

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING

23 01 00 – Operation and Maintenance Requirements

1. Environmental Design Criteria
 - a. RIT is located in Monroe County, NY; climate zone 5A.
 - b. Heating and cooling dry bulb design temperatures: consult with RIT.
2. District Heating and Cooling
 - a. RIT has two main heating and cooling plants.
 - i. The East Plant serves the residence halls and surrounding buildings
 - ii. The West Plant serves many of the academic buildings and Global Village.
 - iii. See Appendix 1 for the area served by the East and West Plants.
 - iv. Some buildings not connected to either plant.
 - b. All new buildings must be reviewed for connecting into the medium temperature hot water plant and chilled water plants for heating and cooling.
3. District Heating
 - a. Design Criteria
 - i. Equipment connected to the East or West Plants will use the same design criteria.
 - ii. The supply water temperature from the boiler plant is 240°F.
 1. This is referred to as Medium Temperature Hot Water (MTHW).
 2. The MTHW is available year round except during a one week maintenance period immediately following Commencement.
 - iii. All equipment directly connected to the MTHW loop must be rated for continuous operation at 250°F or higher. There shall be no exceptions.
 - b. Heat Exchangers
 - i. New Heat Exchangers should be designed for 240°F inlet water temperature and 180°F outlet water temperature on the primary (Hot) side of the HX under maximum load.
 - ii. Sondex TM plate and frame heat exchangers or approved equal shall be connected to the MTHW loop.
 1. Written approval for a variance must be obtained from the FMS Director of Utilities.
 - iii. Connection to the MTHW system shall be designed with multiple heat exchangers such that if one heat exchanger fails it may be valved-off and removed from service and the remaining heat exchanger(s) shall still be able to provide 100% of the designed heating capacity.
 - iv. Building Connect Pumps
 1. Pumps shall be designed for optimum energy efficiency at partial load conditions.
 2. Provide at least two pumps such that if one fails it can be removed from service and repaired while the remaining pump(s) stay in service.
 3. With one pump failure the system must be capable of flowing enough hot water to provide 85-90% of the design BTUs to the building.
 - c. Capacities
 - i. The West Heating Plant is comprised of two 45,000,000 BTU gas fired boilers in the James E. Gleason Hall (Building 09). The boilers generally run one at a time in a lead / standby configuration. Except during winter, when both are operational.
 - ii. The East Heating Plant is comprised of three 35,000,000 BTU gas fired boilers in the Mark Ellingson Hall (Building 50A). Generally only one boiler is run at a time, but the system is designed for two boilers running with one standby boiler.
4. District Cooling
 - a. Common Design Criteria
 - i. All equipment connected directly to the chilled water distribution system shall be designed to operate with 44°F inlet water and at least a 16°F ΔT
 - ii. When connecting a building to the chilled water distribution system.
 1. Provide two or more pumps in parallel so that if one pump fails, it may be removed and repaired while the other pump(s) stays in operation.
 2. If the load is for comfort cooling then the pump set should be designed for optimal energy efficiency under partial load conditions.
 3. With the failure of one pump, the system shall be able to provide enough flow to satisfy 75-85% of the designed maximum BTU load.

