



RAPID TRANSIT SYSTEM EXTENSION  
COMPENDIUM OF DESIGN CRITERIA

VOLUME II  
STATION DESIGN CRITERIA

CHAPTER 5  
MECHANICAL DESIGN CRITERIA

INTERIM RELEASE  
REV 1

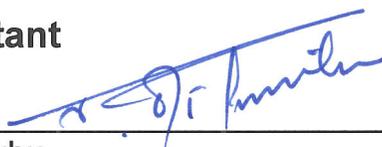
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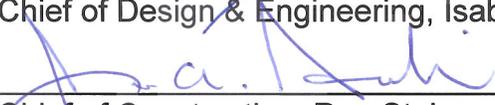
VOLUME II - STATION  
CHAPTER 5 – MECHANICAL DESIGN CRITERIA  
REVISION 1

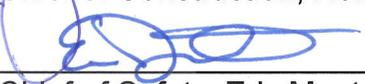
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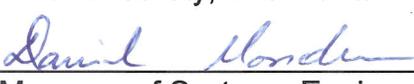
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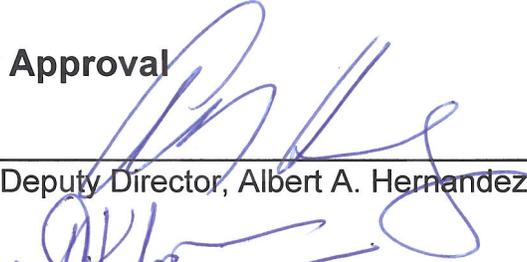
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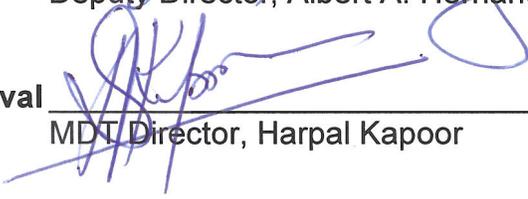
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DOCUMENT REVISION RECORD

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1	10-30-08	Revisions to incorporate MIC-EH design specifications that have been adopted by MDT.

ISSUE NO.	SECTIONS CHANGED
1	No changes were made to this chapter in this revision.

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## **5.01 GENERAL**

### **5.01.1 SCOPE**

These criteria describe the functional requirements, operation and control and shall govern the design of the mechanical element subsystems for the elevated stations and at grade ancillary facilities of the Miami-Dade County System. The criteria prescribed herein set minimum standards which must be adhered to by the Section Designers, however, if higher standards can be achieved without increased life cycle cost, consideration shall be given by MDT to implement the higher standards.

Mechanical subsystems are as follows:

- Heating, Ventilating and Air Conditioning
- Plumbing
- Building Management System (BMS)
- Fire Protection

These criteria are intended to promote uniformity of design and standardize the type of equipment used and its location throughout the system.

### **5.01.2 CODES AND REGULATIONS**

The current adopted version of the codes, standards and regulations shall apply, and unless otherwise directed, all addenda, interim supplements, revisions and ordinances by the respective code body shall also apply. Where conflicts exist between these, the more stringent requirement shall take precedence, unless otherwise directed by MDT.

- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
- American National Standards Institute (ANSI)
- National Fire Protection Association (NFPA)
- Occupation Safety and Health Administration (OSHA)
- ANSI 117.1 Specifications for the Physically Handicapped
- Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
- National Electrical Code (NEC)
- Air Conditioning and Refrigeration Institute (ARI)
- Air Moving and Conditioning Association, Inc. (AMCA)
- Underwriters' Laboratories, Inc. (UL)
- Federal Specifications (FS)
- American Water Works Association (AWWA)
- American Welding Society (AWS)
- American Society for Testing and Materials (ASTM)
- Instrument Society of America (ISA)
- Air Diffusion Council (ADC)
- Associated Air Balance Council (AABC)
- American Iron and Steel Institute (AISI)
- Dade County Fire Prevention and Safety Code
- Dade County Public Works Manual
- Local Ordinances

### **5.01.3 INTERFACE DEFINITION AND CONTROL**

The design and construction of all the mechanical element subsystems shall entail close coordination with a number of other system elements. In every

case of system element interface, that interface shall be defined, controlled and changed only by MDT. Subsystem interfaces within each mechanical element subsystem shall be defined and controlled in the design process by MDT.

#### **5.01.4 MECHANICAL DESIGN**

Of particular concern is the need for efficient utilization of energy and maintainability. The mechanical element subsystem shall be designed to use energy efficiently while maintaining acceptable thermal environmental conditions at economically justifiable cost. The design of the mechanical element subsystem should emphasize simplicity of layout and control features as well as the utilization of standard components to the fullest extent possible. Building services should be designed with minimum accepted clearances as shown on standard or directive drawings and located as centrally as possible to shorten runs and reflect economies in both construction and operation. Products for this project shall have been installed and satisfactorily performed on similar applications.

