. Each row shall have a maximum of 10 fins per inch.
         b) A sensible load-cooling coil with a minimum of 4 rows. Each row shall have a maximum of 10 fins per inch.
         c) A reheat coil using condenser reject heat or an electric duct heater as a heat source.
      2) Unless required by Florida Conservation Code, use of an enthalpy or desiccant wheel system for humidity control requires M-DCPS written acceptance on a per condition basis.
      3) Rooftop mounted units are not allowed unless accepted in writing by M-DCPS, on a per condition basis. When used, rooftop or exterior air-handling units shall have welded frame construction, with proper casing and tie downs, complying with the FBC as stated elsewhere in this Division.
      4) Minimum acceptable AHU filter shall consist of a single 2 inch thick, disposable, pleated particulate filter, MERV 6, located in a filter box upstream of each AHU coil.
      5) Smoke detectors connected to the fire alarm system shall be provided as required by section 606, Florida Mechanical Code.
   b. Option 2: Providing demand control ventilation with appropriate carbon dioxide measuring devices and outside air controls.
      1) An outside air coil as per Option 1 shall be provided if Option 2 is selected.
      c. Provide an LCCA analysis between Options 1 and 2.

5. Provide AHU filter housing with side accessible gasketed, double walled, and insulated doors. Doors shall have corrosion resistant stainless steel hinges and shall be provided with quick opening latches having progressive adjustment.
   a. Provide a differential pressure switch across the filter housings wired to the EMS system.

6. Odor Considerations:
   a. At areas where odor-generating conditions are present and cannot be independently air-conditioned, provide the following:
1) Self-contained fan powered re-circulating IAQ room air purifier, having particulate and gas filter media, may be used in isolated areas provided prior written permission is obtained from M-DCPS on a per condition basis.

2) There shall be a 30% - 45% dust spot efficiency pre-filter (MERV 6) and a 95% dust spot efficiency final filter (MERV 13) in between the chemical gas filter media.

3) Provide a disposable chemical gas filter media consisting of activated carbon granules impregnated with potassium hydroxide or other accepted equivalent chemical material designed to remove a variety of gaseous organic compounds. Gas filter media shall be contained in rigid, 1/8” thick, water resistant cardboard frames.

4) Chemical filter media shall contain not less than 4 cubic feet of media per 1,000 CFM of airflow. The maximum allowed velocity through the filter media shall be 350 fpm.

7. Air filters shall not contain fiberglass.

8. Outside air shall be ducted to the AHU.
   a. When on roof, air intake shall be located at least 36 inches above the roof.
   b. Wall mounted air intakes must be 8 feet above grade to bottom of intake at areas subject to pedestrian traffic.
   c. At installations requiring more than 7.5 CFM of outside air per occupant, outside air shall be introduced by using a dedicated fan.
      1) If the system is VAV, provide an outside air fan to maintain a constant outside air volume.
      2) Use a permanently installed air measuring station in outside air intake system with the transducer wired to the EMS system to ensure minimum outside air volume and maintain building pressurization.
      3) EMS system shall be capable of monitoring, recording, and modulating outside air through the O.A. motorized damper.

9. Roof mounted outside air intakes and exhausts shall be installed in properly flashed curb, having side mounted and gasketed screws. The curb assembly shall be counterflashed as necessary.

10. Return air shall be ducted to the AHU. Corridor return air-plenums are not allowed. An exception may be made for small administrative area alternations and renovations when accepted in writing by M-DCPS, on a per condition basis.

11. AHU rooms shall not serve as an outside air plenum.

12. AHU rooms in existing facilities that are not used as return air plenums shall be provided with a supply and return air register for conditioning.

13. AHU condensate drain pans shall be IAQ type:
   a. Pans shall be sloped at least 1/4” per foot to drain with a double slope break in the metal, and shall be designed to drain dry with no standing water.
   b. Pans shall extend horizontally at least 1/2 the height of the coil face drainage area.
   c. Pans shall comply with IAQ requirements of ASHRAE Standard 62.1, 5.11 through 5.11.4, and have a level lip with at least a 4-inch depth.

14. Provide premium low leakage motorized dampers at all outside air intakes including locations where supply air/outside air fans are installed:
   a. Provide manual volume dampers with memory stops, downstream of motorized outside air dampers. Manual volume dampers are not needed in branch ductwork having supply/outside air fans.
b. Provide controls and actuators as required to interlock all supply/outside air fans, their motorized dampers, and exhaust air fans, with their corresponding AHU’s so no exhaust or supply/outside air is activated, and no outside air is introduced for a period of 30 minutes during start-up, or during unoccupied periods.

c. A return air fan to exhaust excess air to the outside is the preferred method to be used.

d. The use of barometric dampers to exhaust excess air is not allowed.

e. At each space with a fume hood, the emergency exhaust system shall consist of a supply fan and an exhaust fan:
   1) The exhaust fan grille shall be located near and above the hood. Locate the supply air outlet at the most remote location in the room from the exhaust fan grille, to completely sweep the room of fumes.
   2) Provide premium low leakage motorized dampers for the supply and exhaust fans.
   3) Provide a properly labeled single interlocked switch for both fans near the exit door.

15. Buildings shall be pressurized by providing 10% more outdoor supply air than the sum of return and exhaust air. The preferred method of exhausting excess air is to provide a return air fan to exhaust excess air to the outside.