4. Do not use a decoupled pumping system. Instead use a direct coupled pumping system with a bypass around the pumps that allows the central plant pressure to flow directly through the building at low load conditions.
- b. East Chilled Water Plant (Appendix 1)
 - i. Design Criteria
 1. The East Plant only provides chilled water when the outside air temperature meets the following criteria:
 - a. When the outside air temperature is 60°F or higher the chilled water will be running.
 - b. When the outside air temperature is 50°F or lower the chiller will be off.
 - c. Between 50°F and 60°F the chilled water may or may not be available.
 - ii. Capacity
 1. The East Plant consists of one 2,000 Ton chiller.
- c. West Chilled Water Plant (Appendix 1)
 - i. Design Criteria
 1. The West Chilled Water Plant operates 24 / 7 / 365.
 2. Historical uptime has been about 99.5%.
 - a. Design critical process equipment connected to the central chilled water plant to safely operate during the 0.5% downtime or use an alternative cooling source.
 - ii. Capacity
 1. The plant consists of three 2,400 Ton chillers as well as a winter evaporative “free” cooling system.
 - a. Two 2,400 Ton chillers located in James E. Gleason Hall (Building 09).
 - b. One 2,400 Ton chiller located in Louise Slaughter Hall.
 2. In the summer, two of the 2,400 Ton chillers are always available.
 3. In the winter, capacity is reduced to about 800 Tons when the “free” cooling system is employed. This is mostly used for process and specialty cooling.
5. General
 - a. RIT HVAC Equipment Modification form shall be completed and submitted to RIT for projects where new mechanical equipment is installed RIT HVAC Equipment Modification Form.pdf (Contact Engineering Manager).
 - b. No mechanical equipment shall be hung from the ceiling.
 - c. Where possible, avoid the construction of confined spaces; any such confined space that must be constructed, must be approved by RIT Director of Engineering in advance.
 - d. All new HVAC system design should include a system with main air distribution supplied by an air handling unit(s) with heating and cooling coils, and terminal units- VAV's are the standard practice at RIT. Any type of heat recovery should be included in the base design where feasible. Design team must review concept with Director of Utilities.
 - e. All new Air Handling Units should be located inside the building or in a penthouse. If infeasible, a utility corridor must be integral to the rooftop unit. (i.e. stairs)
 - f. Platforms for roof mounted equipment shall have 24 inches minimum clearance between bottom of platform beams and roof for purposes of re-roofing.
 - g. Safety railing for compliance with OSHA Fall Protection and compliance with Section 1013.5 of the BC of NY State shall be provided for any rooftop mechanical equipment. In addition, tie-off points shall also be provided as needed.
 - h. Pitch pockets shall **NOT** be used for roof penetrations for conduit or piping. Cones or “Witched Hats” with a stainless steel “radiator hose” style clamp (with stainless steel worm screw) shall be used. For multiple or large pipes, a “dog house” box shall be used with pipes and conduits exiting the side wall of the box.
 - i. Serviceable equipment shall be installed with appropriate service access, to accommodate all trades.
 - j. Do not use di-electric unions. Use brass bodied ball valves instead.
 - k. Duct work connected to air handlers shall be designed (long enough straight section) so that sampling tube type duct smoke detectors can be installed.
 - l. Isolation valves are to be provided at take offs at mains for each radiation zone, reheat zone, and units (i.e. cabinet units heaters).

1. HW and CHW flow meters shall use ultrasonic or electromagnetic measurement flow meters (see 23 09 13 – Control Valves).
2. Contact RIT Director of Utilities for flow and BTU meter information.
3. Use the RIT specification for gas, electric, and water meters. Contact RIT FMS directly for these specifications.
4. Gauges with ball valves shall be installed on natural gas services at building entrance, before and after any gas regulator, and at each gas appliance.
5. Underground valve or metering vaults shall not be installed.

23 05 23 – General-Duty Valves

1. Do not use di-electric unions. Use brass bodied ball valves instead. If necessary use a dielectric nipple with isolation ball valve.
2. Butterfly valves shall not be used any system, except for flow control.

23 05 29 – Hangers and Supports for HVAC Piping and Equipment

1. Support vertical piping and tubing at base and at each floor. Install supports for vertical copper tubing every 10 feet. Install supports for vertical cast-iron soil piping every 15 feet. Install supports for vertical PVC piping every 48 inches for sizes up to and including 6 inches. Consult with RIT Director of Engineering for larger sizes.
2. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
3. Provide Insulation shields on horizontal piping.

23 05 53 – Identification for HVAC Piping and Equipment

1. Pipe Labels
 - a. Pretension Pipe Labels; pre-coiled, semi rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
 - b. Self-Adhesive Pipe Labels; printed plastic with contact-type, permanent-adhesive backing:
 - i. MS-900 Self-Adhesive Pipe Markers; Marking Services, Inc.
 - ii. DuraLabel
 - c. Paint: Sherwin Williams or approved equal.
 - i. Topcoat: B54YZ0437 – Industrial Enamel HS Safety Yellow
 - ii. Topcoat: B54RZ0038 – Industrial Enamel VOC Complying Safety Red
 - d. Color field lengths and letter heights:

Outside Diameter of Pipe Covering	Minimum Length of Color Field	Letter Height
Less than 1-1/2"	8"	1/2"
1-1/2" – 2"	8"	3/4"
2-1/2" – 7"	12"	1-1/4"
8" – 10"	24"	2-1/2"
Larger than 10"	32"	3-1/2"

- e. Content: include information of piping service using designations listed below, pipe size, and flow direction arrow.