#### **5.01.5 ENERGY CONSERVATION**

The design of the mechanical element subsystems must comply with the requirements of ASHRAE Standard 90.1 wherever possible.

#### **5.01.6 EXPOSED PIPING**

Water, sanitary or drainage pipes shall not be permitted in electronic, battery, electrical, elevator or escalator spaces except as required to serve that specific equipment.

## 5.01.7 CORROSION CONTROL

Particular attention shall be paid to the presence of dissimilar metals electrically in contact in a conductive fluid. Where the interconnection of different metals is necessary, they shall be electrically isolated using approved dielectric materials.

Material selection shall be submitted to MDT for approval.

Mechanical systems shall be protected using approved methods as outlined in Chapter 4, Section 4.05.

### 5.01.7.1 Access For Inspection

All equipment which may be subject to corrosion, or may require periodic maintenance, shall have reasonable access for inspection.

### 5.01.7.2 Nonmetallic Materials

In some instances, metallic and nonmetallic materials shall be acceptable alternatives for the same service. As a rule, preference should be given to the non-metallic material, if its durability is approximately equal to the metallic material.

Plastic materials shall be made to the pertinent Society of Plastic Industry and/or ASTM standards, where applicable.

### 5.01.7.3 Buried Piping

All buried metallic pipe shall be coated and cathodically protected.

#### 5.01.7.4 Pipe Anchor Rods

All metallic anchor bands, tie rods, anchor rods, bolts and nuts utilized for assembly of buried ductile iron or cast-iron pipes shall be coated with a cold-applied bitumen coating intended for underground service.

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## **5.02 HEATING, VENTILATING AND AIR CONDITIONING (HVAC)**

The design of HVAC subsystems for facilities shall be based on ASHRAE 90.1 and ASHRAE, Handbook of Fundamentals. For air conditioning systems, provide 5% design safety factor.

### **5.02.1 OUTDOOR DESIGN CONDITIONS**

Summer:	90 F dry bulb
	79 F wet bulb
Winter:	45 F dry bulb

These conditions are in accordance with the latest U. S. Weather Bureau 10 year average data for Miami.

### **5.02.2 INDOOR DESIGN CONDITIONS**

5.02.2.1 The indoor environmental design conditions shall be 76 F for summer and 70 F for winter. Additional design parameters are described in Table I - DESIGN FOR STATIONS.

5.02.2.2 Cooling and heating loads shall be calculated in accordance with ASHRAE to meet the environmental requirements shown in TABLE I -DESIGN FOR STATIONS. Full consideration shall be given to the heat dissipated from mechanical and electrical equipment within the spaces to be conditioned.

**TABLE 1 – DESIGN FOR STATIONS**

	Design Conditions		RH % (Max)	Min. No. of Air Changes per Hr.	OA (min)	No. of People	Vent. Type (A*)	Filter Type (B*)	Control Type (C*)	Space pressure type (D*)
	Winter F (Min.)	Summer Fdb (Max.)								
Ancillary Areas Revenue	65	104		10	100%		E		1	-
Maint. Storage	65	104		10	100%		E		1	-
Trash	41	104		20	100%		E		1	-
Janitor	65	104		20	100%		E		1	-
TC & C	65	80	80		30 CFM	2		1	4	N
Battery	65	78	60		30CFM			2	4	N
Elec.	65	104		10			E		3	-
Mechanical	50	104		10	100%		E		3	-
Toilets (WC)	65	104		20	100%	1	E		2	-
Elev. Mach.	65	78			30 CFM			2	4	N
Elec. Equip.	65	104		10	100%		E	2	3	-
Traction Power Substation	50	104	90	10	100%		S	1	3	N
Gap-tie Station	50	104	90	01	100%		E	2	3	-
Dispatcher's	72	80			15 CFM	1		2	6	N
Station Attendant's Booth	72	80			15 CFM	1		2	6	N
Emergency Generator Room										

5.02.2.3 Notes For Table 1 - DESIGN FOR STATIONS

- A. Vent Type: S = Supply  
E = Exhaust

- B. Filter Type:
  - 1. Manual Roll Filter
  - 2. Throw away
- C. Control Type: Ventilation
  - 1. Switch with light
  - 2. Continuous
  - 3. CoolingHeating and Air Conditioning
  - 4. Cooling
  - 5. Heating
  - 6. Heat-Off-Cool
  - 7. Off-Fan-Cool
- D. Space Pressure + = Positive  
Relative To N = Neutral  
Ambient - = Negative

#### 5.02.2.4 Ventilation Rate

Ventilation rate shall be as indicated in TABLE I - DESIGN FOR STATIONS, with a minimum of 10 air changes per hour or maximum 10° F temperature rise, whichever is greater.

#### 5.02.3 EQUIPMENT REQUIREMENTS

For equipment selection, consideration shall be given to standardization, maintainability, noise and durability. Equipment selected shall be manufacturer's standard and cataloged product suitable for competitive bidding. Equipment shall meet the applicable requirements of Section 5.01 and shall bear the ADC, AMCA, ARI and UL labels where available. Equipment shall be selected and installed in accordance with the

requirements in Section 5.02.17 Noise and Vibration Control. Refer to TABLE I-DESIGN FOR STATIONS for indoor conditions and mechanical standard or directive drawings for system layout.