16. All outside air intakes shall be provided with a low leakage motorized damper interlocked with its corresponding AHU.

17. Exhaust fans shall be provided with low leakage motorized dampers and they shall be properly interlocked with their corresponding AHU.

H. Acoustical Considerations:

1. Include passive measures to reduce noise transmitted to occupied spaces, as recommended by ASHRAE and SMACNA, since fiberglass and internal insulation are not allowed in contact with airstream. At Auditoriums or CCTV Studios and where sound attenuation is required, the use of duct lining in contact with the airstream is allowed as follows:

2. Duct lining shall consist of a sheet of flexible, closed cell, foam composition, either an elastomer or a polymer, with a substantially smooth surface on both sides, with a thickness between 1/4 and 1 inch and a density ranging from 3 to 4.5 pounds per cubic foot (PCF) and meeting other requirements as specified.

3. For sound attenuation the first 20 feet of supply and return ductwork at each AHU shall be lined with an approved liner as described above and specified in contract documents.

4. The spectrum shape of the background noise shall approximate the appropriate ASHRAE Room Criteria (RC) curve over at least 3 continuous octave bands without exceeding the limits defined by the specified RC curve, ± 2 dB. The following limits shall be maintained:

   a. Corridors RC 35 to 40
   b. Cafeteria/Cafetoriums RC 35 to 45
   c. Classrooms and Laboratories RC 25 to 30
   d. Offices RC 30 to 35
   e. Media center and Music Room RC 25 to 30
   f. Mechanical Rooms and Gymnasiums RC 40 to 50

5. Evaluate systems and building components to comply with criteria.
6. Required design methods for the reduction of sound transmitted by the HVAC system to occupied spaces shall be according to the ASHRAE Handbook, Applications, Chapter Noise and Vibration Control recommendations and as follows:
   a. Do not install air-conditioning equipment in equipment rooms with noisier equipment.
   b. Chiller plant shall be located a minimum of 100 feet from a music teaching area.
   c. Provide AHU fans with internal isolators. Duct connections shall be by means of flexible connections. AHU or filter unit casing shall be isolated from the building structure by means of either rubber pads or spring isolators as required.
   d. Select air-handling equipment for lowest practical sound generation and fan speeds. Show the manufacturer’s sound ratings of selected equipment in equipment schedules.
   e. Use flexible duct connectors to diffusers, grilles, and other air distribution devices.
   f. Avoid locating an AHU room next to noise sensitive areas such as classrooms. If this becomes unavoidable, select AHU for lowest available sound rating.
   g. Locate the first duct branch connection or outlet location at a distance from the unit discharge which, according to ASHRAE’s acoustical considerations, changes in direction and good engineering design practices, assures an acceptable Noise Criteria level. Use ASHRAE and SMACNA recommended, not maximum allowed, velocities in duct systems and at air distribution devices to minimize air noise generation:
      1) Use of higher velocities requires written M-DCPS acceptance on a per condition basis.
      2) Pressure loss through a sheet metal duct downstream of a VAV box shall not exceed 0.08″ of water per 100 feet.
      3) Use double thickness turning vanes at change in direction in supply or return air square/rectangular ducts with minimum side dimensions exceeding 8”.
      4) For Low Velocity duct systems, size ducts at 0.08 inches per 100 feet pressure drop max with maximum velocity at 1,800 fpm. For lined ducts, use a maximum velocity of 1,500 fpm.
      5) For Medium Velocity duct systems, size ducts at 0.3 inches per 100 feet pressure drop max with maximum velocity at 2,400 fpm. For lined ducts, use a maximum velocity of 2,000 fpm.
      6) On systems with variable frequency drives, fan motor HP selection, shall be based on filters being loaded. On constant speed systems, fan motor HP selection shall be based on clean filters.
   h. Seal wall openings around duct perimeters and provide external acoustical treatment when penetrating equipment room walls to reduce sound transmission via the duct or opening.
   i. Provide spring or rubber mounts as required under vibrating pieces of equipment not factory isolated and provide flexible piping connections to them.
   j. The sound generated by an outside or interior installed chiller, air-cooled chiller condenser, or cooling tower shall not exceed 70 dbA at a distance of 30 feet from the equipment and 55 dbA at the property line:
      1) At interior or exterior chillers, cooling towers or air-cooled condensers, a factory approved hush kit and/or other sound attenuation measures, including sound barrier walls, shall be provided to meet the maximum allowed noise levels referenced above.
2) The sound barrier wall shall be tall enough to screen the noise produced by the equipment from all adjacent occupied structures, but in no case shall be less than the height of the top of the equipment.

3) Locate equipment as far as possible from school buildings as well as adjacent off-site construction.

4) See Division 2 for fencing requirements.

k. Follow the industry recommended or required good engineering practices and standards.

I. Pumping And Piping Systems:

1. Provide flow meters at each chiller’s chilled water and condenser water piping. Signal from flow-meter to control device will regulate flow to modulate flow and maximize delta T.

2. Provide automatic valving and chiller bypass piping to maintain lead chiller on line when the minimum system flow is 10% of the system demand.

3. Provide control and isolation valves necessary to allow operation of any chiller with any chilled water pump or any condenser water pump and cooling tower.