SYMBOL	SERVICE TYPE	PIPE LABEL	BACKGROUND and LETTERING COLORS
CHWR	Chilled Water Return	CHWR	BLUE BACKGROUND, WHITE LETTERING
CHWS	Chilled Water Supply	CHWS	BLUE BACKGROUND, WHITE LETTERING
CWR	Condenser Water Return	CWR	GREEN BACKGROUND, WHITE LETTERING
CWS	Condenser Water Supply	CWS	GREEN BACKGROUND, WHITE LETTERING
CWGLR	Chilled Water Glycol Return	CWGLR	GOLD BACKGROUND, BLACK LETTERING
CWGLS	Chilled Water Glycol Supply	CWGLS	GOLD BACKGROUND, BLACK LETTERING
HWGLR	Hot Water Glycol Return	HWGLR	GOLD BACKGROUND, BLACK LETTERING
HWGLS	Hot Water Glycol Supply	HWGLS	GOLD BACKGROUND, BLACK LETTERING
DTS	Dual Temp Return	DTR	BLACK BACKGROUND, WHITE LETTERING
DTR	Dual Temp Supply	DTS	BLACK BACKGROUND, WHITE LETTERING
HPR	Heat Pump Return	HPR	TEAL BACKGROUND, WHITE LETTERING

HPS	Heat Pump Supply	HPS	TEAL BACKGROUND, WHITE LETTERING
LTHWR	Low-Temp Hot Water Return	LTHWR	ORANGE BACKGROUND, BLACK LETTERING
LTHWS	Low-Temp Hot Water Supply	LTHWS	ORANGE BACKGROUND, BLACK LETTERING
MTHWR	Medium-Temp Hot Water Return	MTHWR	RED BACKGROUND, BLACK LETTERING
MTHWS	Medium-Temp Hot Water Supply	MTHWS	RED BACKGROUND, BLACK LETTERING
PRCWR	Process Chilled Water Return	PRCWR	GREY BACKGROUND, WHITE LETTERING
PRCWS	Process Chilled Water Supply	PRCWS	GREY BACKGROUND, WHITE LETTERING
PRHWR	Process Hot Water Return	PRHWR	GREY BACKGROUND, BLACK LETTERING
PRHWS	Process Hot Water Supply	PRHWS	GREY BACKGROUND, BLACK LETTERING
STM	Steam	STEAM	PINK BACKGROUND, WHITE LETTERING
COND	Condensate	COND	PINK BACKGROUND, WHITE LETTERING

- i. Basis-of-Design: MS-900 Self-Adhesive Pipe Markers; Marking Services, Inc., Milwaukee, WI 53225, www.markserv.com

2. Valve Tags

- a. RIT valve tagging is limited to the main heating and cooling plant loops only. Coordinate with RIT for correct valve tag numbers.
- b. Specifications:
 - i. Size: 2" x 2" square with hole drilled in top center
 - ii. Font: HEL Medium 4L
 - iii. Word Size: .30"
 - iv. Contractor to provide Excel spreadsheet of valve tags and system to RIT.
 1. Provide valve tag chart in electronic and physical format to owner. Valve tag chart columns shall indicate (from left to right) building number, description, type, number. Frame and place under clear glass. Provide one (1) in water service room and one (1) adjacent to hot water heating plant.
- c. Provide a sign for each tagged control, sectional, and drain valve identifying the portion of the building or system served. Signs shall be permanently attached to the piping, the valve, or the nearest wall. Signs shall not be hung from the piping of valves with wires or chains.
- d. Basis-of-Design: Marking Services, Inc.
- e. Valve tag contents:

SYMBOL	SERVICE TYPE	VALVE TAG
CHWR	Chilled Water Return	(BLDG.)-CHV-##
CHWS	Chilled Water Supply	(BLDG.)-CHV-##
MTHWR	Medium-Temp Hot Water Return	(BLDG.)-MTV-##
MTHWS	Medium-Temp Hot Water Supply	(BLDG.)-MTV-##

3. Duct Labeling

- a. All duct shall be labeled at a minimum every 12 feet.
 - i. A label shall be required less than the 12 feet interval if obstructions prevent the viewing of labels from within a single space. (e.g. if labels are placed every 12 feet and there is an eight foot wide room with walls to the deck with labels to either side of the room which are not visible from within the ceiling of the room, then the duct in the room also needs a label.)
- b. Labels may be painted to the duct with a stencil or printed with a label making machine.
- c. All paint and labels must be rated for plenum placement even if the area is not a plenum space.
- d. Preprinted labels shall be MS900 vinyl with pressure sensitive acrylic backing rated to adhere indefinitely.
- e. Minimum Letter height:
 - i. Duct within 12 feet of the floor: 1-1/2" tall letters
 - ii. Duct above 12 feet of floor: 2-1/2" tall letters.

