



**Design and
Construction
Guidelines**

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DIVISION 00 – PROCUREMENT AND CONTRACT REQUIREMENTS**00 00 00 – General Conditions**

1. Reference Procurement website for Policies and Procedures, <https://www.rit.edu/fa/procurement/content/policies-procedures>
2. Consultants working at RIT must be pre-qualified and entered into the Approved Vendor List at Facilities Management Services (FMS). Application/information forms are available in hard copy or electronic format and will be sent to interested vendors upon request.
3. This guideline is for both new construction and renovation work.
4. While many parties may be involved in RIT construction projects, RIT FMS is the authoritative client for all projects. Suggestions, directions, needs, etc. which are raised by others during design phase work or construction phase work are not to be acted upon without approval of the designated Project Manager assigned by FMS to the job.
5. RIT recognizes that sustainability is a concept that seeks to provide the best outcomes for human and natural environments by meeting the needs of the present generation without compromising the ability of future generations to meet their needs. Whenever possible the University attempts to foster sustainability. Include sourcing products that can be recycled or are biodegradable and that contain less toxic and hazardous chemicals and additives; source reduction; and solid waste reduction as well as purchasing local goods that are grown in environmentally sound ways or buying products through systems that produce the least amount of environmental pollutants. The University desires that the Provider foster sustainability and partner with the University in the expanding areas of sustainability.
6. RIT new buildings may be capable of LEED certification, but the University shall not pursue on all projects. Verify requirements with Project Manager.
7. We encourage our design consultants to apply a universal and inclusive design approach to ensure that our facilities are accessible to the entire community that RIT serves. In addition to accommodating the general public, RIT's community includes students with a variety of special needs. It is important to our campus that this approach include any accessibility requirements set forth by state building codes; and since we are a 'place of public accommodation', that all ADA requirements be adhered to, as required by the Federal government. **Note that the needs of the diverse RIT community may exceed statutory requirements in some cases.** In addition, for some projects, focus groups may be created to review the design to ensure that we do not install textures and colors that produce visual contrast issues for specific segments of the RIT community.
8. RIT Owner-Consultant Agreements
 - a. These requirements do not supersede any requirements put forth in the standard contract language or general conditions.
 - b. Firms are responsible to review this document in detail and discuss any concerns with FMS.
 - c. Contractors should raise any questions or concerns before work is bid.
 - d. Successful bidders shall confirm that their proposed methods meet these guidelines prior to installation.
 - e. For more information, see <https://www.rit.edu/procurement/construction-documents>
9. Drawings/Specifications
 - a. A/E and Contractors are required to follow the CAD Specifications per Division 00 Appendix 1.
 - b. A/E are required to follow the DSRs included during the RFP process.

00 65 00 – Instructions for Payment / Lien Release

1. Information can be found at <https://www.rit.edu/facilitiesmanagement/sites/rit.edu.facilitiesmanagement/files/Vendor%20Contractor%20Info/Design%20and%20Construction%20Guidelines/instructionsforpayment.pdf>

00 73 16 – Insurance Requirements (Plan Review Guidelines)

1. Reference Insurance Plan Review Guidelines for RIT.

00 73 19 – Health and Safety Requirements

1. Reference the RIT Environmental Health and Safety (EHS) website for all requirements at the following link, <https://www.rit.edu/ehs/>
2. Laboratory Guidelines
 - a. Laboratory renovation and construction has a number of OSHA standards to be applied during design. Each of these standards calls for different engineering controls to be considered: ventilation, storage cabinets, interlocks, separation of electrical and water sources, fire system requirements, building material and guarding requirements. Additionally, the ANSI standard for eyewashes and safety showers

must be met for labs where chemicals are to be used. EHS should be involved early in design reviews of labs to ensure that the hazards are being addressed through building and room systems.

- b. This link - <https://www.osha.gov/sites/default/files/publications/OSHA3404laboratory-safety-guidance.pdf> - provides a comprehensive guide to hazards and standards that should be taken into account, including:
 - i. The Air Contaminants standard (1910.1000) provides rules for protecting workers from exposure to over 400 chemicals.
 - ii. The Ethylene Oxide standard (29 CFR 1910.1047) requires employers to provide workers with protection from occupational exposure to ethylene oxide (EtO).
 - iii. The Formaldehyde standard (29 CFR 1910.1048) requires employers to provide workers with protection from occupational exposure to formaldehyde.
 - iv. The Hazard Communication standard (29 CFR 1910.1200) is designed to protect against chemical source illnesses and injuries by ensuring that employers and employees are provided with sufficient information to recognize, evaluate and control chemical hazards and take appropriate protective measures.
 - v. The Occupational Exposure to Hazardous Chemicals in Laboratories standard (29 CFR 1910.1450), commonly referred to as the Laboratory standard, requires that the employer designate a Chemical Hygiene Officer and have a written Chemical Hygiene Plan (CHP), and actively verify that it remains effective.
 - vi. The Bloodborne Pathogens standard (29 CFR 1910.1030), including changes mandated by the Needlestick Safety and Prevention Act of 2001, requires employers to protect workers from infection from human blood borne pathogens in the workplace. The standard covers all workers with “reasonably anticipated” exposure to blood or other potentially infectious materials (OPIM).
 - vii. Ionizing Radiation standard (29 CFR 1910.1096). Ionizing radiation sources may be found in a wide range of occupational settings, including, but not limited to, healthcare facilities, research institutions, nuclear reactors and their support facilities, nuclear weapons production facilities, and other various manufacturing settings. These radiation sources pose considerable health risks to affected workers if not properly controlled. This standard requires employers to conduct a survey of the types of radiation used in the facility, including x-rays, to designate restricted areas to limit worker exposure and to require those working in designated areas to wear personal radiation monitors. In addition, radiation areas and equipment must be labeled and equipped with caution signs.
 - viii. Occupational Noise Exposure standard (29 CFR 1910.95). This standard requires employers to have a hearing conservation program in place if workers are exposed to a time-weighted average of 85 decibels (dB) over an 8-hour work shift.
 - ix. The Control of Hazardous Energy standard (29 CFR 1910.147), often called the “Lockout/Tagout” standard, establishes basic requirements for locking and/or tagging out equipment while installation, maintenance, testing, repair, or construction operations are in progress. The primary purpose of the standard is to protect workers from the unexpected energization or start-up of machines or equipment, or release of stored energy.
 - x. Electrical Hazards standards (29 CFR 1910 Subpart S). Wiring deficiencies are one of the hazards most frequently cited by OSHA. OSHA’s electrical standards include design requirements for electrical systems and safety-related work practices. If flammable gases are used, special wiring and equipment installation may be required.
 - c. Laboratory ventilation rates are determined by EHS based on occupancy and hazards present. Consult with EHS to verify rates are appropriate for the research being conducted and/or if the initial use of the room changes. The following exchange rates are required:
 - i. Ten-eight (10-8) ACH while a room is occupied
 - ii. Eight-six (8-6) ACH while a room is unoccupied
 - d. Additional information can be found at the following links:
 - i. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10106
 - ii. <https://www.osha.gov/SLTC/laboratories/otherresources.html>
3. In addition to contractors’ respective policies and OSHA Fall Protection standards, contractors will adhere to the following,
 - a. Safety railings and/or tie-off points for compliance with OSHA Fall Protection shall be provided for rooftop inspections and service of mechanical equipment, electrical equipment, roof drains, and the roof membrane.
 - b. Where possible, avoid the construction of Confined Spaces (i.e. pump in manhole for water feature).

- c. Provide OSHA 29CFR-1910 compliant Fall Protection both inside and outside the building (parapet height of 42 inches, railing, or anchor points), and provide testing of anchor points. Submit testing certificates to Owner at close out. Guards to be galvanized powder-coated finish.
4. Hot Work Permits
 - a. Anytime work requires brazing, cutting or welding, that utilizes open flame and/or could produce sparks that could accidentally start a fire, the contractor or employee doing the work is required to obtain a Hot Work Permit (<https://www.rit.edu/fa/grms/ehs/sites/rit.edu/fa.grms.ehs/files/docs/hotworkpermit.pdf>). Submit permit online and pick up from the EHS Office in the Facilities Management Building, room 1280. Permits should be requested at least 24 hours in advance of the start of the hot work.
 - b. See <https://www.rit.edu/fa/grms/ehs/fire/hotworks.html> for detailed requirements.
5. Lockout/Tagout
 - a. RIT's Lock Out Tag Out (LOTO) program outlines practices and procedures to be used by authorized employees that affix the appropriate types of locks and tags to disable machinery/equipment prior to maintenance or service work.
 - b. See <https://www.rit.edu/fa/grms/ehs/content/lockouttagout> for detailed requirements.

00 73 43 – Prevailing Wages

1. Certain projects performed for RIT may be funded with Federal or State monies and therefore subject to Davis Bacon Prevailing Wage requirements. When specified in the Supplementary Instructions to Bidders, these RIT construction contracts will be bound by these prevailing wage requirements. Such contracts will be subject to the following provisions:
 - a. The Prevailing Wage Schedule in force at the time of the award of Contract, will become part of the Contract.
 - b. Each employee engaged in work on the project shall be paid not less than the current rate of prevailing wage, including supplemental benefit payments listed for his/her occupation.
 - c. If the prevailing rate changes after the Contract has been let, the Contractor is required to pay not less than the new rate that is prevailing at the time the work is performed at no change in contract price.
 - d. Certified payrolls, documenting compliance with the Prevailing Wage Rates shall be submitted with each application for payment.
2. Current prevailing wage schedules may be obtained at <https://sam.gov/content/wage-determinations>.

Appendix 1 – CAD Specifications

1. General
 - a. CAD files are required on all alteration, addition, and new construction projects.
 - b. The CAD Specifications shall apply to all CAD programs, specifically Revit and AutoCAD.
 - c. This document outlines content and formatting requirements within the project CAD files.
 - d. Reference DSR 5 for submission / file transfer requirements.
2. Space Data
 - a. Room Numbers
 - i. All room numbers and names will be assigned by the Planning & Design department during the Design Development phase. Any changes to the wall layouts or door locations after the initial room numbering assignments have been issued shall require a review by the Planning & Design department. It is the Architect's responsibility to notify RIT of the changes and obtain updated room numbers, if any.
 - ii. For each space with an assigned room number, include the room number, room name, and square footage in the room identity information.
 - iii. Room number shall be written using the "TEXT" command on the layer named "EC1 Space Numbers"; color 7-White. Do not use the "MTEXT" command.
 - b. Architect shall draft Area Polylines in all AutoCAD file submissions for new buildings or building additions.
 - i. Used to define total building gross square footage, indicative of the gross footprint of the building / floor.
 - ii. Draw on the layer named "EC1 Area Polygons"; color 6-Magenta.
 - iii. Use the "close" command to complete polygon.
 - iv. Two polylines shall be included: one for the outside face of the exterior wall perimeter; one for the inside face of the exterior wall perimeter.
 - c. Architect shall draft Space Polylines in all AutoCAD file submissions for each individual room / space in which the layout was altered.
 - i. Used to define room / space square footage.
 - ii. Draw on the layer named "EC1 Space Polygons"; color 3-Green.
 - iii. Use the "close" command to complete polygon.
 - iv. Draw on the dominant interior face of the exterior wall and party walls, regardless of thickness or material type. For small enclosures built against the exterior wall, place line on the interior face of the exterior wall.
 - v. If an enclosed space is located between a room and a corridor (such as a pipe chase), it is not included in any room SF. It does still require a space polygon.
 - vi. Mechanical equipment and related piping and ductwork located inside walls will not be considered when locating polylines.
3. Drawing Content
 - a. Revit files shall be a modeled version of the physically-built environment. AutoCAD files shall be a line drawing representation of the physically-built environment. Files used during the design phases shall be maintained throughout the life of the project, concluding at Record Documents. The files shall be updated through Construction and shall include all addenda, bulletins, sketches, etc.
 - b. Revit file requirements include the following:
 - i. Accurate layout of building elements including walls, doors, windows, mullions, ramps, stairs, and MEP equipment, fixtures, piping, conduit, ductwork, structural steel, etc.
 - ii. Optional: actual materials, textures, and colors used on all building element surfaces (walls, floors, doors, windows). Ensure associated material reference folders are included with submission of Revit files.
 - c. AutoCAD file requirements include the following:
 - i. Accurate layout of building elements including walls, doors, windows, mullions, ramps, stairs, and MEP equipment, fixtures, piping, conduit, ductwork, structural steel, etc.
 - ii. Each floor shall have its own file.
 - iii. Terms and Abbreviations: Refer to UDS Module 5.
 - iv. Layers: Drawings shall use the NCS Standard (AIA CAD Layer Standard). No drawing objects will be stored on layer '0' (zero) or layer 'Defpoints'.
 - v. Lineweights, Linetypes, Colors: Plot using the **RIT Standard BW.ctb** file as the basis for your own plotter configurations to provide proper colors and lineweights per the RIT Specifications. Do not change the file in any way. Contact the Design Manager for .ctb file.

- vi. Text and Font:
 - 1. Notes with leaders shall be one entity. Use multi-leaders at scale in which drawing will be printed. Do not explode or break apart text from leader.
 - 2. Maintain, at minimum, .9 line space factor between text lines. Maintain, at minimum, .75 font width factor between letters.
- vii. Blocks and Hatching
 - 1. Refer to Module 6 of the UDS for Standard Reference Symbols.
 - 2. All blocks will be created using "By Layer".
 - 3. Size blocks in relation to the drawing plot scale.
 - 4. Fill in any attribute fields that are included in the block.
 - 5. Do not mirror blocks.
 - 6. Temporary blocks used in drawing creation should be exploded and purged out of the drawing. This includes entities that are copied/pasted within or between drawing files.
 - 7. RIT follows no hatch standards. Patterns, scales, angles are selected at user's discretion. However, hatching should occur on the associated service layer with appropriate linetypes, lineweights, scales, and colors.
- 4. Drawing Sheets
 - a. All drawings shall use the RIT Title Border file. Contact the Design Manger for title border file.
 - b. Floor plans shall not be less than 1/8" = 1'-0". All final drawings shall conform to ARCH D (24" x 36") plot size. ARCH E (36" x 48") will be accepted with approval from the Design Manger.
 - c. Cover sheet shall include, but is not limited to,
 - i. RIT Project Number
 - ii. Official Project Title
 - iii. Location on RIT Campus, including building name, building number, floor, etc.
 - iv. Architect and Engineer name and address
 - v. Professional seal and signature (include on all drawings)as required by NYS Department of State
 - vi. Addendum number and date if applicable
 - d. All services shall have dedicated drawing sheets, as outlined per section 5b. Additional requirements may be necessary:
 - i. Security and Access systems shall have dedicated drawing sheets, including motion sensors, door sensors/switches, door lock releases, key card readers, central stations, with spaces indicated.
 - ii. Any special fire systems shall have dedicated drawing sheets (foam, other); indicate system type, area served, component locations, discharge nozzles, detectors, connections to alarm/power/HVAC.
- 5. Sheet Organization (reference UDS Module 1)
 - a. Format: Discipline Designator and Sequence Number. Example: A101-R1
 - b. Discipline Designators (Reference UDS Module 1):

Order Sequence	Designator	Discipline
1	G	General
2	H	Hazardous Materials
3	V	Survey/Mapping
4	B	Geotechnical
5	C	Civil
6	L	Landscape
7	S	Structural
8	A	Architectural
9	I	Interiors
10	Q	Equipment
11	FA	Fire Alarm
12	FP	Fire Protection / Sprinkler
13	P	Plumbing
14	M	Mechanical / HVAC (Ductwork and Piping)
15	E	Electrical (Lighting and Power)
16	T	Telecommunications (A/V, Phone, Data, Systems)
18	R	Resource

c. Sheet Type Designators (Reference UDS Module 1):

Numerical Series	Description
000	General (symbol legend, abbreviations, notes)
100	Plans
200	Elevations
300	Sections
400	Large Scale Drawings, Interior Elevations
500	Details
600	Schedules and Diagrams
900	3D Representations (isometrics, photographs, etc.)

6. Text Styles

- a. All text shall be 1/8" or 3/8" height when plotted.
- b. Create all text in uppercase lettering, except for industry standard recognized unit designators (kHz, Vac, etc.) Sheets that consist mainly of text may use lowercase lettering.
- c. Text shall read from left or bottom of sheet.
- d. Approved fonts include,
 - Georgia – used for titles, headings, etc. ("RIT" font).
 - Arial – used for notes and general information.

7. Dimensions

- a. Specify dimensions of less than one foot in inches and use zero suppression.
- b. Specify dimensions one foot or greater in feet and inches.
- c. Do not stack fractions.
- d. Locate dimension text above dimension line. Text must be read from left or bottom of page.
- e. Arrows, slashes, ticks are all acceptable arrowheads; keep consistent throughout drawing set.

End of Division 00

DIVISION 01 – GENERAL REQUIREMENTS**01 31 19 – Meetings**

1. During the project design phase, conduct a minimal of four review meetings per project: stakeholders meeting (programming), SD design review, DD design review, and CD design review.
2. A/E firm is responsible for documenting meeting minutes and distributing within 4 days of the meeting.
3. See the Detail of Services and Responsibilities (DSR) for more information.