4. Chilled water piping systems shall be ASTM A-53 Grade A or B, schedule 40, seamless, black steel pipe made in USA:
   a. Piping 2-1/2" and larger shall be welded with flanges used for valves and other similar appurtenances requiring disassembly for servicing.
   b. Piping less than 2-1/2" shall be screwed with ground joint unions instead of flanges.
   c. Victaulic or similar couplings are accepted for interior aboveground use.
   d. Condenser water piping may be the same as for chilled water piping, except that exterior condenser piping shall be PVC, Schedule 40.
   e. Determine friction drop values and velocity values for steel pipe using the Williams and Hazen formula with C = 100 for “aged pipe” and C=130 for PVC piping.
   f. Size piping with diameters larger than 2 inches at a friction loss equal to 4 feet water head pressure loss per 100 feet of pipe. Pipe velocities shall not exceed 8 feet per second for underground pipes and 6 feet per second for aboveground pipes:
      1) Size piping with diameters 2 inches or less, to not exceed 4 feet per second.
      2) Evaporator and condenser tube velocities inside chillers shall not exceed 12.0 feet per second. Use an evaporator fouling factor of 0.0001 and a condenser fouling factor of 0.00025.
      3) Provide isolated flanged connections for access and connection of a portable chillers and portable cooling towers.

5. Pressure test all piping after installation.

6. Provide necessary accessories at both ends of each piece of equipment, such as flow meters, isolation valves, balancing valves, control valves, flanges or unions, valved pressure gage wells, temperature wells, strainers, valved drains and air vents, dielectric fittings, and all other appurtenances necessary for balancing and maintaining the water side. Arrange piping to allow for the removal and/or service of coils, condensers, evaporators and heat exchangers in general without interruption of service:
   a. Chillers and air handling units shall be provided with thermometers and pressure gauges. Pumps shall be provided with pressure gauges at flanges.
b. Balancing valves 2 inches and smaller shall be a combination circuit setter for two-way, or plug valves with memory stops for three-way valves.

7. Balancing valves 2-1/2 inches and larger shall be butterfly type equipped with memory stop. Automatic flow control valves may be used as balancing valves, not as control valves.

8. Full ported renewable seat ball valves are allowed as shutoff valves for sizes 2 inches and smaller. Butterfly valves may be used as shut-off valves in sizes 2-1/2" and larger.

9. Provide eccentric reducers at pumps suction and concentric at discharge. Provide non-slam check valves on discharge and strainers with blow-off at suction. Suction piping at pumps shall be designed for ease of priming and high, available, net positive suction head (NPSH). Piping creating an air trapped high point at the suction side of the pump shall not be permitted.

10. At all vibrating pieces of equipment provide spring or rubber mounts and flexible piping vibration isolators placed in the horizontal position.

11. Run horizontal piping above the ceiling space as high as possible or in unfinished areas and following the building lines. Underground piping shall be installed in landscaped or asphalted areas. Pressure piping is not allowed under a slab on grade. Runs under courtyards or sidewalks require M-DCPS acceptance on a per condition basis.

12. Isolate underground piping distribution systems at branches 3 inches and larger.

13. Isolate piping at entrance to each building.

14. Piping shall be suitably supported and allow for expansion and contraction of the installed piping, including surrounding insulation. Loops and anchors shall be provided, if necessary. Assume installation temperature to be 92°F db.

15. Vertical piping shall be installed in architecturally finished chases or in unfinished areas such as mechanical rooms. Walls shall not be channeled for installation of piping.

16. Provide manual air vents with shut-off valves at all chilled water piping high points where air will accumulate and not just the single highest point in the loop.

17. Provide taps at each chiller’s chilled water and condenser side, and, at each cooling tower’s condenser piping. Taps shall be provided with sufficiently large ball valve screwed fittings and caps to be able to introduce the flow measuring device without water spillage.

18. Piping drops to chillers and pumps shall be supported from the floor and have floor vibration isolation. Piping drops to air-handling units shall be supported within one foot of the horizontal elbow before the drop.