- f. The content shall consist of three pieces of information. Each piece of information may be a separate label or one combined label.
 - i. Item (1) Duct Type
 1. Supply Air (SA) - White Letters on a Green Background
 2. Return Air (RA) - Black Letters on an Gray Background
 3. Exhaust Air (EA) - Black Letters on a Yellow Background
 4. Outside Air (OA) - White Letters on a Blue Background
 5. Other, Please consult RIT if the duct does not serve one of the four predefined categories
 6. The Duct Type may be omitted on the discharge side of a VAV as the VAV is a supply air only device.
 - ii. Item (2) Airflow direction
 1. An arrow indicating airflow direction
 - iii. Item (3) Equipment served
 1. Indicate the RIT Equipment number of the associated device.
 2. If label space is an issue, the first portion of the RIT equipment number may be omitted as long as it is clear that the duct is connected to equipment in the same building
 3. Examples

a. 071-AHU-03	or	AHU-03
b. 071-VAV-0305	or	VAV-0305
c. 001-EF-12	or	EF-12
 - iv. Examples of complete labels

1. 071-AHU-03 SUPPLY AIR ►	or	AHU-03 SA ►
2. 001-EF-12 EXHAUST AIR	or	EF-12 EA ►
3. 001-AHU-12 RETURN AIR	or	◄AHU-12 RA
4. 400-AHU-04 OUTSIDE AIR	or	AHU-04 OA ►

23 05 93 – Testing, Adjusting, and Balancing

1. Adjustable sheaves are only for balancing and shall be replaced with fixed sheaves after balancing by the mechanical contractor or installer. Fixed sheave information shall be forwarded to RIT at closeout in final TAB report.
2. When performing start up for refrigerant systems, document superheat, sub cooling, amp draw and the amount of refrigerant use. Provide documentation to RIT FMS.
3. Equipment shall be adjusted to ensure proper function, distribution of air, temperature and vibration. Air systems shall be adjusted to air volumes as specified. Provide written documentation for all systems including but not limited to:
 - a. Air Systems:
 - i. CFM at each outlet
 - ii. Dry/wet bulb at each temperature sensor or thermostat
 - iii. RPM of fan/blower
 - iv. RPM of motor and amperage of motor
 - v. Static pressure in inches of water at inlet of fan or blower
 - b. Coils:
 - i. Entering/leaving temperature
 - ii. CFM across coil and face velocity
 - iii. Dry/Wet bulb air temperature entering and leaving coil
 - iv. Capacity of coil in BTUH and GPM
 - c. Pumps:
 - i. Pump GPM
 - ii. Suction and discharge pressure (psig)
 - iii. Motor amperage
 - iv. At No Flow Condition (valve off) measure suction and discharge pressure and motor amperage
4. Provide Testing and Balancing Report. Follow NEBB and SMACNA Standards

23 07 00 – HVAC Insulation

1. Provide insulation on all exposed ductwork.
2. Provide insulation on all heating hot water piping, chilled water piping, domestic hot water piping, refrigerant piping and roof drain piping as needed.
 - a. Engineer of record is responsible to provide type of insulation, thickness and R value.

- b. Provide a PVC jacket for all piping less than 7 ft. AFF, minimum acceptable thickness is 30 mil for light traffic areas and 60 mil for heavy traffic areas. Jacket to be white in color.
- c. Provide Aluminum jacket for exterior and exposed piping.
- d. Insulation shields on all horizontal piping.

23 09 00 – Instrumentation and Control for HVAC

- 1. The Building Management control system on campus is Automated Logic. Please reference the 23 09 00 guidelines.
- 2. HVAC control panels shall be mounted in mechanical rooms, and no more than 3 feet above finished floor, and shall have Equipment # on panel.
- 3. Packaged Rooftop Units, Fan Coil Units and any other HVACR systems or equipment shall have ALC hardwired points and controllers as the primary method of controls. Integrated controls (via BACnet or other protocol) shall be a secondary means of monitoring and control. Integrated controls require prior written approval from RIT Director of Engineering.

23 09 10 – Laboratory Airflow Control System

- 1. Acceptable Manufacturer: Phoenix Controls
- 2. Consult with RIT Director of Engineering for approval of alternate manufacturers.