01 33 00 – Submittal Procedures

1. Submittals shall be transmitted via method determined by RIT Project Manager.
2. Required submittal types
 - a. Product Data, Shop Drawings
 - b. MDS
 - c. Certifications
3. All products used in construction shall be submitted by the contractor and reviewed by the design team and RIT FMS.
4. Reference RIT *General Conditions of the Contract for Construction*, found at <https://www.rit.edu/fa/procurement/construction/constructiondocs.html>

01 33 29 – Sustainable Design Reporting

1. Reference NYSERDA and LEED Construction Process document, <https://www.rit.edu/facilitiesmanagement/sites/rit.edu.facilitiesmanagement/files/Vendor%20Contractor%20Info/Design%20and%20Construction%20Guidelines/RIT%20FMS%20NYSERDA%20Process%2009%202012.pdf>

01 44 19 – Contractor Rules

1. Project Administration
 - a. Provide a work schedule prior to starting work.
 - b. Ensure that a Workforce Log (available from FMS) is completed daily and submitted weekly.
 - c. Submit detail documentation for any T & M work.
 - d. Obtain the Project Manager's approval prior to undertaking any changes that will incur additional cost.
 - e. Provide record drawing files, as-built files, O&M manuals, and other materials outlines in the Detail of Services and Responsibilities (DSR) at end of jobs.
2. Conduct
 - a. Respect students, faculty, and staff. Harassment (e.g. leering or use of foul language) or disturbance (e.g. radios or loud talking) will not be tolerated.
 - b. Assure workers are properly attired.
 - c. Normal work hours are 7:00 AM to 3:30 PM unless prior arrangements are made with the Project Manager.
 - d. Smoke in approved areas only. There is no smoking inside any buildings.
 - e. No two-way radios or cell phones are allowed inside Wallace Library.
3. Housekeeping
 - a. Clean worksite daily.
4. Communication
 - a. Ensure that the Project Manager is advised of any deviations from schedule or scope.
 - b. Do not take directions from anyone but the Project Manager.
5. Teamwork
 - a. Take ownership of every facet of the project, and maintain an owner's perspective of quality balanced with budget.
6. Accidents and Emergencies
 - a. Report any accident to Campus Safety.
 - b. Call Campus Safety (475-3333) to request emergency or ambulatory assistance.
7. Keys
 - a. Obtain necessary keys from Project Manager prior to starting work.
 - b. A \$500 fine will be imposed for lost keys.
8. Shutdowns
 - a. Give advance notice of and get approval for Utility and/or Fire Alarm shutdown ten working days in advance.
9. Fire Alarms

- a. Bag smoke detectors within or adjacent to the work area prior to starting work each day. Bags must be removed at the end of each day. A \$500 fine will be imposed for each avoidable false alarm.
10. Safety
- a. Be aware of the deaf and hard of hearing population on campus (delivery vehicles, forklifts, cranes, etc. must utilize flagmen).
 - b. Comply with all codes and safety rules, regulations, practices.
 - c. Apply for a Hot work permit on the Environmental Health and Safety website, <https://www.rit.edu/ehs/hot-work-permit-program>
 - d. Reference Section 00 73 19 for further safety requirements.
11. Parking and Transportation
- a. All vehicles parked in campus lots must have valid parking permits, available through Project Manager.
 - b. No vehicle shall be permitted to park on grass areas or pedestrian walkways unless specifically authorized by Project Manager.
 - c. The contractor shall not store vehicles, equipment, or material on campus property without approval.
 - d. Loading and unloading of equipment shall be performed at the location determined by Project Manager.
 - e. Parking for workers shall be determined by Project Manager. Workers will need to be shuttled to the site as needed.
 - f. Each site has unique requirements for student and faculty safety and convenience that will impact the location and type of construction safety fencing, barricades, signage, etc. The bid documents shall require that the contractor prepare a plan for these items for review with the Project Manager before commencing with the project.
 - g. Park only in "General" parking spots in regular parking lots and display contractor permits.
 - h. Driving or parking on sidewalks is prohibited.
 - i. Fire Gates are to remain locked at all times. If you need to open a gate to drive through, you must stop and lock it immediately behind you.
 - j. Citations issued to contractors must be paid within 10 days. Parking passes will not be issued to contractors with outstanding citations.
 - k. Acquire a parking permit via the web-based form on the Parking and Transportation website, <https://www.rit.edu/parking/vendors-contractors>

01 50 00 – Temporary Facilities and Controls

1. Contractor may be permitted to use existing utility services for minor renovation projects with Owner's permission. Design team needs to confirm availability before issuing bid documents.
2. Temporary Facilities
 - a. Enclose construction area with fence; coordinate product with owner. Reference RIT *General Conditions of the Contract for Construction*, found at <https://www.rit.edu/fa/procurement/construction/constructiondocs.html>
 - b. Provide self-contained toilet units as required.
 - c. Field Offices: Provide separate offices for contractor as required. Local permitting for office trailer use is the responsibility of the contractor.
3. Contractor shall provide and maintain signage that restricts access to site of all persons not employed by contractor or authorized university employees.

01 73 29 – Cutting and Patching

Reference RIT *General Conditions of the Contract for Construction*, found at <https://www.rit.edu/fa/procurement/construction/constructiondocs.html>

01 77 19 – Closeout Requirements

1. A punch list walkthrough shall be performed prior to project closeout.
2. Refer to Division 1 Appendix 2 for documents required throughout phases of project and as-built requirements.
3. Retainage shall be paid in response to obtaining all close-out documents.

01 78 46 – Extra Stock Materials

1. No attic stock shall be purchased unless otherwise noted during the design phase.
2. Any unused or leftover finishes and fixtures shall be turned over to RIT unless noted otherwise.

01 81 13 – Sustainable Design Requirements (RIT Climate Action Plan)

1. Adhere to RIT's Climate Commitment, <https://www.rit.edu/sustainablecampus/climate-commitment>

01 84 00 – Space Definitions and Guidelines

1. Offices
 - a. Types
 - i. Closed; visual and audible separation with full walls or panels to or through the ceiling, lockable door, natural light preferable but not required
 - ii. Semi-Closed; visual separation and partial audible separation with (approximate) 84" high walls or panels, door, borrowed light preferable but not required
 - iii. Semi-Open; shared office space with partial height panels providing visual separation when seated
 - iv. Open; shared office space with screen separation of work areas
 - b. Appendix 1 shows the recommended NASF for a person by position type. These guidelines are not a guarantee that an employee or affiliate of the University will receive a specific office type or amount of square feet, but rather defines the maximum NASF an employee should occupy. NASF is defined as the area of a building suitable for occupancy, measured from the interior walls, including closets and secondary corridors within assignable space. This excludes main corridors, bathrooms and other non-assignable space.
2. Restroom Types
 - a. Student / staff only
 - i. Used on a general/daily basis by local occupants and the overall campus community
 - ii. Not typically used by public; used by public only during special events like open houses, festivals, etc.
 - b. High-profile / public-facing
 - i. Intended for the general public in public-access buildings/spaces
 - ii. Locations include public-facing areas in/near event centers, cafeterias, sports arenas, theaters, auditoriums

01 89 00 – Site and Parking Lot Design Standards

1. Include the following notes and specifications in engineering packages.
 - a. Approved drawings
 - b. Schedule of work
 - c. Call both RIT and Dig Safely at least four days in advance for utility stakeouts.
 - d. Provide survey/utility drawing based on RIT datum.
 - e. Provide and maintain erosion control as noted on plan prior to start.
 - f. Provide proper signage during construction to maintain traffic flow.
 - g. Provide required maintenance and protection of traffic.
 - h. Strip and stockpile topsoil on site per RIT direction. Discuss requirements **per project** with Grounds Foreman prior to issuing bid drawings.
 - i. Excess non topsoil to be determined by RIT if left on site or removed from site.
 - j. Provide required temporary and permanent signage.
2. A turning radius of 43 feet shall be required for RIT shuttle busses.

Appendix 1 – Position NASF Table

	Position/Title	Area (SF)	Type			
			Closed	Semi-Closed	Semi-Open	Open
EXEC	President	360	X			
	Provost	240	X			
	Sr. Vice President	240	X			
ACADEMIC	Dean / Associate Provost	240	X			
	Associate/Assistant Dean	120	X			
	Administrative/Chair	120	X			
	Tenured / Tenure-Track	96	X			
	Non-Tenure Track	96	X	X		
	Adjunct	24			X	X
	Post-Doc	80		X	X	
	Grad Student - PhD	48			X	X
	Grad Student – Masters TA or RA	48			X	X
	Grad student – Masters Research	24				X
	Grad Student – Masters FA/Architecture	80/48			X	X
	ADMINISTRATIVE	Vice President	240	X		
Associate/Assistant Vice President		120	X			
Director		120	X			
Associate/Assistant Director		96	X			
Manager/Supervisor		96	X			
Full-time Exempt Staff		96/80	X	X		
Full-time Non-Exempt Staff		96/80	X	X		
Part-time Non-Exempt Staff		80/48		X	X	
Temporary Full-time (IE: Coop)		80/48		X	X	
Temporary Part-time (IE: Student Emp)		48/24			X	X
GENERAL	Department Office and Reception (per module) [1 mod ≤ 10 HC < 2 mod ≤ 80 HC < 3 mod]	96				
	Conference (per FT faculty / staff HC)	25				
	Collaboration (per FT grad and undergrad student HC)	2.5				
	Lounge/Gathering (per FT / staff HC)	10				
	Office Support (% of office NASF)	25%				

HC: head count
FT: Full-time
Mod: module

Appendix 2 – Project Record Documents

1. General

- a. The Architect and Engineer shall provide RIT with the following digital files that reflect the final, constructed conditions of the project during Closeout:
 - i. As-Built Drawings
 - ii. Record Drawings
 - iii. Model
 - iv. O&M Manuals
 - v. Approved Submittals
 - vi. Warranty Letters
- b. The Architect and Engineer must submit one copy of all project-related Revit and AutoCAD drawing files on USB-drive or via file share site along with electronic PDF files of all record drawings, as-built markups, and O&M Manuals. Drawings must follow conventions and guidelines outlined in this specification in addition to those outlined in the RIT CAD Specifications.
- c. Submit a list, using Microsoft Word (.doc) or Microsoft Excel (.xls), of all drawings included in the submittal package, including drawing numbers, titles, and file names. The A/E firm is responsible for including any copyright information or restrictions pertaining to these documents.

2. Revit models are required on all construction projects with a total project funding of **\$2,000,000 or greater**.

- a. The final Revit files used in the Design Services phases of a project, including all project revisions and modifications, shall be transmitted to RIT according to section 6. Schedule.
- b. Submit separate building models for each trade, not part of a worksharing central file.
- c. All models must be drawn using at least Revit 2016 version and not more recent than Revit 2020. Files shall be .rvt file extension and not password protected.
- d. Revit models shall include all geometry, physical characteristics, and product data needed to accurately represent the design and construction work of a project. Drawing sheets, schedules, simulations, and services required for assessment, review, bidding, and construction shall be extractions from this model.
- e. Any use of Revit translation software must result in 100% compatibility with the RIT computer hardware and software.
- f. Purge all unused items before submitting.
- g. Remove all unnecessary links.
- h. Providing Revit files does not preclude also providing AutoCAD files.

3. AutoCAD files are required on **all** alteration, addition, and new construction projects.

- i. "Repair" or "replace in kind" projects do not require AutoCAD files. Examples: removing an existing door to install a new door would not require AutoCAD files; moving a door location would require AutoCAD files.
- j. The final AutoCAD files used in the Design Services phases of a building project, including all up-to-date revisions and modifications, shall be transmitted to RIT according to section 7. Schedule.
- k. Submit separate files for each trade.
- l. All models must be saved as an AutoCAD 2013 version. Files shall be .dwg file extension and not be password protected.
- m. AutoCAD files shall include all geometry, physical characteristics, and product data needed to accurately represent the design and construction work of a project. Drawing sheets shall be extractions from this file.
- n. Any use of AutoCAD translation software must result in 100% compatibility with the RIT computer hardware and software.
- o. Apply the following settings prior to submitting:
 - i. Convert all 3D objects to 2D. All linework should be at elevation 0'-0".
 - ii. Use the "PURGE" command to remove ALL unused objects (blocks, dimstyles, layers, linetypes, shapes, materials, styles, etc.).
 - iii. Turn off "SNAP" and "GRID".
 - iv. Change the background color to BLACK.
 - v. Lock all viewports.
 - vi. Name the Layout tabs as intended for printing using drawing designators outlined in section the CAD Specifications.
 - vii. Remove all unused Xref files, and use the "BIND" command to attach all Xref files to the drawing files on the 0 – XREF layer.

4. PDF files are required on all construction projects, regardless of total project funding or scope.

- p. The final PDF files used in the Design Services phases of a project, including all project revisions and modifications, shall be transmitted to RIT according to section 6. Schedule.
 - q. The files shall not be password protected.
 - r. Each sheet shall be its own unique file.
 - s. For construction projects with a total project funding of \$500,000 or greater, PDF files shall be created as a plot from the Revit model or AutoCAD drawing, scaled appropriately on ARCH D or ARCH E size media. Include all geometry, physical characteristics, and product data needed to describe final constructed conditions of a project.
 - t. Scanned As-Built PDF drawing files are required for all construction projects.
 - i. Markup construction drawings with red line edits as applicable. If no construction drawing was provided initially, contractor shall provide a sketch layout showing project scope and constructed conditions.
5. Operation and Maintenance (O&M) Manuals are required on all construction projects. The files shall include all installed equipment and materials.
- u. Provide PDF digital files of equipment O&M manuals in addition to approved submittals, warranty letters, inspection certificates.
 - v. Files shall be organized appropriately as per CSI Masterformat Divisions.
6. Schedule (copy from DSR 5)

<i>Items</i>	<i>File Format</i>
DSR 1 – Program Verification and Concept Design Report	PDF
DSR 2 – Schematic Design Report	PDF
DSR 3 – Design Development Report	PDF
DSR 4 – Construction Documents and Bidding 90-95% Drawings and Specifications Review Set "Issued for Permit" Drawings "Issued for Bid" Drawings Project Manual	PDF As requested by local authority PDF, DWG floor plans PDF
DSR 5 – Construction Administration and Closeout "Issued for Construction" Drawings Certificate of Occupancy As-Built Drawings (all trades) Record Drawings (final, constructed conditions) Digital Model (final, constructed conditions) O&M Manuals Approved Submittals Warranty Letters	PDF, DWG floor plans PDF PDF PDF, DWG RVT PDF PDF PDF

End of Division 01

DIVISION 02 – EXISTING CONDITIONS

02 26 00 – Asbestos Containing Materials Reference

1. The owner shall require certification that all materials included in any work completed by the Contractor will be free of asbestos. Acceptable certification will be Safety Data Sheets (SDS) for each type of material.
2. For purposes of this requirement, materials include but are not limited to the following,
 - a. Surface Treatments
 - Fireproofing
 - Finish plasters
 - Acoustical plaster
 - Skim coats of joint compound
 - b. Thermal System Insulation
 - Equipment insulation
 - Boiler, breeching, boiler rope, duct or tank insulation, cement or mortar used for boilers and refractory brick
 - Piping and fitting insulation including but not limited to wrapped paper, aircell, millboard, rope, cork, perforated plaster, job-molded plaster and coverings over fibrous glass insulation
 - c. Roofing and Siding Miscellaneous Materials
 - Insulation board
 - Coatings
 - Flashing
 - Cementitious board (transite)
 - Non-metallic or non-wood roof decking
 - Vapor barriers
 - Felts
 - Shingles
 - Galbestos
 - d. Other Miscellaneous Materials
 - Floor tile
 - Cove base
 - Ceiling tile
 - Vibration isolators
 - Chalkboards
 - Electrical wire insulation
 - Fire blankets
 - Brakes and clutches
 - Caulks
 - Wallpaper
 - Plasterboard
 - Textured paint
 - Glazing compound
 - Gaskets, seals, sealants (including for condensate control)
 - Floor leveling compound
 - Vermiculite insulation
 - Laboratory tables and hoods
 - Cementitious board
 - Fire curtains
 - Fire doors
 - Mastics, adhesives, glues
 - Sheet flooring
 - Drywall
 - Spackling/joint compound
 - Grout
 - Terrazzo

END OF DIVISION 02

DIVISION 03 – CONCRETE

03 01 00 – Maintenance of Concrete

1. If exposed exterior concrete is used, the Designer must include preventative measures to address potential efflorescence.

END OF DIVISION 03

DIVISION 04 – MASONRY

04 21 13 – Brick Masonry

1. RIT Belden Brick: Supplier - Weckesser #470-479 Dark A RIT Iron Spot.
2. RIT mortar mix for brick: C-2 ESS ROC/RIVERTON-FLAMINGO.
3. RIT caulk for brick areas: Sika-Flex or equal as approved by owner, "Redwood Tan".

END OF DIVISION 04

DIVISION 05 – METALS

05 05 13 – Shop-Applied Coatings for Metal

1. Exterior architectural metal work is to be powder-coated semi-gloss in color, exceptions on a case by case basis approved by the Director of Campus Planning & Design Services.

END OF DIVISION 05

DIVISION 06 – WOODS, PLASTICS, AND COMPOSITES**06 41 00 – Architectural Wood Casework**

1. General
 - a. Manufactured with low emitting materials; adhesives and composite wood products containing no added urea formaldehyde.
 - b. Mechanical joinery with body components secured utilizing concealed interlocking mechanical fasteners.
 - c. Finish at fabrication shops. Defer only final touchup, cleaning, and polishing until after installation.
 - d. Provide filler and closure panels where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated appliances. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.
 - e. Provide knee space / modesty panels at spaces between base cabinets, where cabinets are not installed against wall or where space is not otherwise closed. Fabricate from same material and with same finish as exposed cabinet backs.
 - f. Casework shall be designed to standard sizes.
 - g. Provide rubber under-sink mat with lip for all sink cabinets.
2. Plastic-Laminate Cabinets
 - a. Acceptable Manufacturers:
 - i. Formica
 - ii. Wilsonart
 - b. Cladding for exposed surfaces shall be high-pressure decorative laminate, graded to the following standards:
 - i. Horizontal surfaces other than tops: Horizontal Grade Standard (HGS)
 - ii. Post-formed surfaces: Horizontal General Purpose (HGP)
 - iii. Vertical surfaces: Vertical Grade Post (VGP)
 - iv. Edge banding: Acrylonitrile Butadiene Styrene (ABS)
 - c. Grain Direction for Wood Grain Plastic Laminate
 - i. Vertical on doors, horizontal on drawer fronts
 - ii. Lengthwise on face frame members
 - iii. Vertical on end panels
 - iv. Side to side on bottoms and tops of units
 - v. Vertical on knee-space panels
 - vi. Vertical on aprons
 - d. Construction
 - i. AWI flush overlay
 - ii. NEMA LD 3, grades as indicated or as required by woodwork quality standard
 - iii. Base Cabinets: 24" deep unless noted otherwise
 - iv. Overhead wall-mounted cabinets: 12" deep unless noted otherwise
 - v. Bottoms of base cabinets and tall cabinets: 3/4" inch thick hardwood plywood
 - vi. Bottoms of wall and upper casework: 1" thick
 - vii. Tops and bottoms of wall cabinets and tops of tall cabinets: 1" thick
 - viii. Ends of cabinets: 3/4" thick
 - ix. Shelves: 1" thick
 - x. Drawer fronts: 3/4" thick
 - xi. Drawer sides and backs: Four-sided drawer box with back, front and sides, 1/2" thick with chemical resistant finish and finished top edges. Sides shall be joined by multiple dovetail all four corners.
 - xii. Drawer bottoms: 1/4" thick white coated MDF board, inset into all four sides of drawer box and sealed with hot melt glue process around entire drawer bottom perimeter.
 - xiii. Doors: 3/4" thick

06 41 93 – Cabinet and Drawer Hardware

1. General
 - a. Finish shall be brushed nickel unless noted otherwise.
2. Hinges
 - a. Use concealed European hinges.
 - b. Provide two hinges for doors up to 36" high.
 - c. Provide three hinges for doors up to 60" high.