## **5.02.4 HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT**

### **5.02.4.1 General**

The design concepts for HVAC are shown on the mechanical standard drawings and are described herein. The equipment shall be designed in accordance with these concepts and the design criteria described in Sections 5.01.1 and 5.01.2 above.

### **5.02.4.2 Station Attendant Booth**

This area shall be provided with heating and air conditioning by means of an independent air conditioning unit.

### **5.02.4.3 Ancillary Spaces**

Heating, ventilation and air conditioning shall be provided to the areas of the ancillary space as indicated in the TABLE I – DESIGN FOR STATIONS and as shown on the mechanical standard drawings. The air conditioning equipment shall consist of an air handling unit equipped with a centrifugal fan, direct expansion cooling coil sections, manual roll filter section and outside and return air mixing plenum; supply and return duct work, insulation as applicable, fire dampers, controls and accessories. Remote air cooled condenser shall be provided for each compressor. Two motor driven reciprocating compressors shall be installed within the mechanical equipment room.

Ventilation for spaces indicated on the mechanical standard drawings shall be by means of fans equipped with bird screens, fire dampers and controls as applicable. Fire dampers shall be provided with fire rating appropriate to the structure penetrated.

## **5.02.5 OUTSIDE AIR REQUIREMENTS**

### **5.02.5.1 Air Conditioned Spaces**

Supply 15 CFM/person or 10 percent of the total CFM, amount of air supplied, whichever is greater. Where practical, shut off outdoor air, with motorized damper during periods of non-occupancy, controlled by time clock or Building Management System (BMS) schedule.

### **5.02.5.2 Non-conditioned Spaces (Ventilation)**

One hundred percent outside air. Intake in excess of 1000 CFM shall have bottom opening as far above finished grade as practical.

## **5.02.6 STAND-BY VENTILATION**

On air conditioning, where practicable, provide manually controlled, 100 percent outside air capability without cooling for alternate mode of operation. Provide suitable air relief.

## **5.02.7 LIGHTING LOAD**

In calculating air conditioning loads, if information is not available regarding the load attributable to lights, the calculation shall be based on ASHRAE 90.1. plus one watt per square foot receptacle load, if applicable.

## **5.02.8 POPULATION**

For people load refer to TABLE I - DESIGN FOR STATIONS.

## **5.02.9 FANS**

### **5.02.9.1 General**

Fans shall be rated in accordance with the latest revisions of AMCA Standard 210 "Test Code for Air Moving Devices". Where practical direct driven fans are preferred.

Sound power level rating of fans shall comply with the latest revision of AMCA Standard 301, "Method of Publishing Sound Ratings" and shall be the result of tests made in accordance with AMCA Standard 300 "Test Code for Sound Rating of Air Moving Devices". Fans shall be provided with open mesh OSHA belt guards, vibration isolation, hangers, frames or bases, flexible connections, where applicable, and shall be located for easy service. Provision shall be made for easy shaft replacement and service.

### **5.02.9.2 Battery Room Fans**

Fans shall be direct drive and spark resistant. Motors shall be totally enclosed and out of the air stream. Fans shall run continuously and be connected to the same power supply as the battery chargers. Malfunctions shall be indicated at the Supervisory Control Center.

### **5.02.9.3 Centrifugal Fans**

Fans shall be backward curved, having continuously rising and non-overloading power characteristics.

#### 5.02.9.4 Propeller Fans

Fans shall be direct or belt driven and provided with a wire mesh guard completely surrounding the fan blades. Fans shall be supplied with appropriate motor actuated discharge dampers, where applicable.

#### 5.02.9.5 Roof Fans

Fans shall be direct or belt driven, complete with weatherproof housing, made of aluminum and arranged in such a fashion that they are easily serviced. Fans shall be mounted on a prefabricated, aluminum insulated, roof curb. Curb shall be supplied by the fan manufacturer.

### **5.02.10 AIR CONDITIONING EQUIPMENT**

#### 5.02.10.1 Coils

Coils shall be provided for air conditioning applications as part of a factory fabricated unit, and readily replaceable. Coils shall be of the extended-surface type, fabricated of copper tubing not less than 5/8-inch diameter. Coils shall have copper helical or plate fins. Coils shall not exceed 10 feet in length. Fin spacing shall not be more than 12 fins per inch of tube. Coils shall be of the serpentine type, with copper headers. Coil shall be tin-lead dipped after fabrication, and shall have distributors arranged to insure even distribution of refrigerant to all circuits. Joints in the refrigeration system shall be silver brazed.

#### 5.02.10.2 Refrigeration Compressors

Refrigeration compressors shall be of the hermetic, or semi-hermetic direct belt driven, reciprocating or scroll type. Compressors shall be selected for operation with refrigerant 22, 134 or 410 and shall operate at speed of no more than 1750 RPM.