19. Extraneous piping or equipment shall not be installed inside electrical rooms.

20. In all installations, provide identical parallel chilled or condenser water pumps, each having 50% of its chiller or condenser water flow capacity. Chiller and condenser water installations shall be provided with valved full size chilled water lines piped to the outside of the chiller room and provided with blind flanges suitable for connection to a temporary chiller:
   a. Pump shall be selected so single pump operation shall provide a minimum of 70% of the combined two pumps maximum required flow.
   b. Provide a system friction curve and pump operating curves.
   c. Operating points with a single operational pump and with all pumps operating in parallel shall be indicated in the curves.
   d. Pump motor shall be non-overloading at all operating points.
   e. Provide interlocked motorized butterfly valves to prevent chilled water flows through any unused chiller or to maximize delta T, whenever that possibility exists.
f. Variable speed drives may be used for installations larger than 10 horsepower.
21. Provide horizontal split case double suction pumps for systems 400 GPM or greater. Provide pedestal mounted end suction pumps for all lower flow requirements. All pumps shall have mechanical seals.
22. Bolt pumps directly to a concrete slab or an inertia anti-vibration base according to this Division.
23. Install braided metal flexible connections so movement is not in the axial mode.
24. Show on the pump schedule, service, gpm, total dynamic head in feet of water, NPSH required, Pump efficiency, type of pump, motor horsepower, phase, volts, motor efficiency, and RPM.
25. Pumps shall be bronze fitted.
26. Specifications shall include request for submittal of impeller and trim information demonstrating compliance with Hydraulic Institute guidelines.
27. Provide a chemical feeder that serves the chilled water system.
28. Provide a gate valve, wye strainer, long radius elbow and eccentric reducer at the suction side of each horizontal split case, double suction pump.
29. Provide a concentric reducer, check valve and a balancing cock on the discharge side of each pump.
30. Suction diffusers are allowed for end suction pumps with a 90-degree piping entry.
31. Pipe all drips and drains intended by the pump manufacturer to drain water, away from pump and into floor drains. No water shall be permitted to accumulate on pump, base or supports.
32. Pumps with flanges shall have flanges drilled and tapped for gauges.
33. Provide 2 parallel condenser water pumps each with equal 50% flow requirements and the following:
   a. Size piping using the Williams and Hazen formula with C = 100 for “aged pipe” to allow for corrosion. If using PVC pipe, Use C=130.
   b. Verify NPSH available against pump NPSH required.
34. Equipment installations shall comply with M-DCPS water treatment requirements. See Design Criteria Appendix – Water Treatment.

J. Pipe Insulation:
1. Chilled water piping shall be insulated using the thicknesses and materials as follows:
   a. Interior aboveground except inside chiller room: Provide foamed plastic inserts every 40 feet and at changes of direction with cellular glass insulation.
      1) 1" and smaller: 1" foamed plastic.
      2) 1-1/4" to 2": 1-1/2" cellular glass.
      3) 2-1/2" to 6": 2" cellular glass.
      4) 8" and larger: 2-1/2" cellular glass.
   b. Exterior aboveground or inside chiller room: Increase interior aboveground insulation by one size.
   c. Exterior underground:
      1) 2" thick cellular glass: With expansion and contraction controls as needed.
      2) Optional: Urethane pre-insulated piping system, with factory recommended thicknesses and consisting of seamless black steel ASTM A-53 Grade B pipe, Schedule 40, with foamed-in-place closed cell polyurethane insulation and ASTM D-1784 outer jacket. Seal ends and couplings. Seal and protect piping.
and insulation against moisture intrusion during and beyond installation. Provide concrete anchors at elbows.

2. Provide jacketing for insulated pipe as follows:
   a. Unless otherwise approved in writing by M-DCPS, finish above ground piping exposed to weather with 0.016” thick sealed, aluminum jacket, continuous over pipe, except at valves, and fittings. Install with seam underneath pipe.
   b. Exterior underground jacketing:
      1) For all sizes of urethane piping, use PVC jacketing provided with pre-insulated pipe.
      2) For all sizes of cellular glass piping, use factory applied jacket with field installed joints.
   c. Interior aboveground jacketing:
      1) Concealed: Provide factory applied all service jacket (ASJ).
      2) Exposed fittings everywhere: Provide field applied fabric and mastic finish consisting of 10 x 10 glass fabric embedded in two coats of white breather weather barrier mastic.

3. Note on the drawings the interior or exterior designation of piping installed at areas that might generate different interpretations.
   a. Define interior and exterior design conditions and locations in contract documents to include interior corridor ceilings, exterior or walkway concealed overhangs, and other similar areas.

K. Equipment Selection:
1. Outdoor Air Intakes.
   a. Locate outdoor air intakes on the upwind side of exhaust openings, based on the prevailing summer southeast wind direction, and separated by:
      1) 15 feet minimum from kitchen exhausts and plumbing vents through roofs.
      2) 25 feet minimum from process exhaust.
      3) 36 inches minimum from the finished roof deck.
   b. Intakes shall not exceed 800 fpm velocity through the net louver free area at 100% fresh air to minimize noise pressure drops and rain carry over.
   c. Selection and sizing of outside intake louvers and the management of rain entrainment through them shall be in accordance with ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.
   d. Provide a minimum of one floor drain next to air-handling units in each equipment room. Provide a hose bibb in each large AHU room.

2. Air Filters:
   a. Provide 2” thick MERV 6 throwaway media type air filters with reusable metal frames at air-handling units. Filters shall not contain fiberglass.

3. Air Handling Units and Outside Air Supply Fans:
   a. Air-handling units shall be floor mounted. Air-handling units supported from ceilings or roof structures or accessed by climbing over any equipment are not allowed.
   b. Air-handling units shall be provided with access doors to reach items requiring periodic maintenance. The use of access panels in lieu of access doors for this purpose is not allowed.
   c. Provide adequate service space around unit and in front of access doors for required service to take place.