- d. Provide four hinges for doors up to 84" high.
- 3. Pulls / Handles
 - a. Typical Wall and Base Cabinets
 - i. Heavy-duty aluminum wire institutional type
 - ii. One pull on drawings less than 27" wide and two pulls on drawers 27" wide and larger.
 - iii. Anchored at 4" on center.
 - b. Specialty Wall and Base Cabinets specified to receive wood veneer casework
 - i. Basis of Design: Richelieu modern metal pull #5632; 5-1/32"; finish as specified
 - ii. One pull on drawings less than 27" wide and two pulls on drawers 27" wide and larger.
 - c. Tall Cabinets
 - i. Three-point locking systems consisting of dummy handle on left hand door and three-point locking handle on right door, providing positive latching engagement at top, bottom and middle of door.
 - ii. Rod ends for three-point system extend into cabinet body and have a steel plate guide to protect the anchoring hole from wear.
- 3. Magnetic Catches
 - a. Basis of design: KV 918 ALUM Heavy-Duty Aluminum Magnetic Catch; 2-1/16" by 1"; pull strength of approximately 7 pounds; aluminum finish
 - b. Screw-mounted catch and strike plate have slotted holes for adjustability
 - c. Provide one catch for doors up to 36" high.
 - d. Provide two catches for doors 36" high or greater; located top and bottom.
- 4. Drawer Slides
 - a. BHMA A156.9, B05091
 - b. Heavy-duty, side-mounted, full-extension, zinc-plated steel ball-bearing
 - c. 100 lb. load capacity
- 5. Locks
 - a. Provided where shown or noted only.
 - b. Cylinder type, die-cast, five disc tumbler mechanism with removable core
 - c. Inactive door shall be secured by using an elbow catch.
 - d. Key as directed by RIT. Typical options:
 - i. Keyed differently by room
 - ii. Keyed differently by department
 - e. Provide two keys for each lock or fewer if approved by RIT.

END OF DIVISION 06

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 20 00 – Thermal Protection

1. Envelope performance requirements for new buildings shall exceed the minimum requirements of the Energy Conservation Construction Code of NY State by a minimum of 10% and comply with RIT's Climate Action Plan (CAP) unless otherwise determined by the Director of Planning and Design.
2. Envelope to meet the requirements of ASHRAE Standard 55-2010, Thermal Comfort Conditions for Human Occupancy, with errata or local equivalent.

07 53 23 - Ethylene-Propylene-Diene-Monomer Roofing

1. Basis of Design: Carlisle Golden Seal Total Roofing System with 30-year warranty; 75 mil reinforced EPDM membrane fully adhered.

07 72 00 – Roof Accessories

1. Pitch pockets shall not be used for roof penetrations for conduit or piping.
2. Cones or "witches hats" with a stainless steel "radiator hose" style clamp (with stainless steel worm screw) shall be used.
3. For multiple or large pipes, a "dog house" box shall be used with pipes and conduits exiting the side wall of the box.
4. Roof scuppers:
 - a. Roof scuppers are required by RIT and by code. Scupper serves as secondary roof drain system. Scupper shall be open to daylight.
 - b. Primary roof drains shall be installed and piped to storm drain.

07 80 00 – Fire and Smoke Protection

1. Fire-stopping to be performed by a Fire-Stopping Contractor. There shall only be one fire-stopping contractor per project to cover the work of all trades. Tested and approved fire-stopping details and assembly numbers are to be included in the A/E permit and bid drawings. Contractor to submit fire-stopping package for review and comment.
2. All fire separations (fire walls, fire barriers and fire partitions) shall be labeled "Fire Rated x Hours" (where x is the time) above the ceiling. Labeling to be stencil painted or applied vinyl graphic in red color with min. 3" high letters in sans serif font, such as 'Arial', with min. 1/2" brush stroke; located at maximum 20'-0" intervals and positioned so as not obstructed by ductwork and/or piping.

END OF DIVISION 07

DIVISION 08 – OPENINGS**08 11 13 – Metal Doors and Frames**

1. Door frames shall be painted to match wall on which it is installed unless noted otherwise. Reference Division 09 91 23 for door and frame paint comments.
2. In renovation projects, door frames and panels shall receive fresh coat of paint, color as noted by RIT Planning and Design or construction drawings.
3. Provide welded door frame in lieu of knockdown unless otherwise noted.

08 11 16 – Aluminum Doors and Frames

1. Sections acts as reference for furniture standards for full height architectural wall systems.
2. Warranty Period: 10 years from date of substantial completion.
3. Interior Glazed Aluminum Curtain Walls
 - a. Basis of Design: EFCO Series 401 framing; EFCO D200 or D300 Stile doors. Kawneer substitution subject to approval by RIT.
4. Interior Fire-Rated Glazed Aluminum Curtain Walls
 - a. Basis of Design: TGP “Fireframes” frame system with wide-stile Designer Series doors and “Pilkington Pyrostop” glazing. SAFTI FIRST and Kawneer substitutions subject to approval by RIT. Aluflam is not accepted.
5. Legacy steel framed assemblies to be replaced in kind unless noted otherwise.

08 42 00 – Entrances

1. Main Entrance – New Building
 - a. Exposed metal structural elements: basis of design is extruded aluminum anodized, heavy duty profile; changes to be approved by the Director of Campus Planning and Design Services on a case by case basis.
 - b. Doors to be heavy duty high use rating with continuous hinges (see 08 71 00 – Hardware).
 - c. In addition to code requirements for doors and openings, glazing shall be clear, ¾” insulated (see 08 80 00 – Glazing).
 - d. In addition to being ADA compliant in design, provide electric push-button power-assist actuators (manufacturer: LCN) accessible on approach and exit at each main entrance.
 - e. Provide hydronic snow melt systems and walk-off mats.
 - f. Reference Division 21 for Fire Suppression requirements.
 - g. Reference Division 28 for Electronic Safety and Security requirements.
2. Main Entrance – Existing Building
 - a. Design to match existing architectural vocabulary of existing system and building.
 - b. Approved by RIT Planning and Design Services.

08 71 00 – Hardware

1. General
 - a. A power-assist door operator shall be provided at the following locations,
 - i. On one leaf at each building entrance
 - ii. Any circulation fire-rated door with a pull force greater than 5 pounds; if double door, only one leaf required to have power-assist operator
 - b. One card-reader shall be provided at the primary building entrance.
 - c. Card swipe electronic access to certain interior spaces may be required on a project and program specific basis; design for electric strike, coordinate electric strike and hardware with access system provider.
 - d. Use electric strikes in lieu of electrified locksets for interior or exterior applications. Do not use Mag Locks. Locks shall default to the “Locked” mode during a power failure.
 - e. Locking and latching hardware is subject to ADA Technical Requirements concerning access for disabled persons. Conformance to such requirements, as well as other building code or life safety regulations, is required.
 - f. Contractor to provide and install door hardware. A/E firm to confirm with RIT Project Manager prior to issuing construction documents if cores and keys are to be provided by contractor or RIT.
 - g. Reference Division 09 91 23 for door and frame paint comments.
 - h. Cylinder/lock cores, US 26D finish, to accept Schlage Everest 29 Restricted 7-pin **small format interchangeable core**.
 - i. Thresholds should have anti-slip characteristics (not 6 inch brass, which create trip hazards in winter).
 - j. For specification assistance contact:

Scott Lambe, Allegion Security and End User Hardware Consultant
(585) 747.9999 Scott.lambe@allegion.com
Gary Magnafici, Specification Hardware Consultant
(716) 399.1252 gary.magnafici@allegion.com

- k. Delivery, Storage, and Handling
 - i. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
 - ii. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - iii. Deliver keys and permanent cores to Owner by registered mail or overnight package service to RIT FMS-Lock Shop, 120 Lomb Memorial Drive, Rochester, NY 14623
- l. Key and Core Packaging Specifications
 - i. Core mark to be etched in the metal (no ink) on each core. Etch to be on side of core so that it is concealed when installed.
 - ii. Keys are to be packaged individually and labeled with core mark and door location.
 - iii. All keys are to be serialized.
2. Interior Non-Rated Assemblies Specifications
 - a. Finish: Brush Chrome unless noted otherwise
 - b. Refer to following table for models. Any deviations shall be approved by the Design Manager.

<i>Item</i>	<i>Manufacturer</i>	<i>Model</i>	<i>Comments</i>
Lockset, Cylindrical	Schlage	ND Series RHO US26D	Specific function TBD
Lockset, Mortise	Schlage	L9000 Series 06A	Specific function TBD
Hinge	Ives	5BB1HW 4.5" x 4.5" 652	Non-Removable Pins (NRP)
Door Stop, Wall	Ives	WS406/407-CVX US26D	
Door Stop, Floor	Ives	FS13 US26D	
Door Silencer	Ives	SR64	
Smoke Seal	Zero	488	
Door Sweep	Zero	8192 / 8197 / 8198	Verify hard bristle / neoprene with RIT
Closer	LCN	4011/4111 689	Specific arm TBD
Pull Plate	Ives	8302-0 4" x 16" US32D	10" center to center
Push Plate	Ives	8200 4" x 16" US32D	
Kick Plate	Ives	8400 10" x 34" US32D	Width determined by door
Panic Bar / Push Pad	Von Duprin	99 Series	HM door applications; cylinder dogging as specified by project
Panic Bar / Push Pad	Von Duprin	33A Series	Narrow stile door applications
Power-Assist Door Operator	LCN	4630/4640	Reference 08 71 00, Section 1a
Electromagnetic Holder	LCN	SEM7830/7850 689	Recessed preferred
Electric Strike	Von Duprin	6000 Series	Specific function TBD
Electric Strike	Locknetics	RS	Specific function TBD
Lock Guard	Ives	LG14	Specific function TBD
Touchless Actuator	LCN	8300 Series	Interior use only
Push-Button Actuator	LCN	8300 Series	Exterior

3. Exterior Specifications
 - a. Finish:
 - i. New buildings: finishes determined during design with RIT Planning & Design
 - ii. Renovation work: bronze finish (to match existing)
 - b. Exit Devices: VonDuprin (function to suit situation)
 - c. Pulls: Ives 8190EZHD or Rockwood TBF158, bronze (1" diameter tubular pull, 12" center to center, 3-1/2" projection, 4" offset)
 - d. Hinges: Roton #780-224 HD, bronze
 - e. Closers: LCN #4114H Cush-n-Stop, bronze (HD arm is std.)
 - f. At exterior doors where wind resistance is a major concern, the swing door operator shall be the Besam SW200i by ASSA ABLOY.

4. Function Sets
 - a. Set #1: Entrance
 - i. Lockset: Schlage, ND53BD x RHO, for 7 pin small format interchangeable core, US26D finish, office function, key on outside - push and turn button
 - ii. Typical use: office and suite doors without card access
 - b. Set #2: Classroom
 - i. Lockset: Schlage, ND70BD x RHO, for 7 pin small format interchangeable core, US26D finish, classroom lock, outside lock/unlock - key only
 - ii. Typical use: classrooms without card access
 - c. Set #3: Store Room
 - i. Lockset: Schlage, ND80BD x RHO, for 7 pin small format interchangeable core, US26D finish, store room function, always locked – operated by key only
 - ii. Typical use: offices, suite, and classrooms with card access; doors that remain locked from outside at all times
 - d. Set #4: Passage
 - i. Lockset: Schlage, ND10S x RHO, US26D finish, passage set, no lock
 - ii. Typical use: doors that remain unlocked at all times
 - e. Set #5: Privacy
 - i. Lockset: Schlage, ND40D x RHO, US26D, privacy function, push bottom
 - ii. Typical use: single-user restrooms or dressing rooms
5. Power-Assist Operators
 - a. Interior: LCN touchless actuator
 - b. Exterior: LCN push-button actuator

08 79 13 – Key Storage Equipment

1. Two “Knox” lock boxes shall be installed:
 - a. A Knox box for a building key card shall be placed at the designated entrance for use by the Fire Department.
 - b. A Knox box for building keys (fire panel, mechanical rooms, etc.) shall be mounted above the Fire Alarm Annunciator Panel or main Fire Alarm Control Panel if the control panel is in a public area.

08 80 00 – Glazing

1. New buildings: window glass color and profile to be approved by the Director of Planning and Design Services.
2. Existing buildings: match existing glass color with insulated glass profiles as approved by Director of Planning and Design Services.

END OF DIVISION 08

DIVISION 09 – FINISHES

09 06 00 – Schedules for Finishes

Install the following finishes unless noted otherwise.

Space Type	Finish		
	Flooring	Wall	Ceiling
President	Determined on a case by case basis		
Vice President	Determined on a case by case basis		
Dean	Determined on a case by case basis		
Faculty / Staff Office	Carpet	Paint	2x4 ACT
Open Office	Carpet	Paint	2x4 ACT
Office Suite Reception	Carpet; Resilient Tile	Paint; Wall Covering	2x4 ACT
Classroom	Carpet	Paint	2x4 ACT
Classroom Lab	Resilient Tile	Paint	2x4 ACT
Research Lab	Resilient Tile; Resinous	Paint	2x4 ACT
Student Lounge	Carpet	Paint	2x4 ACT
Toilet Room	Resinous; Ceramic Tile	Ceramic Tile (wet wall); Paint	2x4 ACT; Gypsum Board
Food Preparation and Service	Epoxy	Determined on a case by case basis	
Corridor	Textile Composite	Paint	2x4 ACT
Vestibule / Entry	Resinous	Paint	Gypsum Board
Mechanical Room	Paint	N/A	N/A

09 30 00 – Tiling

1. General
 - a. This Section Includes:
 - i. Quartz tile
 - ii. Ceramic tile
 - iii. Porcelain tiles
 - b. Locations: Toilet room floors, 'wet walls' and within 48" of plumbing fixtures, building entries, and vestibules
2. Products
 - a. Manufacturers: Dal-tile; Crossville
 - b. Epoxy grout; verify final selections with RIT prior to ordering / installing
3. Execution
 - a. Maintain minimal grout lines by using larger floor tile.

09 51 00 – Acoustical Ceilings

1. General
 - a. Design to minimize hard ceilings and provide maximum access to utilities above ceiling.
 - b. Replacement Work: match existing tile, when possible, provide standard tile and grid
 - c. All ceiling systems (grid and tile) to white, unless otherwise approved by RIT FMS Planning & Design.
2. Ceiling Height
 - a. Classrooms, Labs, Conference Rooms, and Seminar Rooms shall be 10 feet - 0 inch, not to exceed 11 feet - 0 inch, with the following exceptions:
 - i. Classrooms, Conference Rooms, and Seminar Rooms under 30 seats can be reduced to 9 feet 6 inch.

- ii. Classrooms and Auditoriums of over 65 seats should be considered an exception and the height should be raised as sight line and considerations dictate.
 - b. Offices and corridors should have a minimum ceiling height of 9 feet - 0 inch except for large office spaces and special corridors, which may be taller.
- 3. Material – Standard Specification (academic areas, classrooms, labs, and offices)
 - a. Tile: mineral board non-directional fissured, 2 feet x 4 feet x 5/8 inch, white, lay-in or tegular, sag-resistant, Class A, minimum 30 year limited warranty
 - b. Grid System: 15/16 inch exposed tee system, heavy-duty service, white
 - c. Basis for design:
 - i. Armstrong; Fine Fissured 1714 and Prelude XL or ML
 - ii. USG; Radar ClimaPlus High-durability (Educational)
- 4. Material – Special Area Specification (public areas and circulation spaces)
 - a. Review with the Director of Planning and Design Services.
 - b. Tile: Non-directional fissured, 2 feet x 4 feet x 3/4 inch, white, tegular, sag-resistant, Class A minimum 30 year limited warranty
 - c. Grid system: 15/16 inch exposed tee system, heavy-duty service, white
 - d. Basis for Design:
 - i. Armstrong Cirrus Open Plan (15/16 inch square lay-in or angled tegular)
 - ii. Armstrong Cirrus Second Look I and II (beveled tegular)
 - iii. USG Frost square lay in or fineline bevel
- 5. Material – Support Area Specification (kitchens, bathrooms, locker rooms and some labs)
 - a. Tile: 2 feet x 4 feet x 5/8 inch, white, tegular, sag-resistant, min. xx year warranty
 - b. Grid system: 15/16 inch exposed tee system, heavy-duty service, white
 - c. Basis for Design:
 - i. Kitchens: Armstrong Ceramaguard
 - ii. Toilet Rooms: Armstrong Armatuff

09 61 00 – Common Work Results for Flooring

- 1. Surface Prep
 - a. The floor shall be a smooth dense surface, free of holes, cracks, protrusions and irregularities. Repairs shall be made as necessary to provide a smooth surface for carpet and cushion installation.
 - b. The floor shall be dry; new slabs shall be cured and dried; Floors should be vacuumed, mopped if necessary, and otherwise thoroughly cleaned prior to carpet installation. Excessive use of water for cleaning is not recommended, though mopping with a slightly damp mop is useful to remove dust from the floor surface.
 - c. Surface shall be free of dust and chemicals. All contaminants that may prevent good adhesion need to be removed.
 - d. When curing compounds, hardeners, sealers, or parting compounds have been used, they must be completely removed by sanding, sandblasting or grinding prior to the installation of materials as this will impair the bond of the adhesive. A MOISTURE TEST SHALL ALWAYS BE CARRIED OUT PRIOR TO INSTALLATION.
 - e. Floor preparation products may include but are not limited to:
 - i. Concrete slab primer
 - ii. Patching compounds
 - iii. Trowel-able underlayment

09 62 00 – Textile Composite Flooring

- 1. Refer to 09 68 00 – Carpeting.
- 2. Basis of Design: J+J Flooring Kinetex and Flotex flocked Flooring by Forbo

09 64 00 – Wood Flooring

- 1. The use of hardwood floors shall be avoided and requires the authorization by Campus Architect and Directors of Planning & Design and Building Services.

09 65 13 – Resilient Base and Accessories

- 1. Wall Base
 - a. Provide 4" cove base for all flooring types unless directed or noted otherwise.
 - b. Material: Roppe 1/8" 700 Series Vinyl Cove Base or Johnsonite 1/8" Traditional Cove Wall Base.

- c. Color selections: 123 Charcoal or 193 Black Brown
 - d. Exception: when less than 50% of the entire room is affected, provide base to match.
2. Stair treads and Risers
- a. Interior exit stair treads shall be rubber tread and riser
 - i. Extreme Heavy-duty rating
 - ii. Raised texture
 - iii. Neutral gray/brown color with contrasting color flecks
 - iv. Contrasting nosing insert for traction and visual feedback
 - v. Basis of design: 'Roppe #93 textured design profile in renew color "R123 charcoal", "R194 burnt umber", or "R193 black brown".'
 - b. Stair stringers shall not have exposed metal nosing that is part of the horizontal section of step.
 - c. All stair nosings in assembly areas (occupancy type) and egress stairs shall be finished so that adequate visual feedback is provided, via color.
 - d. Final selection approved by the RIT P&D department.

09 65 16 – Resilient Sheet Flooring

1. General
- a. RIT does not typically use sheet heterogeneous/homogenous vinyl or rubber due to difficulty in replacing and repairing damaged areas.
 - b. Heterogeneous/homogenous vinyl or rubber can be used in laboratory spaces and other locations as authorized by Campus Architect and Directors of Planning & Design and Building Services.