#### 5.02.10.3 Design Capacities

Maximum coil face velocity: 550 FPM. Coils shall be certified in accordance with ARI Standard 410.

#### 5.02.10.4 Air Cooled Condensers

Condensers shall be air cooled consisting of casing, coil, fan, motor, piping and controls suitable for outdoor installation. Condensers shall be designed for minimum two degree sub-cooling circuit and shall safely hold complete refrigerant charge.

#### 5.02.10.5 Air Handling Unit (AHU)

Air handling units shall be designed for 40 year life. The AHU shall be factory manufactured, assembled and tested as a unit complete with galvanized steel or aluminum structural members, double wall insulated casing and easily removable access panels. The same manufacturer shall supply, install and test the fan, coil, coil casing, and stainless steel drain pans. Cooling coils shall be split and provided with independent drain pans. The fan shall have air foil, backward inclined blades, internally spring mounted with integral motor base and flexible connection to casing.

5.02.10.6 Condensers shall be selected based on a continuous circuited duty operation, for high reliability and ease of maintenance and replacement.

5.02.10.7 Roof mounted equipment shall be anchored to withstand a 150 MPH wind.

## **5.02.11 FILTERS**

### 5.02.11.1 General

Filters shall be provided for ventilating and air conditioning air handling units as shown on the mechanical standard and directive drawings. Filter efficiency rating shall be based on the ASHRAE Standard 52. Maximum velocity permitted through the net filter area will be 500 FPM. Media shall be easily replaceable, without obstacles. All filters shall be UL Class type 1.

### 5.02.11.2 Roll Filters

Manual roll filters shall be provided with an efficiency of not less than 35 percent per ASHRAE STANDARD 52. Filters shall have a low initial pressure drop of 0.3. Design for final pressure drop of not more than 0.5 inch w.g. with dirty filter.

Rolls of filter media shall be standardized with a minimum length of 65 feet, by 4 feet wide.

### 5.02.11.3 Filter Gauges

Filter gauges shall be provided on each filter subsystem. Differential pressure gauges shall indicate design operating range in green and over design in red.

## **5.02.12 AIR DIFFUSERS, REGISTERS, GRILLES AND LOUVERS**

### 5.02.12.1 Diffusers and Registers

Supply air diffusers and registers shall be ADC certified, constructed of aluminum, selected to provide the required throw and spread in accordance with ASHRAE recommendations. Terminal velocity at walls, obstructions, or in occupied areas shall not exceed 50 FPM for air conditioning or 100 FPM for ventilation. Registers shall be provided with adjustable double-deflection

blades and opposed-blade adjustable volume dampers, where appropriate. Volume dampers shall be key operated through the face of the register. Extractors and splitter dampers shall be provided for balancing in accordance with SMACNA.

#### 5.02.12.2 Grilles

Exhaust and return air grilles shall be sized for maximum velocities of 500 FPM (free area) and shall be equipped with fixed blades or louvers. If the duct behind them is visible, the duct shall be painted flat black. Multiple grilles on one duct system shall be equipped with locking balancing devices. Transfer grilles and transfer louvers shall be sized for maximum velocity of 250 FPM (free area) and shall be equipped with fixed, non-see-through blades. Where necessary, provide appropriate sound attenuation.

5.02.12.3 Stationary louvers shall be capable of passing 700 FPM, free area velocity, with less than .2 inches of water gauge pressure drop and shall carry over less than .03 ounces of water per square foot during a 15 minute period when tested in accordance with AMCA Standard 500. Test criteria shall be based on a 48 inch square sample.

#### 5.02.12.4 Finishes

Air diffusers, registers and grilles & louvers shall be constructed of extruded anodized aluminum.

### **5.02.13 PIPE, PIPE FITTINGS, SUPPORTING DEVICES, VALVES AND ACCESSORIES**

#### 5.02.13.1 General

Piping shall be designed to meet the requirements of the code for Pressure Piping, ANSI B9.1, and SFBC.

Piping shall be designed and arranged for neat appearance, properly sloped for oil return, drainage and venting. Piping, valves and accessories shall be designed for installation in a systematic manner and in places accessible for operation and service without the use of chains or additional operating platforms. Sleeves shall be provided wherever piping passes through structures. Piping shall be arranged to facilitate removal of coils, servicing and replacing components. Condensate drains shall be provided with plugged tees and crosses for accessible cleanout.

Refrigerant piping shall be silver brazed while being purged with a neutral gas and pressure tested with refrigerant and dry nitrogen in accordance with ANSI B9.1. Before charging, evacuate to a maximum of 500 microns.