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Mechnical
Design Criteria

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M-DCPS
1) Show by dotted lines on drawings the clear space allotted for the coil pull out.
2) Arrange chilled water piping to AHU to allow for coil pull out area without shutting system down and with minimal pipe disturbance.

d. Provide each AHU in a VAV system with a ducted outside air supply fan and downstream VAV box or other engineered means acceptable to M-DCPS to maintain a constant outside air supply throughout the AHU’s full range of operation.

e. Air-handling units assembled with filter banks, coils, cabinet fans, plenums, and dampers shall be draw-through type.

f. Air-handling units shall be double wall construction.

g. Condensate drain pans shall have slopes, drains, curb heights, and other indoor air quality design features.

h. Provide one of the following fans designs:
   1) Non-overloading backward curved blade design selected on a stable point of operation of the fan curve.
   2) Forward curved fans for use in VAV systems.

i. Provide hot-dipped galvanized cabinets, fan wheel assemblies, and structural supports.

j. Provide fans with internal factory mounted vibration isolation. If factory internal isolation is not available, provide field installed external floor mounted vibration isolation with adequate structural rigidity as follows.
   1) Cabinet fans, centrifugal fans, and packaged air-conditioning units with fan wheel diameters of less than 15 inches shall be hung or mounted using rubber-in-shear or spring mounted isolators.
   2) Units with fan wheel diameters of 15 to 24 inches shall be mounted on spring isolator rails.
   3) Units with fan wheel diameters over 24 inches shall be mounted on a concrete inertia base with spring isolators.
   4) Units located on a slab with factory mounted internal vibration isolation do not need duplicate external vibration isolation.

k. Select the proper fans for the required operating conditions, economical operation and to minimize fan noise. Limit fan outlet velocity to +/-5% maximum specified duct velocity.

4. Coils:
   a. Schedule heating and cooling coils on the drawings to include:
      1) Service required.
      2) Cubic feet of air per minute.
      3) Maximum face velocity.
      4) Maximum allowable air friction loss.
      5) Entering and exiting air-dry bulb and wet bulb temperature of heating and cooling medium.
      6) GPM for chilled water coils, with entering and leaving water temperatures.
      7) Maximum pressure drop.
      8) Saturated suction temperature for direct expansion coils.
      9) Minimum number of rows.

   b. See this division for indoor air quality and outside air requirements.

   c. Sensible Heat Ratio: Any AHU otherwise meeting the requirements for not being provided with a dedicated outside air coil or preconditioned air, and having a
sensible heat ratio of 0.70 or below, shall be provided with heat pipes, enthalpy wheel, hot gas reheat or other M-DCPS and Florida Energy Conservation Code accepted energy efficient re-heat method to maintain interior design conditions.

d. Cooling coils shall be designed for 45° F. entering chilled water temperature and 55-57° F. leaving chilled water temperature. Higher temperature differentials require M-DCPS written approval.

e. Air leaving temperature from chilled water coils shall be approximately 55° F.

f. Base selection of direct expansion and chilled water cooling units on a maximum of 500 fpm face velocity for the calculated quantity of air passing through the coil.

g. Chilled water or refrigerant shall flow opposite to airflow with the flow entrance at the downstream airside of coil for flow through the rows, for the most efficient heat transfer. Flow shall also enter at the bottom of coils and exit through the top connection to relieve possible air binding.

h. Provide the following for chilled water coil use:
   1) VAV piping system with 3-way mixing valves capable of bypassing the coil upon reaching desired air leaving temperature on constant volume systems. Variable speed pumps for flow controls and 2-way valves may be accepted by M-DCPS on a per condition basis.
   2) Use 3-way two-position valves for constant volume AHU’s equipped with face and bypass dampers.
   3) VAV systems control valves shall be equal percentage type.
   4) Air vents at the top of the return riser.
   5) Gate valves on the supply side of coil section.
   6) Flow indicating balancing type lubricated plug valves with memory stops or circuit setters on the return side of coil section. Ball valves are not acceptable for balancing.
   7) Thermometers.
   8) Pressure gauges with 1/4" bottom connections, shut-off cocks, and vibration snubbers. Pressure gauges shall be liquid filled, read in feet of water and shall have a maximum graduation interval of 2 feet of water.
   9) 3/4" globe valve drain at system low point connected to a floor drain.
   10) Water strainer upstream of control valve and gate, butterfly, or ball valves in the main chilled water supply and return for shut-off and repair of control valve.
   11) Coil size based on a 10° to 12° F. water temperature rise except thermal storage or low temperature air requirements of a special system design.
   12) Coil selection based on a 1° to 2° F. higher supply water temperature than the chiller set point capacity, but not lower than 45° F.
   13) Two-way or three-way valve sizes shall not be more than 1 size smaller than the coil’s size. Reduce piping at the control valve, and increase immediately thereafter to reduce again at the coil. Control valve pressure drop shall not exceed 50% of the pressure drop of the branch or coil.

i. Provide the following for direct expansion systems:
   1) Minimum steps of capacity controls
   2) Individual suction risers with oil traps as required by the refrigerant.
   3) Stop valves, strainers, solenoid valves, and external equalizing thermal expansion valves at liquid lines.
   4) Isolation valves at each DX piece of equipment for ease of maintenance.
5) Sight glasses installed upstream of thermal expansion valves to observe premature flashing conditions.
6) Filter dryer in suction line.
7) Pump down system as recommended or used by the system manufacturer.
8) Intertwined coils whenever that option is available for the size of the unit.
9) Specify use of a factory installed M-DCPS approved corrosion protective coating not less than 25 microns thick for evaporator and condenser coils.

j. Chillers shall be provided with the manufacturer’s recommended access area fronting required maintenance spaces and removable panels for maintenance access. Show by dotted lines on floor plans the clear space allotted for the coil pull out.
k. Evaporator and condenser coils shall be provided with a corrosion protective coating per M-DCPS Design Standards. Black fin coating or polycoat is not allowed.
l. Evaporator coil shall have a maximum of 10 fins per inch.