09 65 19 – Resilient Tile Flooring

1. General
- a. Section includes
 - i. Solid rubber tile (SRT)
 - ii. Solid vinyl tile (SVT)
 - iii. Luxury Vinyl Tile (LVT)
 - iv. Vinyl composition tile (VCT)
 - v. Flexible Terrazzo Tiles (FTT)
 - b. New and existing concrete subfloors should meet the requirements of the latest edition of ASTM F710, "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring."
 - c. Locations: Solid vinyl tile, rubber tile, and resilient flexible terrazzo tiles are acceptable flooring product for use in public spaces, such as primary circulation areas.
 - i. **Vinyl composition tile should not be installed as a new flooring product. VCT can be used to patch and repair existing VCT installations and as authorized by Campus Architect and Directors of Planning & Design and Building Services.**
2. Product
- a. Minimum product specifications:
 - a. Rubber tile shall be class 1-A or 1-B per ASTM F 1344, homogeneous rubber. Rubber tile size shall be 12" x 12" or 24" x 24" and 1/8" minimum thickness.
 - b. Solid vinyl shall be monolithic tile compliant with ASTM F 1700, Class 1, rating. Tile size shall be 12"x 12" and 1/8" minimum thickness.
 - c. Resilient flexible terrazzo shall be composed of marble or granite chips with resin matrix. Tile size shall be 12" x 12" and 1/8" minimum thickness and should have a Class 1 Fire Ratings per ASTM tests E648, E662, E84.
 - d. Vinyl Composition Tile shall be Class 1 or Class 2 per ASTM F 1066. Tile should have color all the way through the cross section, not just on the surface. Select tiles with high static-load resistance to protect from indentation. Select appropriate tiles for resistance to chemicals found in the particular application. VCT tile size shall be 12" x 12" and 1/8" minimum thickness.
 - e. Resilient tile shall have a static coefficient of friction value of not less than 0.6 for level surfaces and 0.8 for ramped surfaces.
 - f. LVT/EVT shall have a minimum wear layer of 28 mils (.7mm) and a minimum 12 year limited warranty
 - a. Basis for design:
 - i. Tandus Centiva Commercial LVT – Event, Contour, and Victory
 - ii. Bentley LVT
 - iii. Mannington Commercial LVT 'Amtico'

- iv. Interface LVT
 - v. Fritztile Terrazzo Tile
3. Execution
- a. All adhesives shall be low odor and low VOC.
 - b. Elevator cab flooring shall be nora by Interface norament Arago “Unity” or approved equal; 40” x 20” tile. Alternates not accepted unless noted by RIT Planning & Design.

09 67 00 – Seamless Flooring

1. General
- a. Section includes
 - i. Methyl Methacrylate (MMA)
 - ii. Epoxy
 - iii. Polyurethane
 - b. Minimum 1 year warranty from installation date(s)
 - c. Minimum 1/8” thick
2. Products
- a. SW Decorative Mosaic Water-Based Coating System
 - i. Prime coat
 - ii. 1st Body coat
 - iii. Blended Flake Broadcast: full broadcast to refusal
 - iv. 1st Grout coat / 2nd Body coat
 - v. 2nd Blended Flake Broadcast: full broadcast to refusal
 - vi. Final Grout coat
 - vii. Urethane coat: matte finish
 - b. C.A. Reed Associates
3. Execution
- a. Seamless flooring systems should have integral wall bases (flash coving) to form a ‘bathtub’.
 - b. Installers shall provide all material spec sheets and MSDS information on product to FMS Project Manager prior to any installation
 - c. Finish level as specified by design professionals

09 68 00 – Carpeting

1. General
- a. Minimum product warranties required:
 - i. Lifetime non-prorated warranty covering delamination
 - ii. Lifetime non-prorated warranty covering edge ravel (seam zippering)
 - iii. Lifetime non-prorated warranty covering dimensional stability
 - iv. Lifetime non-prorated warranty covering resiliency
 - v. Twenty (20) year warranty against excessive surface wear or more than 15% loss of pile fiber weight measured before and after use.
 - vi. Twenty (20) year warranty for stain resistance
 - b. Approved Locations:
 - i. Offices and office suites
 - ii. Classrooms
 - c. Do not use carpet or carpet tile in the following areas:
 - i. Where food is prepared, served, or eaten
 - ii. Where dampness or water may be present, such as basements or below grade levels
 - iii. At main entrances, lobbies, main floor corridors
 - iv. Utility spaces such as mechanical and electrical rooms
 - v. In areas with wheeled traffic
 - vi. Laboratories
2. Product
- a. All products supplied to be as recommended/approved by carpet tile manufacturer
 - b. Supply calculated zero VOC, releasable, non-flammable, low odor, anti-microbial, non-toxic adhesive. Glue is to be used when requested at seams and peripheral edges only to significantly reduce removal cost and ability to install over VAT.
 - c. Characteristics, Performance and Test Procedure References

- d. Cut, loop, cut and loop and tip shear surface textures are allowed as long as they meet the 'Typical End-Use Description', as defined by CRI.
- e. Dimensional Stability: +/- 0.15% maximum per ISO 2551
- f. Delamination resistance of secondary backing: 2.5 lbs/inch minimum (if applicable) per ASTM D3936
- g. Colorfastness: as recommended by CRI per AATC16 and 16; Solution dyed nylon and dyed yarn are acceptable as long as warranty meets standard for colorfastness.
- h. Type 6-6 Nylon or alternates, as approved by Planning and Design, to be used throughout campus.
- i. Recycled content must be a minimum of 30% with minimum post-consumer recycled content of 5%
- j. Product shall contain no added anti-microbials
- k. Pre-attached, high performance backing, non-urethane preferred, with a minimum rating of NSF-140 Gold.
- l. Must meet the following certifications and bidders must provide proof of certification:
 - i. NSF/ANSI 140, platinum rating
 - ii. Carpet and Rug Institute's Green Label Plus program.
 - iii. 3rd party certified EPD (Environmental Product Declaration)
 - iv. Produced in ISO-14001 certified manufacturing facility
 - v. Cradle to Cradle Silver v3.0 certified
 - vi. TARR rating minimum of 3.0 (Heavy foot Traffic) to 3.5 (Severe +)
- m. All carpet shall be 100% recyclable and manufacturer of product shall offer 3rd party certified closed-loop recycling program.
- n. Manufacturers:
 - i. Bentley Mills
 - ii. Interface
 - iii. J & J Flooring Group
 - iv. Mannington Commercial
 - v. Masland Contract
 - vi. Milliken Floor Covering
 - vii. Mohawk Flooring
 - viii. Tandus Centiva Commercial

3. Execution

- a. Recycling
 - i. Carpet recycling options consist of:
 - 1. Repurposing: re-using product in another application such as donation to charity or not-for-profit organizations
 - 2. Closed loop recycling: turning waste materials of same value
 - 3. Open-loop recycling: creating other product types from the reclaimed product
 - 4. Waste-to-Energy: using carpet for waste-to-energy. This options is last resort and requires justification
 - 5. Landfill or incineration: are not approved disposal methods.
 - ii. All possible recycling options shall be clearly presented and submitted in writing to owner and agreed upon prior to start of job.
 - iii. At the completion of the project, a certificate shall be furnished verifying the reclamation of the carpet and the pounds of material diverted from the landfill
- b. Submittals
 - i. Where carpet color, style and accessories are not specified OR when alternates are proposed, samples of proposed product(s) must be submitted to Planning and Design for review and approval, a minimum of two weeks prior to ordering.
 - ii. Submit shop drawing showing installation orientation.
 - iii. Product data documenting results following tests by an NVLAP approved laboratory
 - 1. Electrostatic propensity
 - 2. Flooring radiant panel test
 - 3. Smoke density
 - 4. Pill test

09 72 00 – Wall Finishes

1. Ceramic Tile

- a. See 09 30 00
2. Polyethylene Terephthalate Glycol (PETG)
 - a. Used in kitchens and serveries
 - b. Basis of Design: Inpro Architectural Products Palladium Rigid Sheets
 - c. Install 8'-0" sheet directly above wall base
3. Fiberglass Reinforced Paneling
 - a. For use in kitchens and serveries.

09 91 23 – Interior Painting

1. General
 - a. Use water-based, acrylic paint systems with no VOCs only.
 - b. Door and window frames in solid walls are to be painted to match adjoining wall color. Wood doors are not to be painted. Flush metal doors may either be an accent color or the adjoining wall color.
 - c. All surface prep, product selection, including primer, and installation shall be per manufacturer's instructions and recommendations and appropriate to the surface material.
 - d. No whiteboard paint shall be allowed.
 - e. Colors: FMS has developed standard paint colors that may be updated on a 10-year +/- cycle. The purpose of these standard paint colors is to provide options to the end users and variety in the appearance of spaces while limiting the amount of paint colors the construction and maintenance departments work with. Variations from this standard are only permitted with specific prior and written permission from RIT FMS Planning & Design.

Neutrals

minimum 75% wall surfaces (three of four walls in a typical room)

- i. SW6385 Dover White
- ii. SW6148 Wool Skein
- iii. SW6120 Believable Buff
- iv. SW6182 Ethereal White
- v. SW6197 Aloof Gray
- vi. SW7655 Stamped Concrete
- vii. SW7006 Extra White
- viii. SW 7662 Evening Shadow
- ix. SW 7664 Steely Gray

Accents

maximum 25% wall surfaces (one of four walls in a typical room)

- x. SW6885 Knockout Orange
- xi. SW6688 Solaria
- xii. SW6710 Melange Green
- xiii. SW6501 Manitou Blue
- xiv. SW9074 Gentle Grape
- xv. SW7075 Web Gray

2. Products
 - a. Basis of Design: Sherwin Williams
 - i. Any alternates shall meet the performance specifications of the products below.
 - b. Concrete
 - i. Epoxy (Water-base)
 1. Prime coat: matching topcoat
 2. Intermediate coat: matching topcoat
 3. Topcoat: maximum MPI gloss level 3
 - a. Armorseal 8100 Satin #B70 series
 - b. Slip-resistant additive: micronized polymer coating addition
 4. Provide at mechanical rooms and 5' x 5' exterior access to mechanical rooms
 - ii. Latex
 1. Prime coat: latex
 - a. Matching topcoat for new concrete
 - b. Extreme Bond #B51 series for painted surfaces
 2. Intermediate coat: latex, low odor/VOC, matching topcoat
 3. Topcoat: latex, semi-gloss, MPI gloss level 5, MPI #147

- c. CMU
 - a. Promar 200 Zero VOC Semi-Gloss #B66 series
 - i. Latex
 - a. Block filler: latex, MPI #4
 - b. Pro Industrial Heavy Duty Block Filler #B42 series
 - c. Extreme Bond #B51 series for painted surfaces
 - 2. Intermediate coat: latex, low odor/VOC, matching topcoat
 - 3. Topcoat: latex, semi-gloss, MPI gloss level 5, MPI #147
 - a. Promar 200 Zero VOC Semi-Gloss #B66 series
- d. Ferrous Metal
 - i. Latex
 - 1. Prime coat: primer, rust-inhibitive, water based MPI #107
 - a. Pro Industrial Pro-Cryl Universal Primer #B66 series
 - 2. Intermediate coat: latex, matching topcoat
 - 3. Topcoat: latex, gloss, MPI gloss level 6, MPI #148
 - a. Pro Industrial Acrylic Gloss Coating #B66 series
 - ii. Dry-Fall
 - 1. Prime coat: primer, alkyd, quick dry, for metal, MPI #76
 - a. Pro Industrial Pro-Cryl Universal Primer #B66 series
 - 2. Topcoat: latex, flat, MPI #118
 - a. Pro Industrial Waterborne Acrylic Dryfall Flat #B42 series
- e. Galvanized-Metal
 - i. Latex
 - 1. Prime coat: primer, galvanized, water based, MPI #134
 - a. Pro Industrial DTM Acrylic Primer/Finish #B66 series
 - 2. Intermediate coat: latex, matching topcoat
 - 3. Topcoat: latex, semi-gloss, MPI gloss level 5, MPI #147
 - a. Pro Industrial Multi-Surface Semi-Gloss #B66 series
 - ii. Dry-Fall
 - 1. Prime coat: primer, alkyd, quick dry, for metal, MPI #76
 - a. Pro Industrial Pro-Cryl Universal Primer #B66 series
 - 2. Topcoat: dry fall, water based, for galvanized steel, flat, MPI gloss level 1, MPI #133
 - a. Pro Industrial Waterborne Acrylic Dryfall Flat #B42 series
- f. Gypsum Board and Plaster
 - i. Latex
 - 1. Prime coat: primer sealer, MPI #149
 - a. Promar 200 Zero VOC #B28 series for new gypsum
 - b. Extreme Bond #B51 series for painted gypsum
 - 2. Intermediate coat: latex, matching topcoat
 - 3. Topcoat: latex, flat, MPI gloss level 1, MPI #143
 - a. Promar 200 Zero VOC Flat #B30 series
 - 4. Topcoat: latex, eg-shel, MPI gloss level 3, MPI #145
 - a. Promar 200 Zero VOC Eg-Shel #B20 series
 - 5. Topcoat: latex, semi-gloss, MPI gloss level 5, MPI #147
 - a. Promar 200 Zero VOC Semi-Gloss #B66 series
- g. Wood
 - i. Latex
 - 1. Prime coat: primer
 - a. Premium Wall & Wood Primer #B28W8111
 - b. Extreme Bond #B51 series for painted surfaces
 - 2. Intermediate coat: acrylic, matching topcoat
 - 3. Topcoat: acrylic
 - a. Promar 200 Zero VOC Flat #B30 series
 - b. ProClassic Waterborne Acrylic Satin #B20 series
 - c. ProClassic Waterborne Acrylic Semi-gloss #B31 series
 - d. ProClassic Waterborne Acrylic Gloss #B21 series
 - ii. Stain and Varnish
 - 1. Prime coat: Wood Classics 250 Stains

2. Intermediate coat: water-based polyurethane, matching topcoat
 - a. Topcoat: waterborne polyurethane
 - i. Wood Classics Waterborne Polyurethane Varnish Satin, A68 Series
 - ii. Wood Classics Waterborne Polyurethane Varnish Gloss, A68 Series
3. Execution
 - a. All surfaces require one primer coat and two finish coats.
 - b. Follow all manufacturer's instructions and recommendations for application. Any inconsistencies between the manufacturer's instructions and this document shall be addressed with RIT prior to specifying or performing work.
 - c. Provide the following finish levels:
 - i. Concrete Floor: satin
 - ii. Concrete Wall: semi-gloss
 - iii. CMU: semi-gloss
 - iv. Ferrous Metal: gloss
 - v. Galvanized Metal: semi-gloss
 - vi. Gypsum and Plaster: eg-shel
 - vii. Wood Paint: semi-gloss
 - viii. Wood Stain: satin

END OF DIVISION 09

DIVISION 10 – SPECIALTIES**10 11 16 – Markerboards**

1. Markerboards to be provided and installed by furniture vendor, if already engaged in project.
2. Install at 36" AFF to bottom of markerboard.
3. Basis of Design: e³CeramicSteel (Polyvision) or LCS Porcelain (Claridge), magnetic, frameless, 96 x 48, white

10 14 00 – Signage

1. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A117.1 and applicable building codes unless noted otherwise.
2. Characteristics as per the Sign Standards located on the FMS website, Vendor and Contractor Information.
3. Identification and wayfinding signs shall be provided by *Takeform*.
4. Consult with RIT Planning & Design (P&D) for all sign types and locations; P&D shall review all sign submittals in conjunction with the Architect / Design Consultants. Sign submittals shall not be returned to the contractor until P&D has reviewed.

10 14 16 – Interior Signage

1. General Design Requirements
 - a. Provide a sign for every space identified with a room number. This includes all doorways, whether it has a door or not, including corridors, lobbies, and similar open areas. No sign submittal or shop drawing shall be valid without the approval of the Planning & Design department.
 - b. Sign shall incorporate building number and room number in the format as follows: ## - ####. Building number shall use two digits; use a leading zero if necessary. Building numbers 100+ shall use three digits. Any building number that is three digits does not need a leading zero. Room number shall be as identified by P&D.
 - c. Raised copy shall be white. Font shall be Arial (ADA).
 - d. Accepted toilet room names to be used include,
 - i. "Women"
 - ii. "Men"
 - iii. "All-Gender Restroom" or "All-Gender Multi-Stall Restroom"
 - e. Accepted toilet room icons to be used include,
 - i. Toilet
 - ii. International Symbol of Access (if applicable)
 - iii. Baby-changing (if applicable)
2. General Installation Requirements
 - a. Install location shall be measured from ceiling down to avoid reflecting an uneven floor line.
 - b. Signs are to be installed 1" away from the doorframe on the latch side of the door. In case of interference or obstruction signs can be moved to 1" from the obstruction, or moved to the hinge side of the door. Where possible, refrain from installing on door sidelight.
 - c. In locations having double doors, plaques shall be mounted to the right of the right hand door.
 - d. For alcove doors, the plaque shall be placed outside the alcove on the latch side as above.
 - e. Where there is no space on latch side of door(s), plaques shall be placed on the nearest adjacent wall. Verify location with RIT Project Manager.
3. Wayfinding – Branded Signage
 - a. Used on all new buildings, additions, major renovations, and suite renovations.
 - b. Reference the Interior Sign Standards on the FMS website:
https://www.rit.edu/facilitiesmanagement/sites/rit.edu.facilitiesmanagement/files/Vendor%20Contractor%20Info/ROC0001_StandardsManual.pdf

10 14 19 – Exterior Building Signs

1. Fire Code Requirements: Place building numbers on building surface at corners facing fire lanes or roadways as required by Section 505 of FC of NY State.
2. Reference the Exterior Building Name and Number standards document on the FMS website:
https://www.rit.edu/facilitiesmanagement/sites/rit.edu.facilitiesmanagement/files/Vendor%20Contractor%20Info/RI_T_exterior%20sign%20standards_building%20name%20and%20number.pdf.

10 21 13 – Toilet Compartments

1. Materials

- a. Laminate partitions for general use
- b. Phenolic partitions for wet or high-moisture areas
- c. No stainless steel partitions
2. Combination of overhead supports with minimal floor-mounted supports allowed for stability.
 - a. Maximum: one floor support every other stall
 - b. Preferred: floor support at corners only
3. Hardware and Accessories
 - a. Use continuous bracket in lieu of saddle/U-style brackets to connect partitions to wall or adjacent partitions.
 - b. Provide occupancy indicators on all compartment latches.

10 26 00 – Door and Wall Protection

1. Include wall protection in spaces with tables and/or chairs on casters.
2. Include corner guards and wall protection in high-use corridors with rolling equipment.