#### 5.02.13.2 Accessories

Piping accessories shall be provided. These accessories shall include: valves, strainers, vent cocks, dirt and drip legs with drain and flush connections, refrigerant driers, vacuum breakers, backflow preventers, shock absorbers, water hammer arresters, liquid flow and moisture indicators, balancing cocks, relief valves; and means to check pressure, flow and temperature. Piping accessories requiring maintenance or replacement shall be located in places accessible from the floor. Dials of gauges and indicators

shall be of sufficient size and arranged so as to be easily read from the operating floor.

#### 5.02.13.3 Supports, Hangers, Guides and Anchors

Pipe supports, hangers, guides and anchors shall be designed to assure proper alignment of pipes during operating conditions. All components shall be designed to support the weight of fluid, pipe, valves and insulation. Hangers and supports shall be arranged to prevent the transmission of vibration from piping to the structure. Anchors and guides shall be designed to allow pipes to expand and contract without excessive stress.

#### 5.02.13.4 Flexible Pipe Connectors

Flexible pipe connectors shall be used as necessary. They shall be of sufficient length to provide an overall stiffness less than that of the resilient mounts used for supporting the equipment. Flexible pipe connectors shall be rated for pressure requirements of the system in which they are installed.

#### 5.02.13.5 Pipe Expansion

The use of pipe expansion joints shall be avoided wherever possible. Pipe systems shall be arranged to have sufficient offsets to accommodate thermal expansion and vibration. Where pipe expansion loops are impractical, pipe expansion joints may be used subject to MDT approval.

#### 5.02.13.6 Valves

Valves shall be located to give a neat appearance and grouping, with all parts accessible for operation and maintenance. Valves and unions shall be required for convenient service of pumps, water heating and cooling coils and similar devices. Valve stems shall be installed horizontally where possible. To

the extent possible, components shall be of one manufacturer throughout any one facility to facilitate the standardization of parts inventory.

#### **5.02.14 ACCESS DOORS**

5.02.14.1 Access doors shall be provided in ducts, ceilings, walls and plenums to enable servicing of duct heaters, coils, fire dampers, valves, instruments, and so forth. Access doors shall be hinged and when large enough for a person, shall be furnished with latches operable from both inside and outside. Doors shall seal against elastomeric gaskets and shall be fastened with cam latches. Access doors, exposed to public view, shall have tumbler locks, be stainless steel and have ASTM A480 No. 4 finish. Minimum door size shall be 12 inches by 12 inches. Access doors in walls and ceilings that have a fire rating shall have the appropriate UL rating.

5.02.14.2 Access to equipment on the roof shall be provided by means of service stair or hatch to the roof, preferably in the room containing the equipment. Access shall not be less than 24 inches by 30 inches.

5.02.14.3 Openings, to the exterior, larger than eight inches in the minor dimension shall have security protection. Provide security protection with bars of not less than 1/2 inch diameter or one by one-quarter inch flat stock spaced not more than six inches apart. Refer to the Miami-Dade County Code.

#### **5.02.15 AIR DISTRIBUTION**

##### **5.02.15.1 General**

Air distribution shall be designed on the basis of recommendations and information contained in the SMACNA and the ASHRAE Manuals. Low pressure ducts shall be designed for a pressure drop not to exceed 0.10

inches w.g. per hundred feet. Sheet metal ducts shall be constructed of galvanized steel and shall be sufficiently stiffened and supported to avoid sagging and vibration.

#### 5.02.15.2 Design Velocities

Design velocities shall be selected for the required system performance, to minimize airborne noise generation, drafts, intake of contaminated air, rain or dust particles. The following maximum velocities shall not be exceeded when designing ventilation and air conditioning distribution equipment:

Main Ducts	1800 FPM
Branch Ducts	1000 FPM
Outside Air Intake	500 FPM (free area)
Transfer Ducts and Grilles	250 FPM
Outside Exhaust	500 FPM (below 8 feet) 1500 FPM (above 8 feet)
Filters	500 FPM (free area)
Fan Outlets	2400 FPM

#### 5.02.15.3 Dampers

Balancing dampers shall be provided for ducts serving more than one outlet. They shall be equipped with locking mechanism. Use of Volume Control at outlet for balancing should be discouraged.

#### 5.02.15.4 Splitter Dampers, Extractors and Turning Vanes

Splitter dampers may be used for balancing. Damper blades shall be sized and sufficiently stiffened to effectively close off the duct, and be free from vibration under all conditions of operation. Factory manufactured air extractors or double thickness turning vanes shall be used in duct take-offs from extended plenums ahead of registers and diffusers. Air extractors shall be of the movable blade, pivoted type and accessible for balancing. Turning vanes shall be used for 90 degree elbows.

#### 5.02.15.5 Fire Dampers

Fire dampers shall be provided where required by NFPA-90A – Florida Building Code and where ducts pass through fire-resistive rated separations. Fire dampers shall meet rating as required by the fire separation, with access doors located for easy accessibility, preferably in the bottom. Install in accordance with manufacturers recommendations and UL 555.

#### 5.02.15.6 Flexible Connectors

Flexible connectors shall be used on fan units when connecting to ductwork. Flexible connectors shall be mechanically secured to unit and duct to provide air-tight joints. Fabric shall be fiberglass cloth, neoprene coated, UL listed and rated for 250 F.