5. Air Duct Design:
a. Supply, return, and outside air shall be ducted. Return or outside air plenums are not allowed. Ductwork shall not be installed on outside walls or roofs of the building.
b. Ductwork shall be galvanized steel designed and constructed according to required or recommended SMACNA standards:
   1) At all pressure classifications, seal seams at supply, return, exhaust, and outside air ducts according to SMACNA Seal Class A using an accepted sealant.
   2) Pressure indicating flags as required by SMACNA shall be used in the drawings.
   3) Duct tape shall not be used as a sealant.
c. Use velocities and pressure drops as noted elsewhere on this document.
d. Make all turns on ducts with both dimensions less than 8 inches with radius elbows. Rectangular elbows with double thickness turning vanes may be used for ducts having both dimensions greater than 8 inches.
e. Provide opposed blade dampers at outlets and provide volume dampers for duct branches not having VAV boxes to allow for proper air balancing:
   1) Dampers shall be stable under operating conditions.
   2) Damper shafts shall be supplied with extensions to properly clear the 2-inch thick insulation and be supplied with memory stops.
   3) Provide medium duty quadrants.
   4) Dampers at air-handling unit rooms, outlets, and branch ducts where the total static pressure is more than 0.5 inches or with any dimension over 12 inches shall be opposed blade.
   5) Damper stems shall be installed parallel to the duct run.
   6) Splitter dampers are not allowed.
   7) Provide access door for large opposed blade dampers.
f. Specifications shall require the contractor to provide duct system fabrication shop drawings at a minimum 1/4 inch scale.
g. Supply and return ductwork shall be sealed and insulated with a 2-inch thick, 1-1/2 pound density fiberglass insulation blanket. Insulation shall comply with the following:
1) Design duct insulation to comply with FBC and FECC. Provide minimum R-6 value.

2) Ductwork located in mechanical equipment rooms and above ceilings shall be insulated

3) Insulation shall be sealed with a continuous Kraft paper vapor barrier on the outside, to prevent moisture intrusion and condensation.

h. Outside air ducts shall be insulated with external rigid insulation to prevent internal condensation.

i. Branches shall not be designed or installed with extractors or scoops:
   1) For rectangular ducts, provide for 45 degree entry tee according to Figure N. Page 14.37 of the SMACNA HVAC Systems Duct Design 1990 – Third Edition.
   3) Branch dampers shall not be placed so part of the damper intrudes into the main duct’s air stream.
   4) Branch damper stems shall only be placed in the horizontal position.

j. Design the duct system for accessibility and ease of maintenance and balancing:
   1) Provide for adequate access to each damper and balancing device.
   2) Access doors shall be the hinged type with locking handle.
   3) Access plates with sheet metal screws or any access requiring disassembly are not allowed.

k. Provide fire, smoke and opposed blade balancing dampers with access doors. Locate access doors only on the bottom of the duct:
   1) Recommended or required NFPA 90A sizing and accessibility requirements shall be followed.
   2) Access doors are required for fire dampers connected to flexible duct connectors. Extend fire damper sleeve to allow for installation of access door.
   3) No accessibility claim shall be made for the disconnection of flexible duct.

l. Mechanical equipment rooms are not required to have fire rated construction, unless adjacent to fire rated conditions. There are no fire damper requirements for ductwork penetrating these walls, unless the walls, floor, ceiling or roof slab are otherwise required to be fire rated.

m. Fire dampers are required for ductwork penetrating fire rated assemblies.

n. HVAC ductwork for M-DCPS projects, including portable classrooms, shall be non-combustible metal. Ductwork shall be designed, fabricated, and installed to comply with ASHRAE and SMACNA recommended and not maximum allowed requirements.

o. Provide round ductwork whenever possible.

p. Rectangular ductwork velocities shall be less than 1600 feet per minute for classrooms and administrative areas and less than 1000 feet per minute for media centers and auditoriums. Higher velocities require written M-DCPS acceptance on a per condition basis.

q. Size conditioned air ductwork using maximum recommended velocities, not maximum allowed velocities, according to SMACNA and ASHRAE. And as specified herein before.
r. Use the minimum recommended velocity for TV studios, media centers, and other sound sensitive areas.
s. Comply with required room noise criteria curve requirements and provide a means of sound reduction. See ASHRAE for additional guidelines. Electronic measures for sound wave cancellation are allowed.
t. Limit distances to 6 feet minimum to 10 feet maximum length for flexible ducts. Avoid kinks, support from structure above, and if necessary where space is limited provide a sheet metal elbow at the register. Flexible ducts shall be continuous in length. Splices are not acceptable.
u. Locate fire damper access doors at the bottom of the ductwork for easy access.
v. Do not use exposed ductwork in student occupied spaces unless necessary and accepted by M-DCPS on a per condition basis. Exposed duct shall be internally lined.
w. Provide accessible access doors in the bottom of ductwork for maintenance of fire dampers, smoke dampers and opposed blade dampers.
x. Provide opposed blade dampers at:
   1) Dampers with a dimension greater than 12 inches.
   2) Supply, return or exhaust air register outlets.