10 28 13 – Toilet Accessories

1. Mirrors
 - a. Contractor shall provide mirrors.
 - b. Individual mirrors installed at each lavatory.
 - c. Model: American Specialties, Inc. Channel Frame Mirror 0620-1836 (18" x 36")
2. Toilet Tissue Dispensers
 - a. RIT shall furnish; contractor shall install toilet tissue dispensers.
 - b. Install on alternate wall in accessible stalls and single-user rooms.
 - c. Model: Tork 56TR
3. Paper Towel Dispensers
 - a. RIT will provide paper towel dispenser for contractor install.
 - b. Provide recessed junction box with blank cover for future hand dryer. Mount behind proposed paper towel dispenser location. Provide conduit and pull string back to electrical room for future use. Label pull string on each end. Coordinate location of dispenser prior to installation.
 - c. Model: Tork PeakServe Continuous Hand Towel Dispenser
4. Hand Dryers
 - a. Provide hand dryers only at Owner's request.
5. Waste Receptacles
 - a. RIT shall provide waste receptacles at project closeout; see 11 82 13. Provide adequate space within toilet rooms for waste receptacles, allowing for proper ADA-clearances.
 - b. No recessed or wall-mount waste containers shall be specified.
6. Soap Dispensers
 - a. RIT shall furnish; contractor shall install soap dispensers.
 - b. Install on 'wet' wall, between mirrors
7. Feminine Hygiene Product Disposal Bin
 - a. RIT shall furnish; contractor shall install feminine hygiene product disposal bins.
 - b. Model: ULINE H-2597
8. Diaper Changing Station
 - a. Contractor shall provide baby changing station and adequate blocking in wall.
 - b. Model: Koala Kare KB300-01; gray horizontal surface-mount
9. Grab Bars
 - a. Contractor shall provide grab bars.
 - b. Stainless-steel, 14 ga, 1-1/2" tubing
 - c. Models: Seachrome IGSS-Series or Bobrick B-6806
10. Shelves, Hooks, Cubbies
 - a. Provide one hook on interior-side of each toilet partition door and in each single-user toilet room.

10 28 26 – Custodial Accessories

1. General
 - a. A Custodial room shall be located on each floor and of sufficient size to accommodate the products listed in this section.
 - b. Custodial rooms shall not share space with electrical or mechanical equipment.
2. Products

- a. Custodial Cart
 - i. Provided and installed by RIT. Provide storage and access to unit within custodial room.
 - ii. Dimensions: 60" x 24" x 48"
- b. PathoSans Unit (Chemical Generator)
 - i. Provided and installed by RIT. Provide location and access for unit within custodial room.
 - ii. Dimensions: 72" x 30" x 84"
- c. Vacuums and Floor Cleaners
 - i. Provided and installed by RIT. Provide location and access for unit within custodial room. Director of Facilities Services shall provide list of units specific to project.
 - ii. Advance ES300 XP / ES400 XLP
 - iii. Hoover CH93619
 - iv. Clarke Vantage 14
 - v. Clarke Focus II
 - vi. Clarke Focus II Rider
 - vii. Avidbots Neo 2.0

10 41 16 – Emergency Key Cabinets

- 1. Knox Box 3265
 - a. Black, surface mount, no tamper switch
 - b. Provide at exterior door of fire department response location; 60" above finished floor.
 - c. Contact RIT for Town of Henrietta key code.
 - d. See 21 11 19 for FDC Cap Lock.

10 43 13 – Defibrillator Cabinet

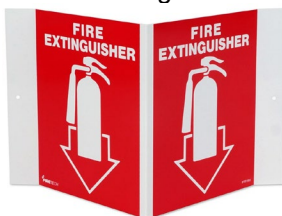
- 1. General
 - a. All new buildings shall be equipped with one AED cabinet in a public area on the ground level.
 - b. Consult with RIT EHS to determine the appropriate location.
 - c. Unit provided by RIT and installed by contractor.
- 2. Contact EHS for model and sizing.

10 44 00 – Fire Protection Specialties

- 1. Fire Extinguishers
 - a. Owner shall provide Fire Extinguishers.
- 2. Fire Extinguisher Cabinets
 - a. Contractor to provide cabinets by JL Industries or Owner approved equal, as outlined in the table below.
 - b. Cabinets shall be non-locking.

SERIES #	Aluminum Trim Style	TUB I.D.			FRAME O.D.		NON-RATED WALL OPENING		
		W	H	D	W	H	W	H	D
2025	Flat Trim	12"	27"	7 3/4"	15 3/8"	30 3/8"	13"	28"	7 7/8"

- 3. Fire Extinguisher Signs
 - a. Installed above cabinet as required by local codes and RIT Environmental Health and Safety (EHS).
 - b. Basis of Design: Activar Construction Products Group Part# 24S, 5"x6" 3D tent



10 55 00 – Postal and Package Distribution

- 1. All postal collection and distribution is handled by RIT Hub Print and Postal Services (<https://www.rit.edu/fa/hub>). The Hub is responsible for selection, placement, and installation of collection and distribution boxes and/or components.
- 2. Package Management Solution shall be Neopost 5 Column Package Solution, large (each box size 14.4" x 17.4" x 24"). Provide graphics as directed by RIT.

10 56 16 – Fabricated Wood Storage Shelving

1. Office shelving is 3/4 inch ash veneered (both sides) plywood banded on three sides, 8 feet long by 12 inch wide or per direction by Project Manager. Support shelving 16 inch OC.

10 73 43 – Transportation Stop Shelters

1. Bike Shelters
 - a. New buildings shall provide short-term bicycle storage for at least 2.5% of all peak visitors, but no fewer than four storage spaces per building within 100 feet walking distance from any main entrance.
 - b. Shelters shall be 8' wide, Vangarde Bike Shelter by Daytech Limited or an approved equal. A black powder coat finish is required. Length shall be 12' or 16'. Install per manufacturer's specifications.
 - c. RIT obtains the shelters from MSS Media. Contact can be made with MSS Media through RIT's Parking and Transportation Office.
 - d. "Lock-It" bike racks from Barco Products, or an approved equal, shall be used in the shelters. Model #05JA1410 (2 bike capacity) shall be used.
 - e. The bike racks shall be spaced 30" on center with the outside racks having equal spacing on their outside edges.
 - f. Shelters shall be installed on 6" concrete pads, reinforced with welded wire mesh, on top of a 6" subbase course that sits on top of a geotextile fabric.
2. Bus Shelters
 - a. Basis of Design: Brasco International
 - b. 8 foot x 20 foot slimline series aluminum structure
 - c. Four sides; front center windscreen with two ADA openings
 - d. Dark bronze anodized aluminum finish
 - e. 1/4" clear tempered safety glass
 - f. Reverse barrel vault standing seam aluminum roof (verify color with RIT FMS)
 - g. Bottom perimeter aluminum wind skirts

END OF DIVISION 10

DIVISION 11 – EQUIPMENT

11 12 00 – Parking Control Equipment

1. Fixed and mobile LPR (License Plate Reader) systems will be Genetec.
2. Parking software and programming will be T2 Flex.
3. Frontrunner is sole vendor to install/maintain items from Genetec.

11 52 00 – Audio/Visual Equipment

1. Classrooms: Designer is to meet with FMS Project Manager and Classroom Learning and Technology (CLT) Consultant to coordinate classroom technology infrastructure.
2. Scheduling Tablet:

11 82 13 – Solid Waste Bins

1. General Container Requirements
 - a. All receptacles (landfill, recycle, and compost) shall meet or exceed the EPA’s most recent guidelines for post-consumer recycled content for receptacles.
 - b. Receptacles shall be co-located into waste stations. Single unit systems shall have the ability to collect a **minimum of two separate streams**. Individual containers shall have the ability to be interconnected or anchored in place.
 - c. All receptacles (landfill and recycle) shall be the same or similar in design, but differentiated by lid color to indicate the appropriate stream (Landfill: Black, Recycle: Blue, Compost: Green).
 - d. Interior stations shall, at a minimum, have signage at eye level (either on the wall or attached to the container). Signage shall be approved by the recycling department and have the ability to be changed with relative ease and minimal expense.
2. Exterior
 - a. Not for new construction; replace in kind only. RIT waste stream interior in lieu of exterior.
 - b. Landscape Forms SCARBOROUGH LITTER RECEPTACLE – with liner 25 inch x 40 inch high, side opening, vertical strap panel, freestanding. Powder coat: Grotto (Black). Wording across top of lid to read “Landfill”.
 - c. Landscape Forms SCARBOROUGH LITTER RECEPTACLE – with liner 25 inch x 40 inch high, side opening, vertical strap panel, freestanding. Body of receptacle powder coat: Grotto (Black). Lid of receptacle powder coat: Ocean (Blue). Wording across top of lid to read “Recycle”.
 - d. <https://cleanriver.com/product/transition-trh/>
3. Public Area
 - a. Main entryways, lobbies, and high-traffic hallways (Transition® TIM102-2, TRH, or other approved Configurable Recycling Container)
 - b. Single unit system with the ability to collect a minimum of two separate streams for centralized collection
 - c. Must have affixed backboard for signage
 - d. Minimum of two sets per floor within public spaces (entrances and/or reception areas and elevator lobbies) is required for basic level of coverage
 - e. Set dimensions: 47.50" x 18.00" x 49"
 - i. Lid opening – Landfill
 1. Shape: square/rectangular
 2. Color: black
 - ii. Lid opening – Recycle
 1. Shape: circle inside of long slot
 2. Color: blue
 - f. Serviced by custodians, who transport material to containers located behind buildings or at loading areas
4. Athletic Facilities (GreenDrop)
 - a. Single unit system with the ability to collect a minimum of three separate streams for centralized collection
 - i. GreenDrop Recycling <http://www.greendroprecycling.com/stations-2/>
 - b. Must have affixed backboard for signage
 - c. Must include front advertising panels
 - d. Minimum set dimensions: 42.50" x 22.8" x 43.7"
 - i. Lid opening – Landfill
 1. Shape: square/rectangular
 2. Color: black



- ii. Lid opening – Recycle
 - 1. Shape: circle inside of long slot
 - 2. Color: blue
- iii. Lid opening – Compost
 - 1. Shape: circle
 - 2. Color: green
- e. Serviced by custodians, who transport material to containers located behind buildings or at loading areas
- 5. Lower-trafficked areas such as restrooms and break rooms (Rubbermaid Slim Jim 23 gallon)
 - a. Collection bins for two streams: landfill (black lid) and single stream recycling (blue lid), including sign frames and connectors; compost (green lid) for restrooms only
 - b. Blue and green lid: (single stream and compost) with 5" diameter circle inside a slot (1.75"W x 16.25"L)
 - c. Black lid: (landfill) with rectangle opening (12.5"W x 7.5"L)
 - d. Custom label graphic for sign frames provided by RIT Sustainability
 - e. Serviced by custodians into rolling collection carts
 - f. Container dimensions: 20"L x 11"W x 30"H (42"H with lid), 23 Gallon capacity, Weight: 6.3 lbs (with lid 7.2 lbs)
 - g. Set dimensions: 26" wide, 20" deep, 42" high
- 6. Desk-Side Recycling and Waste
 - a. Personal desk-side recycling container with companion waste container for administrative workstations and/or desks
 - i. <https://www.rubbermaidcommercial.com/wastebaskets-accessories/deskside-recycling-containers/?sku=FG295673BLUE>
 - ii. <http://www.buschsystems.com/products.html>
 - iii. Dimensions: 14.5" wide, 10" deep, 15" high; 28 quart
 - b. Mini waste container hangs on the side of the recycling container
 - i. <https://www.rubbermaidcommercial.com/wastebaskets-accessories/side-bin-deskside-recycling-containers/>
 - ii. Dimensions: 8" wide, 6" deep, 7" high; 3 quart
 - c. Individuals empty their office bins into nearby stations
- 7. Waste stations should not be placed in classrooms or conference rooms. Occupants shall use the waste stations provided in the hallways and lobbies of buildings.



END OF DIVISION 11

DIVISION 12 – FURNISHINGS

12 21 00 – Window Blinds

1. Exterior Glazing
 - a. Basis of Design: Drapery Industries Blue Shade Architectural series, manually-operated, T-screen, 3% openness, with fascia.
 - b. Exterior-facing side of shade shall be colored to match established building standard. Consult with Planning & Design.
 - c. New building applications shall be white/white-steel (02M228).
2. Interior Glazing
 - a. Basis of Design: Drapery Industries Blue Shade Architectural series, manually-operated, E-screen, 3% openness, with double fascia (room side and corridor side). Color to be white/pearl (002007).

12 36 00 – Countertops

1. General
 - a. Provide 1" overhang from cabinet face.
 - b. Provide backsplash at all wall locations.
 - c. Submit product data and shop drawing for approval. Any counter installed without an approved submittal is subject to replacement or reinstallation.
2. Materials
 - a. High-pressure Plastic Laminate
 - i. Use in all other applications where solid surface or quartz are not used.
 - ii. Thickness: 1/2"
 - iii. Finish: Matte; Fine Velvet Texture; Antique
 - iv. NEMA LD 3, grades as indicated or as required by woodwork quality standard
 - v. Basis of Design:
 1. Formica
 2. Wilsonart
 - b. Solid Surface
 - i. Use in wet areas and specialty public spaces.
 - ii. Thickness: 1/2" or 12mm minimum
 - iii. Finish: Matte
 - iv. Joint adhesive create inconspicuous joints; location shown in shop drawing submittal
 - v. Basis of Design:
 1. Formica
 2. Wilsonart
 3. Corian
 - c. Quartz
 - i. Use only approved by FMS Planning & Design.
 - ii. Thickness: 3/4" or 2cm minimum
 - iii. Finish: Honed
 - iv. Joint adhesive create inconspicuous joints; location shown in shop drawing submittal
 - v. Basis of Design:
 1. Wilsonart
 2. Corian
 3. Caesarstone
 4. Silestone
3. Floating Counter Installation
 - a. Height to top of surface
 - i. Standard: 28" – 30" AFF
 - ii. Counter: 34" AFF
 - iii. Bar: 40 – 42" AFF
4. Surface-Mount Counter Support Brackets
 - a. Basis of design: A&M Hardware; Heavy-Duty Hybrid Bracket; 18" x 18" for 24" deep counters
 - b. Maximum spacing: 32" on center
5. Flush-Mount Counter Support Brackets
 - a. Basis of design: A&M Hardware; Concealed Workstation Bracket

12 48 13 – Entrance Floor Mats

1. If entrance matting is used, it must be high-performance backing material with nylon fiber, not olefin.

12 48 23 – Entrance Grids

1. If a grid is installed, the pan under it must meet the following,
 - a. at least an additional 4 inches deep
 - b. welded non-rusting stainless steel; no vinyl or steel
 - c. no drain
2. Acceptable manufacturer: GatorDeck by Seasafe, fiberglass
3. The grid shall not be the full width or length of a vestibule so that it can be lifted out of the pan from inside of the space.

12 50 00 – Furniture

1. Related Sections/Guidelines
 - a. Section 01 84 00 RIT Space Definitions and Guidelines
2. Intent and Background
 - a. The intent of this standard is to establish a benchmark standards of quality for all furniture and furniture systems installed on the RIT campus.
 - b. Only commercial or 'contract' grade furniture, which comply with the standards of the Business + Institutional Furniture Manufacturer's Association (BIFMA), should be used on campus. Contract furniture comes with a variety of warranties and procurement services should be contacted if there is an issue with any furniture to determine if the warranty is still applicable and to help take the proper steps for repair and/or replacement.
 - c. Furniture and modular office system purchases at RIT are managed by Procurement Services. A representative of RIT's Procurement Services is designated as commodity manager to assist Design Professionals, RIT Project Managers, and end users with operational authority in the coordination of the bid (if necessary), selection, ordering, and installation of the furniture. It is important that RIT's Procurement Services be involved in the early design stages to leverage the University's buying power.
 - d. RIT strives to provide flexibility through interchangeability of furniture while at the same time providing high quality, long lasting products. Only appropriate vendors should be used for contract furniture purchases. Information on RIT vendors can be found at <https://www.rit.edu/fa/procurement/furniture> .
 - e. RIT is committed to providing an ergonomic and healthy learning and workplace environment. Specification and procurement of furniture should support this commitment. Assistance with these aspects of your environment can be found at:
 - i. <https://www.rit.edu/fa/betterme/live-well/ergonomics>
 - ii. <https://www.rit.edu/fa/grms/ehs/content/health-safety>
 - f. RIT is committed to providing equal opportunities for its students and employees through the built environment. While FMS and Procurement Services can assist with the specification and procurement of furniture additional assistance for special accommodations can be found at <https://www.rit.edu/studentaffairs/disabilityservices/>
 - g. RIT is committed to protecting the natural environment and fostering sustainable use of our material, environmental and energy resources. These design guidelines should be used in conjunction with:
 - i. RIT Climate Commitment; reference 01 81 13.
 - ii. RIT Procurement Sustainable Purchasing Policy; reference 00 00 00, Section 1a.
 - iii. University's Commitment to Environmental Sustainability
<http://www.rit.edu/academicaffairs/policiesmanual/p060>
3. Procedures
 - a. It is an RIT Procurement Services Policy that any furniture order greater than \$5,000 requires a competitive bid. Therefore an FMS project should be opened and Planning and Design Services approval obtained prior to ordering. See the following link for more information:
<http://www.rit.edu/fa/procurement/content/procurement-services-manual#bid%20solicitations>
 - b. It is required that FMS Planning, Design, and Construction be involved at the start of the project.
4. Roles and Responsibilities
 - a. Participants in the furniture selection, specification and procurement process may include any or all of the following departments,
 - i. Procurement Services (RIT Commodity Manager)
 - ii. FMS Construction Services (RIT Project Manager)
 - iii. FMS Planning and Design (RIT Designer)

- iv. Consulting Design Firm (Vendor)
- v. Furniture supplier (Vendor)
- vi. Contractor (Vendor)
- b. Architect/engineer, furniture vendor, RIT Project Manager, and end user to coordinate furniture types and locations with building areas and services for fit and serviceability.
- c. Architect/engineer is responsible for coordinating furniture locations/specification with power requirements and receptacle locations.
- d. **Architect/engineer is responsible for coordinating any built-in millwork with associated furniture sizes.**
- 5. Product Requirements
 - a. All furniture used on any part of the campus shall meet the following regulatory requirements.
 - i. NYS building code sections on interior finishes, accessibility and interior environment
 - ii. BIFMA standards
 - iii. California Technical Bulletin 133 (cal 133).
- 6. Furniture Finishes
 - a. Allowable Hard-surface finishes will be limited to the manufacturers' standard offerings and will be overseen by FMS Planning and Design and the Campus Aesthetics Committee
 - b. All upholstery options for classrooms and offices spaces are limited to Grade 1, unless authorized otherwise by Division AVP and Procurement Services, except for Dean's, VPs, SVPs and the President, and will be overseen by FMS Planning and Design and the Campus Aesthetics Committee.
 - c. Upholstery options for lounge furniture are limited to Grade 1 through 8, unless authorized otherwise by Division AVP and Procurement Services, except for Dean's, VPs, SVPs and the President, and will be overseen by FMS Planning and Design and the Campus Aesthetics Committee.
 - d. Finish options will provided for the client's final approval, based on these standards and the finish legend of the construction work, if applicable.

12 51 00 – Office Furniture and Modular Office Systems

- 1. Space definitions and guidelines are found in 01 84 00.
- 2. Panel systems requiring electricity and/or are anchored to walls or floors must be procured through an FMS project.
- 3. All employees are assigned a task chair, which can move with the employee if their work location changes; all other furniture is associated with the office or workspace in which it is located and is intended to remain in that location with the exception of medically required items.
- 4. Office furniture standards can be found at <https://www.rit.edu/facilitiesmanagement/office-standards-furniture>.