5.02.15.7 Back draft and relief dampers, if required, shall be rated and tested in accordance with AMCA Standard 500.

## **5.02.16 THERMAL AND ACOUSTICAL INSULATION**

5.02.16.1 Thermal insulation shall be provided to the piping and duct systems for safety and to minimize heat transfer and condensation dripping inside structures. Insulation materials shall be noncombustible in accordance with NFPA 90A.

## **5.02.17 NOISE AND VIBRATION CONTROL**

To achieve an economical attenuation of the mechanical noise and vibration, the following items should be considered:

- 1) Select mechanical items of equipment for low speed and quiet operation to operate at or near their peak efficiency. The running speed of any rotating equipment shall be at least + 30 percent outside of the natural frequency of the supporting structure and 30 percent below the critical speed.
- 2) Rotating equipment should be statically and dynamically balanced.
- 3) Use resilient mounts for all rotating and vibrating equipment.
- 4) Use straightening vanes for fan inlets and outlets.
- 5) Use flexible connectors where ducts and pipes connect to resiliently mounted equipment. The stiffness of the flexible connectors must be less than the stiffness of the resilient mounts of the equipment. Flexible connectors shall have their longitudinal axis perpendicular to direction of motion. Use two flexible connectors where vibration is in more than one plane.
- 6) Select air outlets for the lowest velocity consistent with required terminal velocities.
- 7) Use a common base, wherever possible, for mounting motor and driven machine to minimize vibration due to misalignment.

- 8) Use acoustical pads between spring mounts and structure to attenuate audible noise transmission.
- 9) Use noncombustible acoustical lining for duct plenums and ducts for sound absorption.

### **5.02.18 TESTS AND SOUND CONTROL**

5.02.18.1 Equipment, apparatus and air distribution systems shall be tested and balanced prior to being put into operation. Capacities shall be determined by operating tests of not less than four hours duration after stable conditions have been established. Test procedures shall be in accordance with applicable portions of the NFPA, ASME, ASHRAE, ARI, SMACNA, AABC, and AMCA publications. Sound level shall not exceed OSHA requirements specified in 1910.95.

5.02.18.2 Air conditioning sound attenuation shall be designed in accordance with ASHRAE Standards. Areas occupied regularly more than an hour a day shall not exceed NC-38. Other areas shall not exceed NC-44. Sound tests to demonstrate compliance with these requirements shall be made at locations selected by MDT and the Final Designer.

### **5.02.19 PIPING AND EQUIPMENT IDENTIFICATION**

5.02.19.1 Equipment and apparatus shall be identified with permanent nameplates securely fastened to permanent portion of components showing function, unit number and area served. Valves shall also have permanent tags.

5.02.19.2 Piping identification shall be required in ancillary areas, mechanical equipment rooms, and where pipes or ducts are running exposed in other areas.

5.02.19.3 Piping identification shall be color coded and lettered, indicating the name of the contents of the system, direction of flow and shall be located at points where pipes enter and leave the rooms or spaces, at junction points, close to valves, dampers and equipment and at intervals of not more than 50 feet. All color coding for the piping shall comply with ANSI 253.1.

## **5.03 PLUMBING**

### **5.03.1 PIPE AND FITTINGS**

- 5.03.1.1 Interior above grade sanitary drainage, vent and storm water pipes shall be DWV pattern, centrifugally spun service weight cast-iron no-hub pipe with neoprene gasket and stainless steel clamp or with bell push joint fittings. Drainage pipe from fixtures shall have a minimum slope of 1/8 inch per foot in the direction of flow.
- 5.03.1.2 Sanitary and storm water drainage piping below grade shall be centrifugally spun service weight cast-iron pipe with bell push joint fittings.
- 5.03.1.3 Potable water service below grade shall be hard drawn copper tubing type "K" with wrought fittings and two coats of bitumastic paint. Above grade piping shall be hard-drawn copper tubing type "L" with wrought brass or copper fittings. All joints to be brazed with lead free high temperature solder.
- 5.03.1.4 Fire water supply piping below grade shall be ductile cast-iron class 22 pipe with mechanical or flanged joints. Fire supply or sprinkler piping above grade shall be galvanized steel with victualic or screwed joints.
- 5.03.1.5 Force mains shall be ductile cast-iron class 22 pipe with mechanical joints.
- 5.03.1.6 Dielectric couplings shall be provided for the connection of dissimilar metals to prevent electrolysis, galvanic action and for corrosion control.
- 5.03.1.7 Hose bibbs in public areas shall be chrome plated and installed in recessed, locked boxes. Hose bibbs in service areas shall be rough brass.

### **5.03.2 ROUGHING-IN**

Sleeves through footings, floor slabs and exterior walls shall be polyvinyl chloride (PVC) or fiberglass reinforced plastic (FRP) with continuous water stop ring. Sleeves shall be of such size to provide a 1/2 inch annular space around the entire circumference of the pipe. Annular space between pipe and sleeve shall be filled with coal tar, asphaltum compound or neoprene link seals. Sleeves shall extend one foot beyond footings and exterior walls.