23 09 13 – Control Valves

- 1. Modulating Control Valves
 - a. All modulating hot water and chilled water control valves shall be Danfoss PIC ABQM family.
 - i. PIC valves are sized by flow rate (GPM) only and not sized by Cv as many traditional valves are. This generally results in a valve that is line-size or perhaps one size smaller than the enclosing pipe.
 - ii. Do not install a balance valve in the same segment of pipe as the PIC valve.
 - 1. PIC valves serve as both a regulating valve and a balance valve.
 - 2. Balance valves may still be necessary where there are multiple pipe paths in segments of pipe that do not have a PIC valve.
 - b. Fail Position
 - i. MTHW (240°F) valves serving Heat Exchangers with a HW (less than 210°F) secondary side shall have fail closed (on loss of power), normally closed (on loss of control signal) valve actuators. This is to prevent damage to the HX or secondary piping and to ensure safety to people in the event of a problem or power loss.
 - ii. Valves that serve equipment at risk of freezing shall have fail open (on loss of power), normally open (on loss of control signal) actuators. This includes HW and CHW coils in ALL air handler units and air handling units located outside of the building envelope (roof).
 - iii. HW valves in air handling units with some chance of freezing shall have fail open (on loss of power), normally open (on loss of control signal) actuators. Example: An AHU which is located inside the building and has an outside air duct serving the AHU, where the cold outside air could potentially freeze the hot water coil if the dampers failed open and the fan was not running.
 - iv. Process and specialty applications shall be evaluated on a case by case basis with the intent that the valve shall fail in the direction that causes the least harm.
 - v. All other valves not mentioned above shall fail in place. With loss of power the valve shall stay in the position it was operating at until power is restored. This includes:
 - Most AHU Chilled Water Valves on AHUs located inside mechanical rooms.
 - Typical VAV or constant volume reheat valves.
 - Typical hot water reheat valves on AHUs located inside mechanical rooms where there is a primary HW valve upstream.
 - vi. Typical fin tube radiation valves shall fail open.
 - c. Multiple circuit coils or heat exchangers.
 - i. When there are multiple coils or heat exchangers controlled in parallel it may be advantageous to install one smaller PIC valve for each coil or HX as opposed to installing one large PIC valve for all circuits and then using balance valves to balance the flow to each coil or HX.
 - 1. When using this method with two Danfoss PIC valves, the control program shall have one pid controlling the AO, one wire leaving the control panel to the first actuator, and then daisy chained to the next actuator, the two PIC valve actuators shall be setup for

sequential operation. If there are more than two valves on the same system, each valve shall have its own signal.

2. When using a PIC valve dedicated to each circuit, do not use balance valves. The PIC valve replaces the balance valve and the flow valve.
2. Two-Position Control Valves
 - a. Two position valves that require regulated flow
 - i. Use Danfoss ABQM valve designed for the desired flow rate.
 - b. Two position shut-off valves
 - i. Valves intended to close or open flow to a pipe without regulating the amount of flow.
 - ii. These valves shall be full port (line-size) ball valves up to and including 6" diameter.
 - iii. Above 6" Diameter use line-size butterfly valves if approved by RIT.
 - iv. Acceptable manufacturers: Belimo
 - c. All Danfoss PICS valves shall be installed in the supply line and shall have a strainer installed upstream of valve.

23 09 23 – DDC Systems for HVAC

1. Please reference the 23 09 23 guidelines.

23 21 00 – Hydronic Piping and Pumps

1. Schedule:
 - a. Hot-water heating, chilled water, and dual temperature piping, aboveground, NPS 2 inches and smaller, shall be any of the following:
 - i. Type-L drawn-temper copper tubing; wrought copper fittings; and soldered joints. ProPress is acceptable on 1-1/2 inch and smaller.
 - ii. Schedule 40 steel pipe; class 125 cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints
 - b. Hot-water heating piping, chilled water, and dual temperature piping, aboveground, NPS 2-1/2 inch and above, shall be any of the following:
 - i. Schedule 40 steel pipe; wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings; and welded and flanged joints
2. Avoid the use of glycol loops if at all possible. If glycol is necessary, use Propylene Glycol.
3. In line circulator pumps shall be Grundfos (ECM if possible), Bell and Gossett cartridge type or Wilo.
4. Base mounted pumps may be Taco, PACO, or Bell and Gossett. Pumps shall be mounted level on contractor provided concrete base pad such that there is no strain on the pump base. Pump shall be aligned for both vertical and angular shaft alignment. Base shall be filled with grout. Alignment shall be again checked after grout sets and shall have a tolerance of +/- .003 inch.
5. Do not use di-electric unions. Use brass bodied ball valves instead.
6. Do not use cut or rolled groove (Vic and similar type) piping on any system (heating, cooling, city water, or DHW).
7. Use flexible expansion (stainless steel hose with stainless steel braid) compensators and loops with proper anchors and guides.
8. Branch tee fittings on copper lines shall not reduce more than two nominal pipe sizes (ex. On a 2 inch main, use 2x2x1-1/4 or 2x2x1-1/2)

23 23 00 – Refrigerant Piping

1. Refrigerant lines (DX Air Conditioning) shall not exceed 30 foot length due to oil leaks and return issues.
2. Refrigerant lines to be rigid copper tubing, with brazed joints.