12 56 52 – Audio-Visual Furniture

- 1. The Center for Teaching and Learning (CTL) provides support for all general-purpose classroom technology. An overview can be found at <https://www.rit.edu/academicaffairs/tls/course-delivery/classroom-technologies>.
- 2. Contact RIT FMS for A/V standards in all other instructional spaces, college classrooms, class labs, etc.
- 3. Contact RIT FMS to receive CTL's latest design standards for classroom podiums. See Appendix 1 for shop drawings.
- 4. Refer to the Center for Teaching and Learning website (<https://www.rit.edu/teaching/>) for more information.

12 56 43 – Common Area and Lounge Furniture

- 1. Individual upholstered seating is preferable, but not required, to multi-person seating unless such furniture is sectional and can be rearranged.
- 2. Consideration should be given to appropriate mix of seating options that allow for work, relaxation and socialization, in terms of type, height, location and arrangement.

12 56 53 – Laboratory Furniture

- 1. Preferred Vendors
 - a. Kraftwerks, Inc.
 - b. VWR International
 - c. Spencer-Virnoche
- 2. RIT shall work with vendor to layout, specify, and procure all laboratory and research equipment and casework.
- 3. Fume hoods, biosafety cabinets, enclosures, and all similar equipment by Labonco. Specific models and features selected based on need.

12 58 00 – Residential Furniture

Contact Residential Life or Housing Operations for information.

12 80 00 – Mechanical Room Furnishings

1. In new building projects, space shall be allowed in each Mechanical room for storage of a 6 foot, 8 foot, and 10 foot fiberglass Type 1A (300 lb. capacity) step ladder and chain to secure same. RIT's Project Manager will purchase the ladders.

12 93 13 – Bike Racks

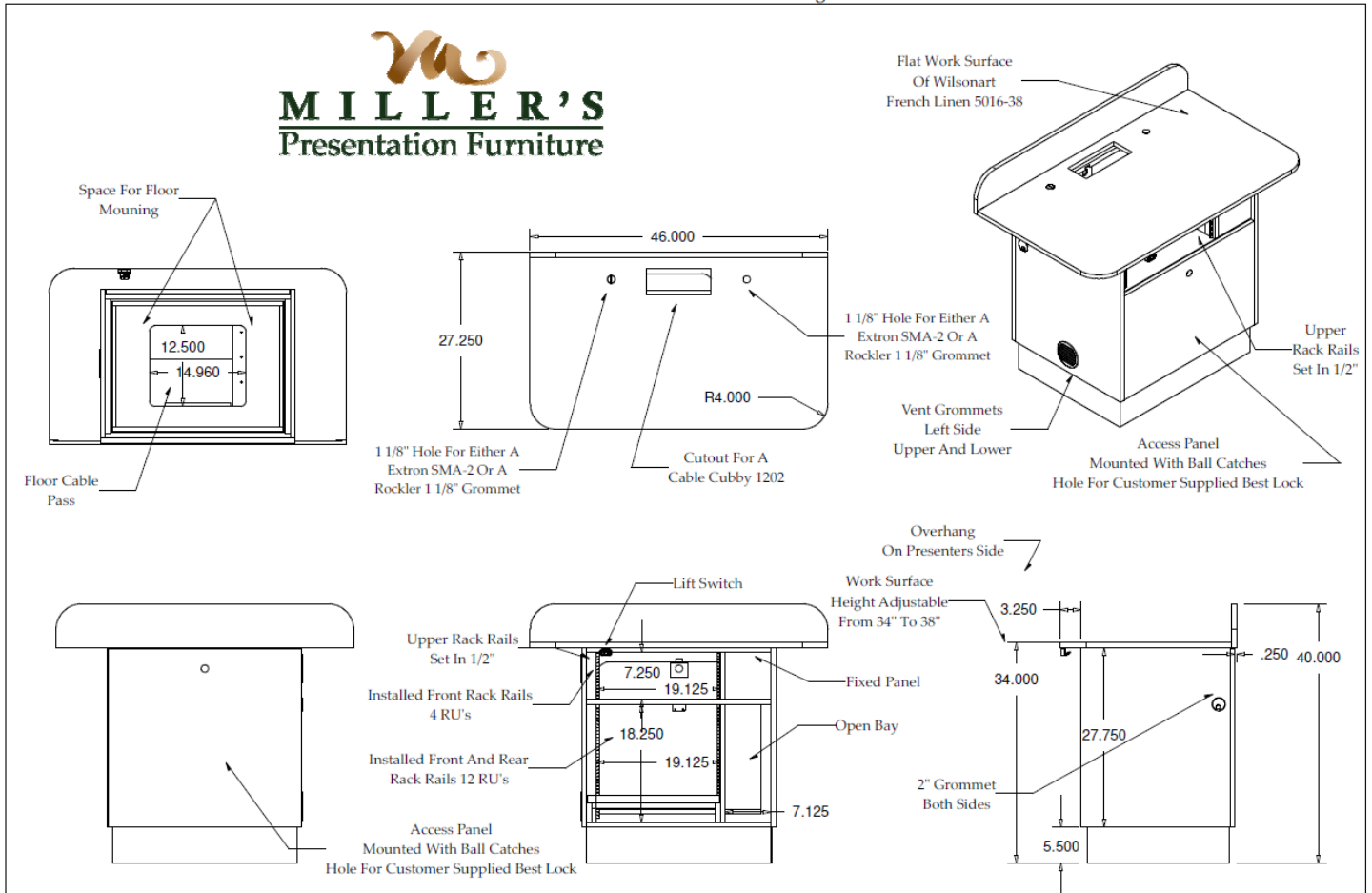
- a. Basis of Design: Peak Racks double sided racks
- b. Black anodized finish

12 93 43 – Site Seating and Tables

1. Landscape tables shall be Parkitects – 4 seat tables – plastisol finish – black perforated metal.
 - a. Part # - 64-959-3 UMB (handicap accessible)
 - b. Part # - 64-959-4UMB
2. Park Benches shall be Columbia Cascade – TimberForm – 2600 series bench – black cast metal – purple heartwood slats. 6' Long.

Appendix 1 – Classroom Podium

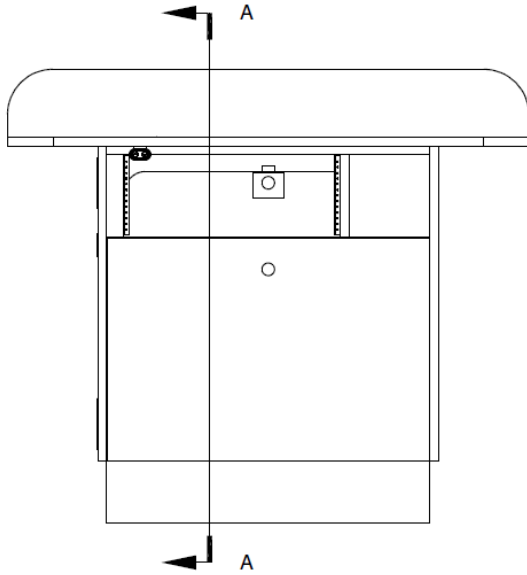
Built In Three Sections - Work Surface - Center Column and Base Pedestal. All Sections Bolt Together With Threaded Inserts / Bolts



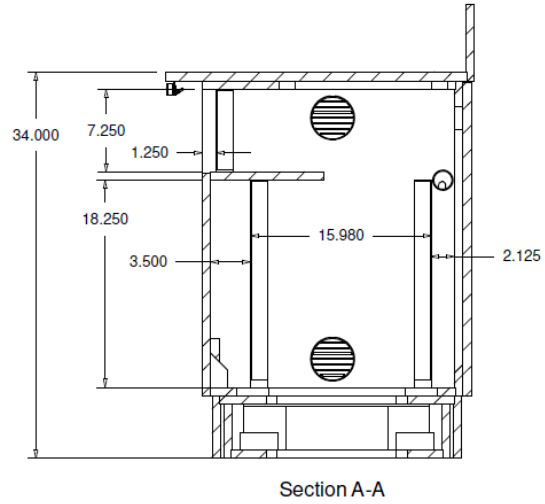
PO#	Installed Base Lift - 4" Of Travel	Drawn By: EV
Wood Species: Laminate	Stain Selection:	Approved for construction _____ Date _____
Date: 09/19/2023	Drawing Number: RIT-4024	This Drawing is property of Miller's Millworks inc. Unauthorized distribution without written consent is strictly prohibited



Front View

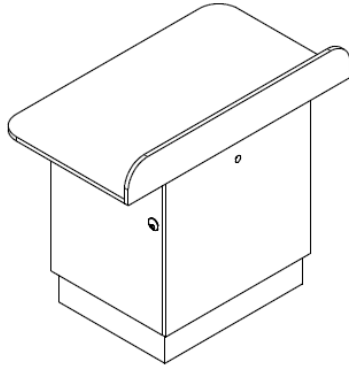


Cross Section View
Rack Rail Layout

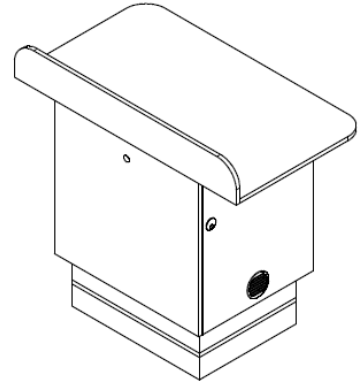


Section A-A

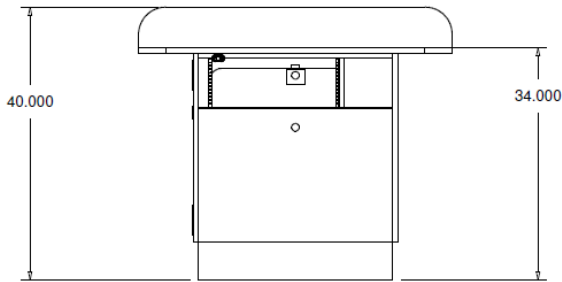
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Wood Species: Laminate	Stain Selection:	Approved for construction	Date
Date: 09/19/2023	Drawing Number: RIT-4024	<small>This Drawing is property of Miller's Millworks inc. Unauthorized distribution without written consent is strictly prohibited</small>	



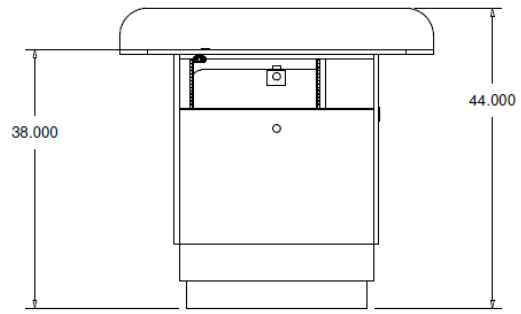
MILLER'S
 Presentation Furniture



Front View - Lowered



Front View - Raised



PO#			Drawn By: EV
Wood Species: Laminate	Stain Selection:	Approved for construction	Date
Date: 09/19/2023	Drawing Number: RIT-4024	<small>This Drawing is property of Miller's Millworks inc. Unauthorized distribution without written consent is strictly prohibited</small>	

END OF DIVISION 12

DIVISION 14 – CONVEYING EQUIPMENT**14 01 00 – Operation and Maintenance**

1. Maintenance Service:
 - a. Perform maintenance, including emergency callback service, during normal working hours.
 - b. Include 24-hour-per-day, 7-day-per-week emergency callback service.
 - c. Response Time: Two hours or less.
 - d. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months full maintenance service by skilled employees of the Elevator Installer to run in same time frame as warranty period.
 - e. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies as used in the manufacture and installation of original equipment. Copies of all monthly maintenance, repair call, and callback slips are to be signed by personnel at the FMS Operation Center. A copy must be left with the Operation Center.
2. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard yearly maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options. Also provide a quote for a five year maintenance agreement
3. Warranty Period: 12 months from date of Substantial Completion.

14 05 00 – Common Work Results for Conveying Equipment

1. Do not place Elevator Machine Room next to an office or other quiet area.
2. See Division 26 to connect electrical power and wiring to elevator controllers and car lights with appropriate lockable disconnects.
3. Definition: Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
4. Elevator company shall comply with all accessibility requirements, including but not limited to,
 - a. Chapter 11 of Building Code of NY State (which references ICC-ANSI A117.1)
 - b. Latest Section 4.10 of US Architectural and Transportation Barriers Compliance Board's "Americans with Disabilities Act" (ADA).
 - c. Latest edition of ADA Accessibility Guidelines (ADAAG)
 - d. Local codes and governing regulations
5. Size
 - a. Elevator shall have a minimum posted capacity of 3,000 pounds.
 - b. Elevator depth (from inside doors to rail on rear wall)
 - i. At least one elevator shall be 90 inches deep.
 - ii. All other elevators shall be no less than 60 inches deep.
 - iii. If depth cannot be achieved, consult with Planning & Design.
6. Components
 - a. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide motor with soft start solid-state starting.
 - b. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.
 - c. Casing for Underground Piping (do not use underground piping unless approved by Owner): PVC pipe complying with ASTM D 1785 joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
 - d. Protective Cylinder Casings: PVC pipe casings complying with ASME A17.1, of sufficient size to provide not less than 1 inch clearance from cylinder, and extending above pit floor.
 - e. Corrosion Protective Filler: A solvent-less, petroleum-based gel formulated for filling the space between hydraulic cylinders and protective casings. Filler is heavier than water, electrically non-conductive, and liquefies at approximately 150 deg. F (Pacific Standard Chemical Co.; Union-Gard 160).
 - f. Car Frame and Platform: Welded steel units.
 - g. Provide non-proprietary microprocessor operation system.
 - h. Emergency Lowering: On failure of building power, cars that are at a floor are lowered to the lowest terminal floor, open their doors, and shut down. Cars that are between floors are lowered to the lowest terminal floor, open their doors, and shut down.

- i. Key Switches: All key switch cylinders shall be by Best (except FE0K1 for Fire Service). Cores shall be supplied by Owner.
- j. Provide a Door Hold feature that holds car at floor with doors open and all other buttons and calls inactive except Fire Service and Fire Service Recall. Door Hold keyswitch to be on COP.
- k. Provide Phase I and Phase II fire emergency service per ANSI/ASME A17.1 and any other requirements in accordance with local laws and ordinances. Fire Service key shall be FE0K1. Emergency operation shall be actuated by the operation of three-position (Reset, Normal, Firemen Service) key operated switches located at the Lobby Floor. Fire Service Recall (Phase I): By activation of Fire Alarm System, the elevator will enter into Fire Service Recall and go to the first floor lobby (known as the Designated floor) if any of the elevator lobby smoke detectors on any floor (except the first floor elevator lobby) or any hoistway or elevator machine room smoke detectors are activated. If the first floor lobby smoke detector is activated, the elevator will enter Fire Service Recall and travel to the second floor (known as the Alternate floor). All other smoke detector or fire alarm activations will not affect elevator service (except hoistway or machine room detectors). Upon Fire Service Recall, the Fire buzzer and display lamp in the cab will be activated. If a hoistway or machine room smoke detector is activated, the "Fire" light in the COP and designated floor hall fixture lobby will flash. When Fire Service Recall is activated by the building fire alarm system panel, Fire Service Recall must be manually reset at the first floor lobby after the fire alarm system has been reset. This is accomplished by inserting the FE0K1 key into the Fire Service key switch at the first floor lobby and turning the switch to the "Reset" position and then back to the "Normal" position. The car will then return to normal service, if and only if, the fire alarm system has been fully reset.
- l. Fire Alarm Shunt Trip: If a heat detector in the elevator machine room or hoistway is activated, or if the flow switch for the fire sprinkler line to the hoistway or elevator machine room is activated, the shunt trip breaker supplying electrical power to the elevator system shall be tripped removing power from the elevator system (including Emergency Lowering).
- m. Shunt trip breaker (with auxiliary contacts for lowering system) for elevator shall be located in elevator machine room.
- n. COP layout drawing to be approved by Owner before COP is released for production.
- o. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural and Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)." On activation, system dials preprogrammed number of monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in COP with identification, instructions for use, and is powered by the telephone line without a battery for memory or any other purpose.
- p. Door Edge Device: Provide electronic safe edge on elevator entrance doors that cause doors to stop and reopen upon detecting an obstruction. Include photoelectric curtain with timed cutout that projects beams across car entrance. The beams, when interrupted, cause doors to stop and reopen. Include Nudging Feature: After car doors are prevented from closing for a predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.
- q. Luminous Ceiling: LED light fixtures using 4 foot T-8 lamps and ceiling panels of translucent acrylic or other permanent rigid plastic complying with flammability requirements.
- r. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.
- s. Provide dielectric couplings at plunger/cylinder units.
- t. Provide vandal resistant signal equipment for elevator with vandal resistant Braille that use LED lamps. Fabricate lighted elements of acrylic or other permanent, non-yellowing translucent plastic.
- u. Engrave Fireman's Service instructions into COP above Fire Service key switch.
- v. Integrate emergency phone into COP.
- w. Elevator unit number to be engraved at top of COP above CPI.
- x. Fire Department Communication System (if required): Provide jack in COP and required conductors in traveling cable for fire department communication system specified in Division 26 (if required).
- y. Provide waterproof well casings to retain walls of well hole.
- z. Install cylinders in well casings. Before installing cylinders, remove water and debris from well casing and provide permanent waterproof seal at bottom of casing.

- aa. Install cylinders plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between protective casing and pit floor with 4 inch of non-shrink, non-metallic grout.
- bb. Sump pump for the hoist way pit shall be equipped with an oil sensing switch (SEE water Inc. Oil Smart or Owner approved equal).
- cc. Do not use Otis Gen II machines as a basis of design. The shaft is the smallest of all machines and this prevents modernization by other companies in the future.

14 27 13 – Custom Elevator Cab Finishes

- 1. General
 - a. Prohibit the use of stainless steel finishes unless infeasible.
- 2. Products
 - a. Flooring
 - i. Nora rubber; confirm product with FMS
 - b. Walls
 - i. Plastic laminate finish
 - c. Ceiling
 - i. Suspended with concealed frame
 - ii. Perforated metal not accepted
 - d. Lighting
 - i. Perimeter linear LED; all sides of cab

14 50 00 – Documentation

- 1. Product Data
 - a. Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
- 2. Shop Drawings
 - a. Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, COP drawing with Best brand key switches with their model number and mechanical operation, cut sheet for sump pump with oil sensing switch detail, hall fixture drawings, coordination with building structure, relationships with other construction, and locations of equipment and signals. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, motor horsepower, motor duty rating, and maximum and average power demand.
- 3. Manufacturer Certificates
 - a. Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, including emergency generator, as shown and specified, are adequate for elevator system being provided.
- 4. Maintenance and Programming Manuals
 - a. Include Operation, Programming, and Maintenance manuals, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at Project closeout as specified in Division 1.
- 5. Inspection and Acceptance Certificates and Operating Permits
 - a. Provide to Owner as required by authorities having jurisdiction for normal unrestricted elevator use. Do not provide a display frame in cab for certificates or permits.