### **5.03.3 WATER SERVICE**

5.03.3.1 The water pipe shall be of sufficient size to provide an adequate supply of water to meet the requirements of the facility at peak demand.

#### 5.03.3.2 Minimum Available Pressure

The distribution system shall be designed on the basis of the minimum available pressure at the water main or other source of water supply.

#### 5.03.3.3 Demand Load

The water supply demand load in the distribution system shall be based upon the number, type and probable simultaneous use of the fixtures to be supplied. Estimate the demand load in gallons per minute (GPM) corresponding to the total number of water supply fixture units. Pipe sizing shall be in accordance with ASHRAE Handbook of Fundamentals and applicable paragraphs of the Florida Building Code, Plumbing. Maximum design velocity shall not exceed 7.5 feet per second.

### **5.03.4 PLUMBING FIXTURES**

5.03.4.1 Plumbing fixtures in public areas shall be vitreous china. For toilet room layout, fixture mounting heights and other characteristics of plumbing fixtures

refer to standard or directive drawings. Fixtures shall meet ANSI 117.1 for the handicapped.

- 5.03.4.2 Water closets will be wall hung, off floor, blow out jet, elongated-bowl and provided with a recessed flush valve.
- 5.03.4.3 Urinals shall be wall hung, siphon-jet and provided with a recessed flush valve. A floor drain shall be provided.
- 5.03.4.4 Lavatories shall be wall hung.
- 5.03.4.5 Mop basin shall be of monolithic, precast, terrazzo, equipped with rim guard.
- 5.03.4.6 Water supplies to fixtures accessible to the public shall have key operated service valves.
- 5.03.4.7 Each connection shall be designed for the pressure recommended by the fixture manufacturer but not less than 25 psi for flush valves for toilets and not less than 15 psi for other fixtures.
- 5.03.4.8 Water supply to lavatories and flush-valve fixtures shall have factory manufactured water-shock-absorbing provisions. Water hammer arrestors shall be sized in accordance with Plumbing and Drainage Institute Standard No. PDI-WH201.
- 5.03.4.9 Vacuum breakers with backflow prevention shall be installed on outlets with hose connections and potentially submerged, potable water fixtures.

Where service water pressure is above 75 psi, reducing valve assemblies consisting of reducing valve, three-way by-pass and strainer at water service entrance and strainer shall be provided.

#### **5.03.5 SEWAGE SERVICE**

Whenever the building sewage cannot flow by gravity into the sanitary sewage system, septic tank with drain field shall be provided. Pneumatic ejectors shall not be used without prior approval of MDT.

#### **5.03.6 EYEWASH**

Battery rooms, where potable water is readily available, shall have one emergency eyewash with body spray. Hose bibb and floor drains will be installed. Portable eyewash and body spray may be provided where potable water is not readily available. Where portable eyewash is used, hose bibb and floor drain are not required.

#### **5.03.7 FLOOR DRAINS**

Floor drains shall be required in areas where non-portable eyewash, fire sprinkler and hose bibbs are located inside a facility.

#### **5.03.8 HOSE BIBBS**

Hose bibbs shall be 3/4 inch size and located as follows:

- At concourse level in fire emergency cabinets.
- At areas such as trash rooms, custodial rooms, and toilet rooms.

#### **5.03.9 ELECTRIC WATER COOLERS**

Shall be provided to serve both the public, operating personnel and handicapped.

#### **5.03.10 TESTS**

Sanitary sewer, drainage and vent piping shall be tested in accordance with the provisions of the Florida Building Code, Plumbing.

Water service and distribution piping shall be tested at 125 psi for a minimum of two hours. Fire protection piping shall be tested at 200 psi for a minimum of two hours.

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## **5.04 BUILDING MANAGEMENT SYSTEM**

### **5.04.1 GENERAL**

It is the intent of this section to outline the type and mode of operation of the control systems and instrumentation as they relate to the station support facilities.

A Central Control Facility shall be used through which communication, operation and control can be established with each remote facility.

### **5.04.2 LOCAL CONTROL SYSTEM**

Each enclosed structure or building shall be provided with its own local control system of the electric type.

The local control system shall be designed to perform the functions and to operate in the required sequence to properly control and monitor the environmental conditions and other related functions associated with the facility.

### **5.04.3 REMOTE SURVEILLANCE AND CONTROL**

Local control functions shall terminate in a cabinet at an assigned terminal strip, properly numbered and identified at a location to be determined by MDT.

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## **5.05 FIRE PROTECTION**

### **5.05.1 SCOPE**

These criteria describe the functional requirements and operation of the fire protection systems and equipment for the stations.