23 31 00 – HVAC Air Distribution

1. All ductwork shall be hard-duct to diffusers. Optionally, flexible ductwork only allowed as final connection to diffusers; maximum 3'-0" length and up to 5" round.
2. Interior lined ductwork shall have stainless steel perforated interior liner.
3. Use of linear supply diffusers is HIGHLY discouraged.
4. Air distribution ductwork shall be labeled on exterior of insulation every 12 feet or less. See 23 05 53 for details.
5. Include branch dampers on ductwork for balancing, use quadrant locking dampers only.

23 34 00 – HVAC Fans

1. Fan Array
 - a. All large AHUs (> 10,000 CFM) shall use an array of fans.

- b. All medium AHUs (5,000 – 10,000 CFM) shall be evaluated to determine if an array of fans is beneficial and feasible.
- c. Small AHUs (< 5,000 CFM) will not use an array of fans.
- d. RIT has specific requirements for the control of fan arrays. See 23 09 00 for details.
- e. All AHU fans shall utilize direct drive.
- f. AHU fans with motors 15 HP shall use timing belts instead of V belts.
- 2. All Air Handling Units should be located inside the building or in a penthouse.
 - a. If the AHU must be mounted on the roof, a utility corridor must be integral to the roof top Air Handling Unit.
 - b. On air handlers in mechanical rooms, ductwork connections should always be on the end or top, not the bottom (safety issue).
 - c. Basis of Design equipment manufacturers: FanWall by Nortek, TMI or RIT approved equal. Do not use Twin City.
- 3. Exhaust Fans
 - a. 120 Volt/1Ø exhaust fans shall use ECM direct drive motor capable of speed adjustments via rotary knob or screw set and restraining cables.
 - b. Basis of Design: Greenheck, Cook or RIT approved equal. Do not use Twin City.

23 36 16 – Variable-Air Volume Units

- 1. Standard HVAC design includes VAV boxes with two row reheat coils, DA temperature sensor, and motion sensor input for scheduling.

23 40 00 – HVAC Air Cleaning Devices (Filters)

The following specification assures the following:

The initial static pressure of the pre-filter and the final filter when in combination will equal the sum of the two initial static pressures.

Example: 24x24x2 pre-filter .28" @ 2000
 24x24x12 MERV 13 .30" @ 2000
 Initial static combined must be .58 (+/- .03")

- 1. Pleated pre-filter
 - a. General
 - i. Air filters shall be medium efficiency ASHRAE pleated panels consisting of cotton and synthetic media, welded wire media support grid, and beverage board enclosing frame.
 - ii. Sizes shall be noted on drawings or other supporting materials.
 - b. Construction
 - i. Filter media shall be a cotton and synthetic blend, lofted to a uniform depth of 0.15", and formed into a uniform radial pleat.
 - ii. A welded wire grid, spot-welded on one-inch centers and treated for corrosion resistance shall be bonded to the downstream side of the media to maintain radial pleats and prevent media oscillation.
 - iii. An enclosing frame of no less than 28-point high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media on all sides to prevent air bypass. Integral diagonal support members on the air entering and air exiting side shall be bonded to the apex of each pleat to maintain uniform pleat spacing in varying airflows.
 - c. Performance
 - i. The filter shall have a Minimum Efficiency Reporting Value of MERV 8 when evaluated under the guidelines of ASHRAE Standard 52.2-2007. It shall also have a MERV-A of 8 when tested per Appendix J of the same standard. The media shall maintain or increase in efficiency over the life of the filter.
 - ii. Initial resistance to airflow shall not exceed 0.23", 0.31" or 0.27" w.g. at an airflow of 350, 500 or 500 fpm on 1", 2" or 4" deep models respectively.
 - iii. The filter shall have an Energy Cost Index (ECI) value of five stars.
 - iv. The filter shall be classified by Underwriters Laboratories as UL 900.
 - v. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.
 - vi. Manufacturer shall guarantee the integrity of the filter pack to 2.0" w.g.