END OF DIVISION 14

DIVISION 21 – FIRE SUPPRESSION**21 05 00 – Common Work Results for Fire Sprinkler System**

1. Submittal and Construction Process
 - a. MEP consultant to Owner will perform preliminary design to applicable codes, standards, RIT Design and Construction Guidelines, RIT insurance carrier requirements, and Town of Henrietta Fire Sprinkler Submittal Checklist (https://www.henrietta.org/sites/default/files/fileattachments/building_amp_fire_prevention/page/1821/fp105_fire_sprinkler_submittal_checklist.pdf).
 - b. Contractor to provide Owner a submittal with a full set of shop drawings, specifications, materials list, product cut sheets, and any other items required as per Town of Henrietta Fire Sprinkler Submittal Checklist for Owner review before applying to the town for the Fire Sprinkler Permit.
 - c. Submittal shall comply with these guidelines and Town of Henrietta Fire Sprinkler Submittal Checklist in addition to all applicable codes, standards, and RIT insurance carrier requirements.
 - d. Submittal shall include a completed copy of the Town of Henrietta Fire Sprinkler Submittal Checklist.
 - e. Owner shall review submittal and meet with contractor to resolve any issues.
 - f. Contractor shall apply for Fire Sprinkler Permit after Owner approves submittal.
 - g. Contractor and Owner shall meet and review materials and installation locations before ordering and rough in. This is to ensure correct materials and mounting height compliance with these guidelines.
2. System Description
 - a. The design criteria for the Fire Protection system shall be in compliance with all applicable laws, codes, rules, regulations, standards, RIT Design & Construction Guidelines, and RIT insurance carrier requirements. All components used in the system shall be FM approved.
 - b. Water supply control valves shall be electrically supervised for proper position. Water flow and supervision circuits shall be in accordance with the requirements of electrical specifications. All valves and test points shall have individual addresses reported on the fire panel.
 - c. Avoid providing a Fire Pump. Consult with Owner if pump is needed.
 - d. Concealed sprinkler heads shall not be used.
 - i. Our experience has shown us that after a few years, the concealed cover assembly plates become obsolete and missing plates cannot be replaced.
 - ii. Use of concealed sprinkler heads requires special written approval from Owner (Director of Electrical Maintenance).
 - e. Flexible drops are NOT to be used. Flexible drops will be allowed only on a case by case basis as approved by Owner (Director of Electrical Maintenance). If flexible drops are allowed, they must include ceiling system modifications (i.e. bracing) for a complete system.
 - f. Grid systems are not allowed.
 - g. In multi-story buildings, design each floor to be a separate independent zone. Provide each zone with a floor control valve assembly consisting of a control valve, tamper switches, flow switch, check valve, pressure gauge, and test/drain connection on each floor within a stairwell.
 - h. Where permanent furniture items (lab benches, library stacks, shelving, etc.) are incorporated in the building, or if partitions extend to within 18 inches of the ceiling, ensure sprinkler system design is appropriate, code compliant, and coordinates with lighting, ventilation, and other building features.
 - i. Where custom ceilings (i.e. clouds) are incorporated in the building, ensure sprinkler system design is appropriate and code compliant (heads above and below ceiling as required).
 - j. Design sprinkler system to minimize testing and maintenance, and be easily maintained.
 - k. Proposed sprinkler head locations shall be shown on architectural reflected ceiling plans and Fire Protection drawing set.
3. Fire Department Connection
 - a. Provide locking FDC Caps (Type used: Knox FDC cap 2 ½") on all Fire Department connections. Must be approved by local Fire Department.
 - b. Non-pressurized FDC shall be Schedule 40 galvanized steel pipe.
4. Main Alarm Valve Equipment
 - a. Water flow indications shall be flow switch only (Pressure Switches are not acceptable) on wet systems.
5. Alarms/Monitoring/Control
 - a. All valves which control the flow of water to water-based fire suppression systems shall be provided with tamper switches.
 - b. Provide each sprinkler/standpipe system and/or zone with a water flow switch.
 - c. All water flow and/or tamper devices shall be individually monitored by the main fire alarm system panel

- as a trouble or alarm point as dictated by the service using a unique addressable input module for each monitoring point.
 - d. Provide an electronic strobe and horn (mounted 6 feet AFF on outside of building above FDC) in lieu of a water motor gong for exterior audible alarm for fire sprinkler systems. Strobe shall only be active to indicate water flow, not general Alarm. (All Notification Appliances placed outside shall be Weather Proof and in a STI-1229-HAZ weather proof enclosure.)
 - e. Do not use a water motor gong for exterior audible alarm for fire sprinkler systems.
 - f. For wet or dry systems, do not use any type of control panel, all switches and device shall be wired to the Fire Alarm Control Panel (FACP).
6. Sprinkler cabinets and spare sprinklers
- a. A wall mounted cabinet for spare sprinkler heads and sprinkler wrench shall be provided. A sprinkler wrench compatible for each type of sprinkler head used shall be provided in the sprinkler cabinet. Spare sprinkler heads of each type used shall be provided in the cabinet.
 - b. Provide a stock of 12 spare sprinklers of each type used in the project. If more than 300 heads of a type are used, supply 24 spares.
 - c. Provide 24 escutcheon plates, trims, and caps for each type used. If more than 300 heads of a type are used, supply 15% spare escutcheon plates trims and caps.
 - d. Residence housing applications require a higher percentage of spares, discuss with FMS Fire Tech before bid time.
7. Test and Drain
- a. Combine test and drain valves, sight glass, and interchangeable restricting orifice, sized for smallest orifice sprinkler zone.
 - b. Locate Test and Drain valves in easily accessible mechanical space or public areas and no more than 6 feet AFF.

21 05 53 – Identification for Fire Sprinkler Piping and Equipment

1. Valve labeling
 - a. Before installation begins the contractor shall provide a numerical list of all valves with a description of each valves operation and function.
 - b. RIT will then assign all valves in the project an RIT specific equipment label and provide this information back to the contractor.
 - c. The contractor shall update all drawings with the RIT supplied valve labels.
 - d. The contractor shall submit an updated set of drawings back to RIT for approval.
2. Control, drain and sectional valves shall be provided with permanently marked identification signs. The signs shall be permanently mounted on the piping or wall at the valve, or on the valve, but shall not be hung on the valve with wires or chains which permits easy removal of sign.
3. All Valves should be numbered accordingly with number tags being affixed to the valve body not the operating handle.

Valve #2301
 Dry Sys Control Valve
 ADD:034-025 PAV-1

4. Installation contractor shall provide an index sheet showing a complete listing of all tagged numbers followed by an associated description for each valve. See example below.

<u>DOUBLE-INTERLOCK SPRINKLER SYSTEM</u>				
Building	Address / Pre-Action	Description	Type	Number
05	034-025 PAV-1	A-475 PAV-1 DRY SYSTEM CONTROL VALVE (Butterfly)	SYSTEM VALVE	2301
05	034-025 PAV-1	A-475 PAV-1 DRY SYSTEM LOW AIR TEST VALVE	TEST VALVE	2302
05	034-024 PAV-1	RM 3464 ABOVE CEILING PAV-1 DRY SYS TEST VALVE	TEST VALVE	2303
05	011-005 PAV-2	A-561 PAV-2 DRY SYSTEM CONTROL VALVE (Butterfly)	SYSTEM VALVE	2304

21 08 00 – Commissioning

1. Prior to Final Acceptance, instruct the FMS Fire System Techs in the proper operation, maintenance, testing, inspection, and emergency procedures for all systems provided.
2. Warranty shall be for One (1) Year and include 4 hour response time 24 Hours per Day, by the installing Fire Protection contractor, including Weekends and Holidays.
3. Provide on one sheet a system schematic drawing (with RIT valve numbers) of the sprinkler system showing all valves and auxiliary equipment. Drawings shall be mounted on wall behind or near main sprinkler supply with a piece of Plexi-glass protecting it.
4. A digital copy of the as-built drawings in AutoCAD and PDF format is to be provided to Owner. As-built drawings to be in black and white only. Drawings shall include but not be limited to
 - a. The incoming fire service(s) into the building from a point 5 feet outside the building,
 - b. The main sprinkler standpipe system riser assemblies and related devices and equipment at the point where the fire services enter the building,
 - c. Main sprinkler/standpipe manifold piping,
 - d. Sprinkler standpipe riser locations and routing,
 - e. All sprinkler/standpipe system control valve assemblies at each floor of the stairwell(s),
 - f. Test and Drain risers and connections,
 - g. Fire hose valve and or hose valve cabinet locations,
 - h. Sprinkler system design criteria, including at a minimum:
 - i. Type of system,
 - ii. Zone or area description,
 - iii. Design density (gpm/Sq. Ft.)
 - iv. Design area (Sq. Ft.)
 - v. Type of sprinkler,
 - vi. Maximum sprinkler spacing (Sq. Ft.)
 - vii. Sprinkler head locations shall be shown on architectural reflected ceiling plans added to the Fire Protection plans.
 - i. All valves shall have numbered tags on them.

21 11 19 – Fire Department Connections

1. Knox FDC Cap Lock
 - a. 2.5 inch, no extra protection
 - b. Provide at all FDC connections.
 - c. Contact RIT for Town of Henrietta key code.
 - d. See 10 41 16 for Knox Box information.

21 13 13 – Wet-Pipe Sprinkler System

1. Piping and valves
 - a. All piping shall be installed to permit drainage of the system through a main drain valve. Main drain valve shall be a ball valve. Where a change in piping direction prevents drainage of the system, Low Point auxiliary drains shall be provided. The auxiliary drain assembly shall consist of a lockable ball valve, nipple and cap or plug. Pipe drain to an accessible location.
 - b. Use only Schedule 40 steel pipe for threaded and rolled groove piping on wet systems.
 - i. Do not use cut grooved piping
 - c. All Control/Sectional valves under 6 inches shall be Butterfly valves with monitoring contacts.
 - d. All pressure switches shall have a vented ball valve installed on the line before the switch (See FIGURE 1 at the end of this document).
 - e. A double check valve shall be provided where sprinkler system connects to public water supply.
 - f. Install chains and break-a-way locks (see Owner for lock information) on ALL valves.
 - g. Install piping with ball valve inside building at base of any/all roof hydrants for draining hydrants.
 - h. Locate ball valve within 72 inches AFF and before connecting to system drain.
2. Installation
 - a. Piping shall not pass directly over electric panel boards, switchboards, motor control centers, or similar electric equipment. However, protection for these spaces shall be provided.
 - b. All discharge water shall discharge either outside of the building onto a splash block where no damage will occur to building or site, or into a sump pit that will handle full flow for at least 4 minutes. Locate test stations in areas where testing does not affect occupants or program, and discharged water does not pool or freeze forming a hazard to pedestrians or vehicle operators.

- c. A 2" full port ball valve shall be at the discharge end of the drain line allowing the drain to be charged to prevent water motion when tampering occurs. A sight glass shall be installed just after the valve and before the drain line leaves the building.
 - d. Provide an accessible pressure gauge near the topmost outlet of each standpipe.
 - e. The Main Drain shall be 2" for drain tests.
 - f. No Valves or flow switches shall be above ceilings except for Low Point Drain valves. Use a red with white lettering label on ceiling grid to indicate Low Point Drain valves concealed by ceiling.
3. Systems in Elevator Shafts
- a. Discharge water for this system can be put into the elevator sump pit with a test and drain valve at the bottom of the sprinkler system to test and then drain the water from the sprinkler system when the solenoid is closed.
 - b. In elevator shafts where sprinklers may freeze, the sprinkler line to the shaft shall have a normally closed solenoid valve controlled by the fire panel so that no water may enter the sprinkler system in the elevator shaft until the elevator shunt trip has been activated.

21 13 16 – Dry-Pipe Sprinkler System

1. All dry systems shall be nitrogen charged using a compressor and molecular sieve.
2. All dry valves requiring manual reset must be externally reset-able.
3. Schedule 40 steel pipe must be used on dry systems.
 - a. Do not use cut grooved piping
4. Install a tee with a ½ inch ball valve and female hose quick disconnect and a shut off ball valve on compressor air line for adjusting cut-in/cut-out pressure.
5. All dry systems shall use a vented ball (Bleeder Valve: Potter: BLV Stock # 1000018) valve installed before pressure switch (used to test pressure switch). See appendix 1 at the end of the document.
6. Air compressors shall be located in non-sensitive areas such that nearby occupants are not disturbed by noise and vibration caused by a compressor.
7. No remote air compressors: use tankless user mount compressor.

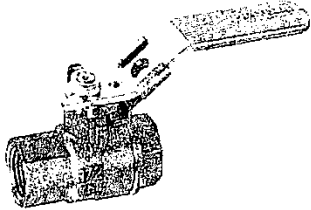
21 30 00 – Fire Pumps

1. Installation
 - a. Use horizontal electrically driven pump, not vertical type.
 - b. Do not use diesel driven pumps.
 - c. Use pilot operated pressure reducing valves (PRV).
 - d. Use the simplest control panels, minimize the use of electronic touch screen controls.
 - e. Fire pumps shall be located in non-sensitive areas such that nearby occupants are not disturbed by noise and vibration caused by a fire pump, location to be approved by Owner
 - f. MEP design consultant shall ensure there is enough normal electrical power and generator provided power for a fire pump installation.
2. Tests
 - a. RIT FMS Fire System Techs shall witness flushing, pump testing, coverage inspections, and all other inspections and tests.
 - b. Give the owner's representative advance notice of final test. All final testing shall be with RIT FMS Fire System Techs.

Appendix 1 – Dry Pipe Sprinkler Valve



BVL LEVER TYPE BLEEDER VALVE



Valve Body: Bronze
Handle: Zinc plated steel
Maximum Pressure: 300 PSI (20.7BAR)
Connections: 1/2" NPT
Exhaust Orifice: .125" (3mm)

Stock number - 1000018

General Information

The Model BVL, lever type bleeder valve, is for use as a test valve for pressure operated devices on wet pipe sprinkler systems that have excess pressure, or dry pipe sprinkler systems.

The BVL should be installed in-line with the pressure device. It provides a convenient means for removal or testing the pressure actuated device without affecting the pressure in the system. Closing the valve (moving the valve handle perpendicular to the 1/2" pipeline) shuts off the water or air from the supply and opens a small orifice (pin-hole) to exhaust the pressure between the valve and the pressure device. This should provide a low pressure actuation of the pressure device, testing its operation.

Installation

The BVL should be installed in-line to the alarm or supervisory device with the "PD" (Potter Device) stamp, or with the arrow pointing toward the alarm or supervisory device that is to be tested.

CAUTION

The BVL should be installed so the exhaust orifice is pointed in a safe direction.

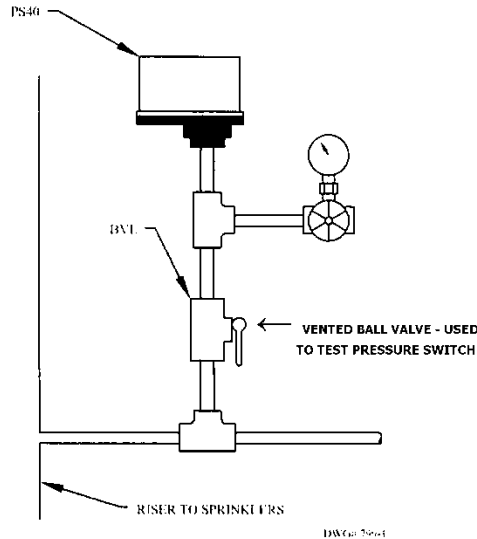


FIGURE 1

END OF DIVISION 21

DIVISION 22 – PLUMBING**22 05 00 – Common Work Results for Plumbing**

1. The maximum distributed DHW temperature in any building shall be 120°F. Any additional temperature required shall be supplied by a booster heater to be part of the equipment being installed.
2. Bio-Hazard Labs – Level II, requires a sink by door.
3. Roof scuppers – secondary system pipe to daylight.
4. Pitch pockets shall **NOT** be used for roof penetrations for conduit or piping. Cones or “Witches 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.
5. Equipment shall not be hung from ceiling (i.e. remote mount cooling unit for water fountains, water filtration systems, etc.)
6. Where possible, avoid the construction of Confined Spaces. Any such confined space that must be constructed, must be approved by Owner in advance.
7. Do not use di-electric unions. Use brass bodied ball valves instead.
8. Do not use cut or rolled groove (Vic and similar type) piping on any system (heating, cooling, city water, or DHW).
9. Use flexible expansion (stainless steel hose with stainless steel braid) compensators and loops with proper anchors and guides.
10. Do not bury cold water, domestic hot water (DHW) supply and return mains in walls, these mains are to be run in hallway ceilings. Isolation valves are to be provided at take offs for each restroom, breakroom, and lab etc.
11. Do not use electric in-sink disposal units – require owner (RIT Director of Utilities) approval to be considered.
12. No piping is to be mounted tight to the roof deck.

22 05 19 – Meters and Gauges

1. All new buildings, additions and renovated buildings shall have new gas and water meters with isolation and by-pass valves.
2. All meters must be submitted to and approved by RIT FMS prior to installation.
3. Gas meters:
 - a. Meters shall have a true pulse contact. (One that alternates between infinite resistance and near zero resistance)
 - b. Pulse contact signal shall be no shorter than 100ms.
 - c. Easy to read visual indication of cumulative gas used.
 - d. 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.
 - e. Meters shall be Roots B Series.
4. Domestic water meters:
 - a. Meters shall have a true pulse contact. (One that alternates between infinite resistance and near zero resistance). Pulse contact signal shall be no shorter than 100ms. Preferred manufacturer: Sensus
 - b. High resistance to water impurities.
 - c. Insensitive to upstream disruptive elements.
 - d. Easy to read visual indication of cumulative water used.
 - e. Gauges with ball valves shall be installed on water services at building entrance, before and after any water regulator.

22 05 23 – General-Duty Valves

1. Butterfly valves shall NOT be used as shutoff devices, except for flow control.
2. Use full port ball valves for shutoff devices.
3. Ball valves shall have a separate packing nut and handle retaining nut.
4. Acceptable manufacturers:
 - a. Apollo
 - b. Watts
 - c. Milwaukee

22 05 29 – Hangers and Supports for Plumbing 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.
2. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

22 05 53 – Identification for Plumbing Piping and Equipment

1. Pipe Labels

- a. General requirements for manufactured labels: preprinted, color-coded, with lettering indicating service and showing flow direction.
- b. Pretension Pipe Labels: pre-coiled, semi rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- c. Self-Adhesive Pipe Labels: printed plastic with contact-type, permanent-adhesive backing.
- d. Acceptable Manufacturers: Marking Services, Inc.
- e. Color Field Lengths and Letter Heights:

Outside Diameter of Pipe Covering	Minimum Length of Color Field	Letter Height
Less than 1-½"	8"	½"
1-½" – 2"	8"	¾"
2-½" – 7"	12"	1-¼"
8" – 10"	24"	2-½"
Larger than 10"	32"	3-½"

- f. Pipe label contents: include information of piping service using designations listed below, pipe size, and flow direction arrow.