6. Air Distribution Devices:
a. Use accepted design practices to select supply grilles and diffusers to provide adequate air distribution for an adequate learning environment. Coordinate outlet and diffusers locations with the lighting layout.
b. Registers serving VAV systems shall be limited to a maximum of 350 CFM each unless accepted in writing by M-DCPS on a per condition basis.
c. The use of perforated type diffusers is not allowed in VAV systems. Use the louvered type.
d. Diffusers shall be sized to fit a 2 foot x 2 foot ceiling grid whenever a lay-in type ceiling is used.

7. Return and Exhaust Air:
a. Ductwork and Plenums:
   1) Return ducts and shafts shall be sized for a maximum 1600 feet per minute velocity.
   2) Provide angle iron reinforcing to prevent buckling due to negative pressure, at fan inlet ducts per recommendations of SMACNA.
   3) Return ceiling plenums and shafts are not allowed by M-DCPS.
   4) Prevent fan noise entering rooms by following ASHRAE guidelines between fan and returns or use electronic sound wave cancellation, if feasible.
   5) Fiberglass duct-board is not allowed.
b. Registers and grilles shall be sized not to exceed RC 35 noise criteria:
   1) Provide a schedule with size, manufacturer, and type of supply, return and exhaust air registers.
   2) Provide insulation at back surface of registers in attics or any other non-conditioned spaces.
   3) Select diffusers to provide adequate air motion throughout space served.
c. Provide motorized dampers and bird screens at exhaust systems as required by FBC.
d. Exhaust fans up to 1250 CFM, to be direct drive with integral variable speed switch. Fans above 1250 CFM to be belt driven.
Special exhaust fan requirements shall comply with FBC and other applicable codes and include the following:

1) At the science lab emergency exhaust: Provide galvanized ductwork.
2) At fume hoods: Provide stainless steel ductwork and fans and housings with chemical resistant metals, plastics, or coatings. Emergency exhaust ductwork shall be galvanized steel.
3) At kilns: Provide fans with forced vented motor compartments and high temperature resistant construction.
4) At paint spray booths: Provide fans with non-sparking wheels and drives and explosion-proof motors as required by NFPA.
5) At dust and sawdust collection systems:
   a) Provide material handling fans and equipment with self-cleaning air-pulse filters.
   b) Locate equipment in mechanical rooms or provide security fencing if at an exterior location.
   c) Shaker type self-cleaning bag-house filters are not allowed.
   d) Do not connect collection systems to air-handlers. Exhaust to the exterior or have HEPA filtering before re-circulating.
6) At clothes dryers:
   a) Provide roof exhaust vents or wall exhaust vents, if not next to patios, walkways, or other circulation areas.
   b) Provide a full size exhaust kit for each laundry dryer, complete with inline filter, flexible hose and painted metal weather resistant, wall or roof cap. Increase the total exhaust run one pipe size for exhaust lengths of 16 feet or if more than two elbows are used. Provide an in line fan for longer runs.

8. Cooling System:
   a. Refrigerant selection shall take into consideration environmental safety issues. Specify the following M-DCPS accepted refrigerants:
      1) HFC – 134a.
      2) HFC – 410A.
      3) The use of any refrigerant, other than what is indicated above, including R123, requires on a per project basis, prior written approval from M-DCPS Office of Facilities Design and Standards. If being considered, A/E must demonstrate the costs and justify the benefits of using other regulated refrigerants.
   b. Direct expansion (DX) systems, consisting of an evaporator, a compressor, expansion valves, an air or water cooled condenser, accessories and possibly a cooling tower shall be used if proven feasible by LCCA and accepted by M-DCPS. A multistage or infinitely variable compressor shall be used when available.
   c. Chilled water systems, easily adjustable for capacity control and consisting of centrifugal, screw, or scroll chiller compressors shall be used in the recommended load ranges in this division:
      1) Provide integrated partial load performance evaluation.
      2) Provide parallel flow piping.
   d. Cooling Towers:
      1) Cooling towers shall only be used for systems sized at 200 tons and larger. Towers less than 200 tons may only be used for replacement of existing
towers. Life Cycle Cost Analysis shall determine the feasibility of complying with this guideline or of retaining existing Cooling Tower. Verify that new Tower will be supported by the existing structure without major modifications.

2) New cooling towers shall be provided with the following items in their domestic water make-up lines:
   a) A reduced pressure backflow preventer having a 1-1/2" minimum size, and including proper supports and manufacturer provided valves.
   b) A Water and Sewer Department (WASD) approved sub-water meter used to deduct the sewer charge portion from the cost of the domestic water used by the cooling tower.
   c) The reduced pressure backflow preventer and the sub-water meter shall be located near the cooling tower, be WASD approved and each shall be sized for a pressure drop of not more than 10 psig and 2% of the condenser water flow.
   d) Replaced cooling towers shall be provided with all items noted above unless they already exist, and are in good working order.

3) Tower manufacturer shall be a member of the Cooling Technology Institute (CTI) and tower thermal performance certified by CTI.

4) Cooling towers shall be of stainless steel construction.

5) Each cooling tower fan motor shall be provided with a variable speed drive in order to achieve a “soft” start and for low energy usage. Two speed motors are not allowed.