- d. **Supporting Data** - Provide product test report including all details as prescribed in ASHRAE Standards 52.2 2007, including Appendix J. along with one sample of a 24"x24"x2" size.
2. **Secondary MERV 13 Filters / Service Specification**
 - a. **General**
 - i. Air filters should be v-bank mini-pleated fiberglass disposable type with pleat separators, polyurethane pack-to-frame sealant, and polystyrene enclosing frame and have an ECI value of five stars.
 - ii. Vendors shall provide pleat count per foot on specifications. The thickness of the card must be indicated with +/- tolerances.
 - b. **Construction**
 - i. Filter media to be of microfine glass fibers formed into uniform pleats with a spacing of 10 pleats per inch and a uniform pleat height of 24mm. Pleats shall be separated at 25mm intervals to ensure uniform pleat distribution and even airflow through the filter pack.
 - ii. Pleats media packs shall be assembled into a v-bank configuration with sufficient total media area to meet airflow requirements. The filter outlet shall be radial in shape with a maximum of 60% open area to maintain low-pressure drop and uniform airflow
 - iii. The media packs to be bonded to the inside periphery of a polystyrene enclosing frame with a polyurethane sealant. The enclosing frame shall include top and bottom molded tracks as an integral part of the frame to ensure a proper seal.
 - iv. Media packs shall be recessed from the header side of the enclosing frame to allow uniform airflow when a prefilter is mounted directly to the enclosing frame. The header shall include a gasket on the vertical side to create a filter-to-filter seal in side-access housing applications.
 - v. Rigid plastic end caps shall be mechanically fastened to the top and bottom of the media pack enclosing structure to ensure a rigid and durable filter.
 - vi. Filters shall come with one side access gasket, to facilitate side access applications, and closed cell roll media shall be provided to RIT to facilitate the gasketing of the downstream side of the header, in case they chose to install these filters in front load frames. Sufficient gasket shall be supplied with each order to facilitate gasketing of that order, should it be required for front load application, as directed by RIT.
 - c. **Performance**
 - i. The filter shall have a Minimum Efficiency Reporting Value of MERV (13) when evaluated under the guidelines of ASHRAE Standard 52.2-2007. It shall also have a MERV-A rating of (13) when evaluated under ASHRAE Standard 52.2-2007 Appendix J.
 - ii. Initial resistance to airflow shall not exceed (0.31) inches w.g. at an airflow of 500 fpm for 24" x 24", 24" x 12" and 24" x 20" sizes.
 - iii. Filter shall have a 5-Star rating when evaluated per Energy Cost Index.
 - iv. Filter shall be listed by Underwriters Laboratories as UL 900.
 - v. The filter shall have an Energy Cost Index (ECI) value of five stars.
 - vi. The filter to be capable of withstanding 10" w.g. without failure of the media pack.
 - vii. Manufacturer shall provide evidence of facility certification to ISO 9001:2015.
 - viii. Supplier shall have the capability of performing an in-situ test once the filters are installed to verify efficiency and pressure drop performance.
 - ix. The manufacturer shall provide a written Performance Guarantee ensuring the filter has the highest energy savings in its class of product, and will maintain its particle capture efficiency throughout its service life.
 - d. **Supporting Data** - Provide product test reports for each listed efficiency including all details as prescribed in ASHRAE Standards 52.2-2007.
 - e. Sample of the proposed filter 24x24x12 will be supplied with a 52.7 2007 appendix J ASHRAE report not less than 2 years old accompanying it.

23 60 00 – Central Cooling Equipment

1. Condensing unit shall be dry whenever possible to avoid the use of pesticides and chemicals, as when using a wet tower.

23 73 00 – Indoor Central Station Air Handling Units

1. Acceptable custom manufacturers
 - a. Air Enterprise
 - b. Airwise

- c. Nortek Air Solutions
- d. TMI
- e. RIT approved equal with written approval by Director of Engineering prior to issuing design documents

23 74 00 – Roof-Mounted Equipment

1. Roof mounted equipment is highly discouraged. Consult with RIT Director of Engineering before adding equipment to the building roof, verify there is not a reasonable method or location to place equipment inside the building envelope.
2. Platforms for roof mounted equipment shall have 24 inches minimum clearance between bottom of platform beams and roof for purposes of re-roofing.
3. Safety railings for compliance with OSHA Fall Protection and compliance with Section 1013.5 of the BC of NY State shall be provided for any rooftop mechanical equipment. In addition, tie-off points shall also be provided as needed.
4. Air Handling Unit Coils
 - a. Do not use Glycol for heating or cooling coils, unless approved by RIT.
 - b. Coils that have a significant risk of freezing shall be equipped with a mechanical device that relieves pressure in the coil and piping caused by the expansion of freezing water, to prevent permanent damage to the AHU, coil or piping (i.e. freeze relief caps, Cooney Freeze Block Technology.)
4. Basis of Design
 - a. York
 - b. Rheem
 - c. McQuay
 - d. RIT approved equal

23 81 46 – Heat Pumps

1. New buildings or additions shall not be designed to use heat pumps.
2. Replacement heat pumps shall be Daikin or approved equal. Alternate approval must be obtained in writing from the Director of Utilities.