### **5.05.2 FIRE PROTECTION SYSTEMS**

Fire protection systems include:

- a. Sprinkler Systems, wet
- b. Standpipe Systems, wet
- c. Clean Agent Fire Suppression Systems
- d. Fire Hose Cabinets
- e. Portable Fire Extinguishers

### **5.05.3 SPRINKLER SYSTEMS**

Sprinkler systems shall include main water supply, fire department inlet connections where required, piping from inlet connections and water supply mains to the sprinkler heads, sprinkler heads (with spares), drain lines, sprinkler alarm located on an outside face of the structure (when required by the provisions of NFPA Standard No. 13), provisions for remote alarm devices, pipe fittings, valves with supervision, hangers, inserts, sleeves and appurtenances.

Sprinkler systems shall conform to the requirements of the latest edition of NFPA Standard No. 13 and shall be installed in accordance with the requirements for ordinary hazard occupancy.

#### 5.05.3.1 Passenger Stations

The following areas of all passenger stations shall be protected with an automatic sprinkler system:

- a. Storage Rooms
- b. Custodial Rooms
- c. Trash Rooms
- d. Other undesignated areas with a more than minimal combustible content.

#### **5.05.4 CLEAN AGENT FIRE SUPPRESSION**

Clean Agent Fire Suppression systems shall be of the total flooding type and shall achieve the designated concentration with a total flooding time as required for the agent used. Acceptable product is limited to FM200.

##### 5.05.4.1 Passenger Stations

Train control and communication rooms shall be protected by an inert gas Fire Extinguishing System.

#### **5.05.5 STANDPIPE SYSTEM**

Standpipe systems shall conform to the requirements of NFPA 14 and Florida Fire Prevention Code.

##### 5.05.5.1 Passenger Stations

Fire hose shall not be required on standpipe systems.

##### 5.05.5.2 Parking Garages

Wet standpipes and fire hose cabinets shall be provided as required in the Florida Fire Prevention Code. Open vehicular ramps used as exits for

occupants may be considered the same as open stairs for the purpose of locating hose cabinets and standpipes.

Each open-air parking garage over 50 feet in height shall have a Class III standpipe system designed in accordance with Florida Fire Prevention Code and NFPA 14. Open-air parking over 75 feet in height shall be protected with an automatic sprinkler system in accordance with NFPA 13. Provide for future extension of standpipes or sprinklers.

Where wet standpipe 1-1/2 inch outlets are installed in parking structures, hose cabinets with 1-1/2 inch hose shall be provided. Hose shall be approved for 100 psi working pressure and where working pressures exceed 100 psi, pressure reducers shall be provided where necessary.

Each hose cabinet shall have sufficient hose to reach any point of the area to be protected as per Florida Fire Prevention Code.

Hose cabinets shall be located outside stairways and within 10 feet of the entrance to the stairway. An approved form of wall-hose reel, cabinet or rack, shall be provided for the hose and shall be located and marked to make the hose accessible and identifiable at all times.

#### **5.05.6 PORTABLE FIRE EXTINGUISHERS**

Portable fire extinguishers shall be installed in accordance with NFPA Standard No. 10- Land Florida Fire Prevention Code and as modified herein below.

Portable fire extinguishers of the types appropriate to the areas being protected shall be installed in the following area/facilities:

- a. Traction Power Substations
- b. Gap Tie Stations
- c. Electric Equipment Room
- d. Each Fire Hose Station or near Fire Department Connection
- e. Parking Garages

#### **5.05.7 FIRE DEPARTMENT CONNECTIONS**

One or more connections shall be provided through which the public fire department can pump water into the sprinkler or standpipe system.

There shall be no shut-off valve in the fire department connection.

In a wet system, two approved silent check valves shall be installed in the domestic water connection, located as close as practicable to the point where it joins the fire system.

Where appropriate, hose connections shall be 2-1/2 inch with 1-1/2 inch reducer (American) National Standard Fire-Hose Coupling Screw Threads.

Siamese hose connections shall be within 25 feet of the access road, and shall be located within 100 feet of a fire hydrant and arranged so that hose lines can be readily and conveniently attached to the inlets without interference with any nearby objects including traffic, buildings, fences, posts or other fire department connections. Refer to Civil Criteria Volume 2, Chapter 2, Utilities.

Fire department connections shall be designated by a sign having raised letters at least one inch in size cast on a plate or fitting reading "AUTO-SPKR," or "STANDPIPE," whichever is appropriate. The sign shall also indicate the buildings or structures, or parts thereof, served by the connection, and be appropriately identified.

#### 5.05.7.1 Standpipe Fire Department Connections

One fire department connection shall be provided for each of the first two required standpipe risers. Where more than one fire department connection is required, the connections shall be remotely located. All standpipes shall be interconnected at their bases and the connection shall be the same pipe size as the largest standpipe connected thereto.

#### 5.05.8 **AUTOMATIC FIRE DETECTION AND ALARM SYSTEMS**

Provide interface with a system of automatic fire detection which shall be installed in each station conforming to NFPA 72A and 72D. The system shall provide means to supervise and trip extinguishing systems and to shut down ventilation.

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