6) Cooling tower total system sizes:
   a) For 200 tons or less, use a single cooling tower.
   b) For 200 to 400 tons, use a two-cell tower of equal size. Multi-cell towers shall not have condenser water bypass go through the non-working cell. Basins shall be able to be isolated from the non-working side.
   c) For over 400 tons, use two independent equal sized towers.

7) Provide full sized flanges in the condenser water supply and return piping between the cooling tower shut-off valves and the condenser water pump suitable for temporary emergency connection of a portable tower at all single tower installations:
   a) Flanged connections shall be accessible for hooking up to the hose or temporary piping connections of the portable cooling tower.

8) The total tower capacity shall be 35% larger than the chiller capacity to account for compressor rejection heat load.
   a) Cooling towers shall be direct drive.
   b) Design for 80° Fwb conditions, 91° Fdb and maximum 86° F. condenser water supply to guarantee full capacity from the chiller at any wet bulb conditions and provide allowances for fouling.
   c) Whenever a cooling tower serves a screw chiller that contains no oil pump, provide an automatic 3-way valve for the condenser water to bypass the cooling tower in order to maintain the chiller’s oil temperature warm enough for its circulation.

9) Cooling Tower Location:
   a) Locate the cooling tower with an appropriate architectural visual screen, above the chiller plant, or at grade level.

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b) Locate tower at least 30 feet away from any buildings.

c) Fan discharge shall be at least 30 feet from any fresh air intake, including generator room.

d) Provide tower with a louvered enclosure. If tower is installed at grade level, provide an 8-foot high chain link fence and a lockable 3-foot wide gate. Locate fencing at least 10 feet away from the tower or any tower pump or accessory.

e) Locate away from standing water, rain water leaders, over-flow scuppers, drains, and any other possible sources of contaminants.

f) Minimize noise to adjacent buildings and properties. Noise levels shall not exceed 70 dbA at 30 feet from cooling tower and 55 dbA at any property line. Provide sound attenuation to meet the noise level requirements.

g) Locate at least 100 feet away from parking areas to minimize staining. Unless otherwise approved by M-DCPS in writing on a one time basis.

h) Consider leakage and wind-spray (carry off) to minimize building staining.

10) Provide platforms, guardrails, ladders and safety cages as required by OSHA and as necessary to service and maintain cooling tower equipment. The platform and guardrail on the cooling tower fan deck perimeter may be omitted when cooling towers are designed by the manufacturer to be serviced from the inside and are equipped with factory installed interior work platforms and permanent ladders.

11) Connect cooling tower drain lines to the sanitary system according to DERM requirements.

12) Painting is required for all metals not stainless steel or hot dipped galvanized after fabrication such as condenser water piping, domestic water piping, valving, piping supports, electrical conduits and boxes. Coordinate with Division 5 – Metals and Division 9 – Painting.

c. Water Treatment:

1) Prior to the completion of the mechanical design, A/E shall request M-DCPS to test the water source to be used for all water-based air conditioning systems. When the supply water has a hardness content of 180 PPM or higher the A/E shall include a water softener system in the design. The requirement for water softener system will typically be determined by M-DCPS facilities.

2) Provide condenser water treatment with submerged sensor controlling bleed and chemical dosage into cooling tower water by measuring water conductivity and the following:

a) A cooling tower T.S. controller with a 0 to 90 minute timer.

b) Flow controller.

c) Biocide timer.

d) Injection manifold.

e) Chemical feed pumps.

f) Bleed-off valve.

g) Pre-cleaning and cleaning of tower and chilled or hot water closed loop systems as specified.

3) Provide chilled and heating hot water treatment with an all steel bypass pot type feeder.
4) For new projects, water treatment shall be provided for the full warranty period and not less than 1 year.
   a) Review test results for approvals.
   b) Contact M-DCPS Facilities Operations, Maintenance for additional information and see Design Criteria Appendix.

9. Heating System:
   a. The following, but not limited to, equipment shall be considered for heating and as described in HVAC System Selection, this Division:
      1) Air VAV system with strip heaters.
      2) Modified multi-zone or single zone units.
      3) Strip heaters.

10. Controls:
   a. Provide HVAC direct digital controls and HVAC automation according to Division 13 of the Design Criteria.
   b. See Operational Sequences in Division 13 for Energy Management System (EMS) regarding lighting, HVAC and ventilation systems. Operating sequences descriptions shall be made part of the construction documents.

L. Existing School Retrofit:
1. Use of available chilled water for small air-handlers may be accepted at instructional spaces by M-DCPS on a per condition basis:
   a. Several instructional spaces may receive in order of preference, a VAV system, or constant volume system and a roof-mounted unit or other system as determined by LCCA and approved by M-DCPS.
   b. Noise levels shall be according to Acoustical Consideration’s paragraph in this division.
2. Instructional spaces and non-instructional areas may receive split direct expansion or packaged DX units if chilled water is not available. Roof mounted DX package units may be used if approved on a per condition basis. DX units may be reverse cycle if available.
3. Provide heating with electric strip heaters mounted at the unit, in the duct or at the VAV boxes.
4. Non-instructional spaces areas shall receive central station single zones or multi-zone units with face and bypass dampers if chilled water is available. Roof mounted units shall be installed if equipment rooms are inadequate or non-existent.
5. See this division for HVAC System Selection for central plant requirements.

END OF DIVISION