23 82 00 – Convection Heating and Cooling Units

1. Radiant Heating
 - a. Radiant heating shall be supplied for all external walls.
 - b. Hydronic baseboard radiant heating equipment shall not be buried, enclosed, or covered by gypsum board or any other wall system.
 - c. Use Runtal Double-Sided Radiator for Glass wall installations (UFLT) panel radiators or approved equal where both sides of the radiator will be visible, such as in front of a full height window.
 - d. In all other cases use Runtal Thermo Touch (TT) Panel radiators or approved equal.
 - e. Alternate approval must be obtained in writing from Manager of Repairs.
 - f. Radiation zones shall be designed to correspond to air movement zones or with multiple radiation zones evenly fitting within a larger air movement zone.
 - i. Examples:
 - Use one radiation zone corresponding to one VAV zone.
 - Or use one radiation zone per room where the VAV spans across multiple rooms.
 - Do not span one radiation zone across multiple VAV zones
2. Snow Melt Systems
 - a. Building entrances shall have hydronic snow melt systems, unless otherwise directed.
 - b. Hydronic snow melt system shall be Class III (Institutional), all snow melted during snow event.
 - c. Snowmelt tubing from building interior manifold valve box to an exterior manifold valve box shall be pre-insulated pipe system, Logstor Pex-Flex, as manufactured by URECON or approved equal. Pipe lengths shall be continuous with no fittings below grade. Connection to interior building piping shall be made in an accessible location
 - d. Manifolds shall be equipped with visual flow gauges, balancing and isolation valves for each circuit, header isolation valves and fill ports. Manifolds to be supplied completely assembled.
 - e. Provide 2" rigid board insulation with vapor barrier below all areas of snow melt.
 - f. In general, snow melt area shall be a ten (10) foot wide path from building entrance to street curb or sidewalk. Actual size dependent on site conditions.
 - g. Provide protective sleeves at expansion joints.

- h. Consider how runoff from snow melt areas is managed (refreeze prevention).
- 3. Cabinet unit heaters and/or fan coil units shall be wall mounted, no higher than 48 inches AFF, not in ceilings.
- 4. Air handler units, chilled water coils shall be 16°ΔT.
 - a. Chilled water and heating coil freeze protection relief valve basis of design: Cooney Technology or approved equal.

The map shows the following buildings and areas:

- WEST PLANT (Left Section):** Includes buildings SLA, SUS, ENT, GOL, CYB, USC, GVE, GVC, GVD, GVP, GVS, CRS, HLC, COL, ROS, BRN, and UCS 1, UCS 2, UCS 3.
- CENTRAL SECTION:** Includes buildings T, J, F, E, D, N, M, LBJ, CSD, PTH, REC, RIA, CLK, CPC, SMT, MON, SAU, WAL, SHD, GOS, GLE, ENG, BOO, GAN, MSS, CAR, BLC, INS, GBT, GOR, HAC, AUG, POL, U, LOW, COL, BRN, ROS, HLC, GVD, GVP, GVS, CRS, HLC, COL, ROS, BRN, and UCS 1, UCS 2, UCS 3.
- EAST PLANT (Right Section):** Includes buildings LBJ, CSD, PTH, REC, RIA, CLK, CPC, SMT, MON, SAU, WAL, SHD, GOS, GLE, ENG, BOO, GAN, MSS, CAR, BLC, INS, GBT, GOR, HAC, AUG, POL, U, LOW, COL, BRN, ROS, HLC, GVD, GVP, GVS, CRS, HLC, COL, ROS, BRN, and UCS 1, UCS 2, UCS 3.

Streets and landmarks include: GENESSEE RIVER, EAST RIVER ROAD, LEVI WARD ROAD, EDWARD LYON CRESCENT, MILLER ROAD, UNIVERSITY COMMONS SUITES, ROYAL PARKWAY LANE, and EDMUND LYON CRESCENT.

$$23 - 12 \mid 12$$