SYMBOL	SERVICE TYPE	PIPE LABEL	BACKGROUND and LETTERING COLORS
CTYW	City Water	CITY WATER	LIGHT BLUE BACKGROUND, WHITE LETTERING
DCWR	Domestic Cold Water Return	DCWR	LIGHT BLUE BACKGROUND, WHITE LETTERING
DCWS	Domestic Cold Water Supply	DCWS	LIGHT BLUE BACKGROUND, WHITE LETTERING
DHWR	Domestic Hot Water Return	DHWR	LIGHT BLUE BACKGROUND, WHITE LETTERING
DHWS	Domestic Hot Water Supply	DHWS	LIGHT BLUE BACKGROUND, WHITE LETTERING
DIW	Deionized Water	DIW	DARK BLUE BACKGROUND, WHITE LETTERING
FP	Fire Protection Sprinkler Water	FIRE-SPRINKLER	RED BACKGROUND, WHITE LETTERING
FDC	Fire Department Connection	FIRE-FDC	RED BACKGROUND, WHITE LETTERING
FMD	Fire Main Drain	FIRE-FMD	RED BACKGROUND, WHITE LETTERING
FPT	Fire Pump Test	FIRE-FPT	RED BACKGROUND, WHITE LETTERING
NG	Natural Gas	GAS	YELLOW BACKGROUND, BLACK LETTERING
CA	Compressed Air	COMP AIR	PURPLE BACKGROUND, WHITE LETTERING
VAC	Vacuum	VACUUM	PURPLE BACKGROUND, WHITE LETTERING

2. Paint

- a. Sherwin Williams of approved equal.
 - i. Topcoat: B54YZ0437 – Industrial Enamel HS Safety Yellow
 - ii. Topcoat: B54RZ0038 – Industrial Enamel VOC Complying Safety Red

3. Label Vendors

- a. Vinyl Labeling Tape: Can-Do National Tape, PO Box 40366, Nashville, TN 37204, 800-643-5996
- b. Transfer Ribbon: Graphic Products, PO Box 4030, Beaverton, OR 97076, 800-788-5572

22 07 19 – Plumbing Piping Insulation

1. Provide insulation on all heating hot water piping, chilled water piping, domestic hot and cold water piping, and interior roof drain piping. Engineer of record is responsible to provide type of insulation, thickness, and R value.
2. All insulated piping in exposed areas (not above a ceiling or inside a chase way) shall have a PVC jacket.
3. Minimum acceptable thickness is 30 mil for light traffic areas and 60 mil for heavy traffic areas.
4. A light traffic area is an area that is not a public space and not a mechanical room. An example would be a non-public corridor or a non-public utility room.
5. Insulation shields on horizontal piping.

22 11 16 – Domestic Water Piping

1. Gauges with ball valves shall be installed on water services at building entrance and before and after any water regulator.
2. Schedule:
 - a. Aboveground New Piping shall be:
 - i. ASTM B 88, type-L copper; ASME B16.22, ASTM B32 soldered joints
 - b. PEX or equivalent tubing shall not be used.
 - c. Do not use di-electric unions, use brass bodied full-port ball valve instead.
 - d. ProPress Copper may be used for repairs only.
3. Domestic Hot Water
 - a. Maximum temperature to be distributed in buildings is 120 deg. F.
 - b. Use Armstrong DRV “The Brain” mixing valves.
 - c. DHW storage tanks shall be maintained at 140°F to 150°F with one or more mixing valves near the tank to reduce the distribution temperature of 120°F.
 - d. If supply temperature above 120°F is required at an end use device, then a booster heater shall be installed at the place of use.
 - e. Exception: Commercial kitchens may be designed with multiple hot water distribution systems, each with a different distribution temperature.

22 11 23 – Domestic Water Pumps

1. Shall have stainless steel internal parts.
2. Acceptable models:
 - a. Grundfos Magna
 - b. Wilo IL series
 - c. Taco 2400, 00 or VR series
3. B&G series 60 type pumps (Taco 1600) or similar style pumps shall not be used.

22 13 16 – Sanitary Waste and Vent Piping

1. Schedule:
 - a. Aboveground, soil, waste, and vent piping all sizes shall be any of the following:
 - i. PVC Sch. 40 Cellular Core (Foam Core)-DWV pipe; PVC socket fittings and solvent-cemented joints. If more than four (4) stories on the vertical riser, pipe to be Sch. 40 Solid Core PVC pipe, supported at each floor. If sound is an issue, use Sch. 40 solid core PVC pipe.
 - ii. ASTM B306, PVC-DWV pipe; PVC socket fittings; and solvent-cemented joints
 - iii. Dissimilar pipe-material couplings: shielded, non-pressure transition couplings
 - b. Underslab soil, waste, and vent piping NPS 4 inches and smaller shall be Sch. 40 PVC foam core pipe, PVC socket fittings and solvent-cemented joints with tracer wire
 - c. Underground sanitary laterals shall be SDR 21 PVC in 20 foot lengths.

22 14 13 – Facility Storm Drainage Piping

1. Schedule:
 - a. Aboveground, storm drainage piping all sizes shall be:
 - i. Sch. 40 PVC pipe; PVC socket fittings; and solvent-cemented joints
 - ii. Dissimilar pipe-material couplings: shielded, non-pressure transition couplings
 - b. Underground, storm drainage piping all sizes shall be:
 - i. Sch. 80 PVC pipe with tracer wire; PVC socket fittings and solvent-cemented joints
 - ii. Dissimilar pipe-material couplings: shielded, non-pressure transition couplings
 - c. Install piping at the minimum slopes, 2 percent downward in direction of flow for piping unless otherwise noted.

22 16 23 – Natural Gas Piping

1. Do not use pro-press or similar systems for gas piping.
2. 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.
3. Plug valves shall not be used on gas lines, use full port ball valves instead.
4. Ball valves shall have a separate packing nut and handle retaining nut.
5. Acceptable manufacturers:

- a. Apollo
- b. Watts
- c. Milwaukee

22 42 00 – Plumbing Equipment and Fixtures

1. Equipment shall not be hung from the ceiling (i.e. remote mount cooling unit for water fountain, water filtration systems, etc.)
2. General Fixture Information
 - a. Reference 01 84 00, item 2 for Restroom Types.
 - b. All vitreous china to be colored white.
3. Fixture Products
 - a. Water Hammer Arrestors shall be provided at sinks and flush valves. Locate above ceilings.
 - b. Wall Hydrant
 - i. For new construction or building exterior renovations, install frost-free automatic draining wall hydrant (Zurn Z1321-1X24 or approved equal) on the outside on each face of building (coordinate location with RIT).
 - c. Hose Bibb
 - i. All bathrooms shall have at least one chrome plated brass bodied hose bib.
 - d. Floor Drains:
 - i. Provide at least one in each toilet room.
 - ii. All floor drains shall use a deep seal style trap.
 - iii. Mechanical rooms shall also use deep basket.
 - iv. Do not use trap primers.
 - v. If trap primers are used, use external remote valve in accessible location.
 - e. Pedigrid:
 - i. New buildings will NOT have drain under pedigrid at door.
 - ii. Use 4" deep non-rusting 316 stainless steel pan.
 - iii. See Division 08 for further information.

22 42 13 – Commercial Water Closets and Urinals

1. Water Closets
 - a. Wall-hung with matching seat color; 1.6 gpf; 2 1/8" trap
 - b. Manual flush valve
 - c. Acceptable open end elongated toilet seat models:
 - i. Bemis Commercial 1955SSCT
 - ii. American Standard Millennium Elongated 3351.101
 - iii. Church
2. Urinals
 - a. Wall-hung; 2" outlet; 3/4" top spud; 1.0 gpf
 - b. Manual flush valve
 - c. Do no use waterless urinals.
 - d. Acceptable model: American Standard Washbrook FloWise Universal 6590.001
3. Manual Flush Valves
 - a. Chrome finish flush valve with side handle.
 - b. Use diaphragm style flush valve, 1.0 gpf for urinals, 1.6 gpf for water closets.
 - c. Acceptable models include:
 - i. Sloan Regal XL or Royal 111.XL
 - ii. Zurn Z6000-WS1 AquaFlush 1.6gpf, Z6003PL-WS1 1.0 gpf
 - d. Use Sloan EBV89A to convert to auto flush. Do not use top mount auto flush units.

22 42 16 – Commercial Lavatories and Sinks

1. General
 - a. All fixtures shall have an individual water quarter turn valve with handle on each supply line.
 - b. Install an additional isolation ball valve on common supply to gang lavatory sinks within two feet of the first sink.
 - c. Do not use compression fittings on water stop valves.
 - d. Do not use flexible supply lines to fixtures; use soft copper or chromed brass.
2. Wall-Hung Lavatories

- a. Vitreous china, 3 hole with 4 inch spread
- b. P-trap shall be 17 gauge, 1 ½-inch diameter, chromed, as manufactured by Dearborn Brass.
- c. Acceptable model: American Standard Lucerne 0355.012
3. Undermount Lavatory for Solid-Surface Countertops
 - a. Consult with Design Manager on locations
 - b. Acceptable model: American Standard 0496.221; color "Linen"
 - c. Install faucets 2-1/2" from edge of counter cutout to center of faucet. Any exceptions shall be reviewed with and approved in writing by the Design Manager.
4. Sinks
 - a. Spray heads will not be accepted.

22 42 23 – Commercial Showers

1. Showers shall be built-enclosures unless otherwise approved by Planning & Design.
2. Acceptable models
 - a. Moen Thermostatic Shower Valve-ExactTemp
 - b. Moen Shower Head 6300 series E-Z clean

22 42 39 – Commercial Faucets

1. Student / Staff Use Only
 - a. Single-user restrooms and bathrooms; dressing rooms
 - i. Manually-operated user-adjustable
 - ii. Acceptable model: Chicago 3600-E2805AB
 - b. Multi-user restrooms and bathrooms
 - i. Manually-operated single-temperature
 - ii. Acceptable model: Chicago 3520-4E2805ABCP
 - c. Kitchenette and breakrooms
 - i. 8 inch fixed centers
 - ii. Provide with hot and cold water 2 inch wing handles, 8 inch L-swing spout, 1.5 gpm aerator
 - iii. Acceptable model: Chicago Faucets 1100-E35ABCP
2. High-profile / Public-facing
 - a. Single-user restrooms and bathrooms; dressing rooms
 - i. Automatic user-adjustable
 - ii. Acceptable model: Chicago E80-A11A-47ABCPT
 - b. Multi-user restrooms and bathrooms
 - i. Automatic single-temperature
 - ii. Acceptable model: Chicago E80-A11A-41ABCPT

22 45 16 – Emergency Plumbing Fixtures

1. Use deck-mounted for emergency eyewash / shower stations.
 - a. Water Saver Model# EW805 or approved equal
2. All emergency eyewash / safety showers must meet the requirements of ANSI Z358.1, including the following,
 - a. General Requirements
 - i. Required where employees can be exposed to hazardous materials and chemicals.
 - ii. Must be installed in well-lit areas and identified with visible sign.
 - iii. Water temperature must be 60-100 degrees Fahrenheit.
 - iv. Travel to the unit must be within 10 seconds and unobstructed by doors, etc.
 - v. Placement must avoid electrical panels, outlets, or other electrical equipment.
 - vi. Units must be capable of delivering a minimum of 15 minutes of flushing fluid.
 - vii. Eyewash units shall be capable of being activated in 1 second or less.
 - viii. Stay open ball valves must be used to accommodate for hands-free rinsing.
 - b. Eye Wash Stations
 - i. Minimum flow for plumbed and portable Eyewash units is .4 GPM at 30 PSI.
 - ii. Flushing fluid must be provided to both eyes simultaneously.
 - iii. Dust caps or dust covers must be installed to protect the unit from contaminates.
 - iv. Spray heads must be positioned between 33" and 45" from the floor and at least 6" from the wall or nearest obstruction.
 - c. Drench Showers
 - i. Minimum flow for Drench Showers is 20 GPM at 30 PSI.

- ii. Drench Shower pull-rod must be installed no more than 69" from the floor.
- iii. Drench Shower spray head must be positioned between 82"-96" from the floor.
- iv. Spray-pattern must be 20" in diameter at 60" above the floor.
- v. Center of spray pattern must be at least 16" away from any obstruction.
- vi. Combination Units must meet both criteria for Drench Showers & Eyewash.

22 47 13 – Drinking Fountains

- 1. Water fountains shall have a cup filler.
- 2. Hydration stations require approval of Director of Utilities.
- 3. Hydration stations shall not have a filter or digital display.
- 4. Model: Elkay EZS8SF with LK1110 cup filler. Do not use Elkay EZH2O System - Model #EZS8WSLK.

END OF DIVISION 22

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. Manufactured pipe labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.
 - b. Pretension Pipe Labels: Pre-coiled, semi rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
 - c. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
 - d. Paint: Sherman Williams or approves equal
 - i. Topcoat: B54YZ0437 – Industrial Enamel HS Safety Yellow
 - ii. Topcoat: B54RZ0038 – Industrial Enamel VOC Complying Safety Red
 - e. Acceptable Manufacturers: Marking Services, Inc.
 - f. 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"

- g. Pipe label contents: 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
- c. Basis-of-Design: Marking Services, Inc.
- d. Valve tag contents:

SYMBOL	SERVICE TYPE	VALVE TAG	BACKGROUND and LETTERING COLORS
CHWR	Chilled Water Return	(BLDG.)-CHV-##	BLUE BACKGROUND, WHITE LETTERING
CHWS	Chilled Water Supply	(BLDG.)-CHV-##	BLUE BACKGROUND, WHITE LETTERING
MTHWR	Medium-Temp Hot Water Return	(BLDG.)-MTV-##	RED BACKGROUND, BLACK LETTERING
MTHWS	Medium-Temp Hot Water Supply	(BLDG.)-MTV-##	RED BACKGROUND, BLACK LETTERING

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 and Fan Coil Units shall have ALC hardwired points and controllers as the primary method of controls. Integrated controls shall be a secondary means of monitoring and control.

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
 - ii. Schedule 40 steel pipe; class 125 cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints
 - b. Hot-water heating piping, aboveground, NPS 2-1/2 to 4 inch, 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.

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 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

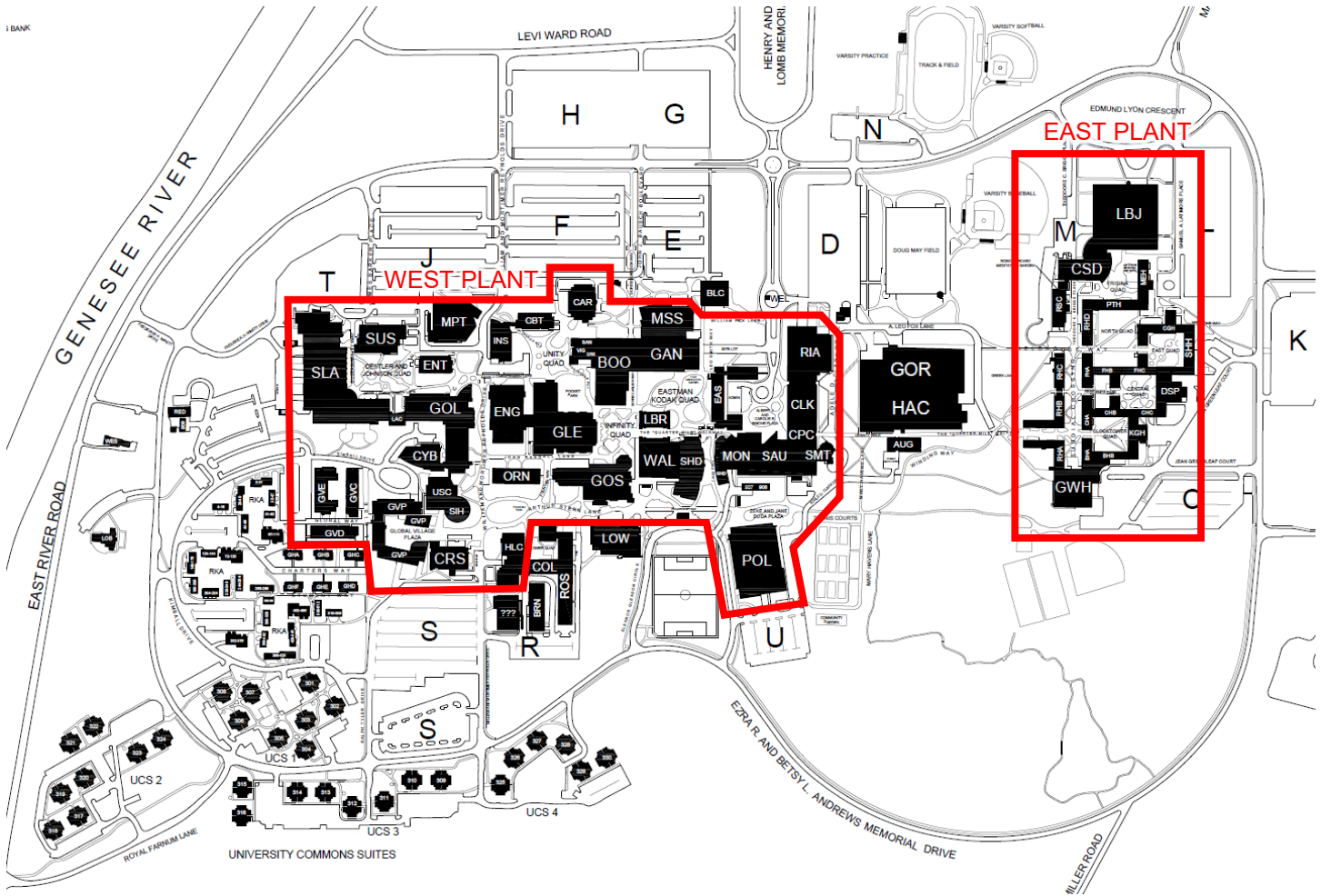
23 81 46 – Heat Pumps

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.

Appendix 1 – East and West Plant Loops



END OF DIVISION 23

23 09 00 – Instrumentation and Control for HVAC
Building Management Systems
Design Guidelines and Best Practices

Revision 04/2019

This document is intended to convey RIT’s standards for building automation control installation and configuration that are above and beyond the manufacturer’s specifications. At all times, the installer is expected to adhere to the manufacturer’s specifications and best practices in addition to adhering to local building codes and standards.

This document is a constant work in progress. Contractors and engineers are encouraged to make suggestions as to how this document and our standards can be improved, clarified, or simplified.

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1. What RIT Expects from its Control Contractors

- a. All control contractor employees working on RIT projects shall attend a two hour orientation program by RIT as needed.
- b. All problems with mechanical equipment discovered by the controls contractor shall be reported to the project manager in a timely manner.
- c. Control Panels shall be orderly, have permanent labels and shall be completely documented.
- d. Commissioning shall be 100% complete before the project is turned over. See the section on commissioning.
- e. Point checkout shall be complete and accurate.
- f. All documentation shall be complete and accurate.
- g. All panel, floor plan and network drawings shall be complete, accurate and turned over to the owner in both PDF and AutoCAD format when the project is complete.
- h. All Server programming and configuration shall be complete, including (but not limited to):
 - i. Equipment Graphic Screens
 1. Every piece (or related group) of equipment shall have its own equipment screen.
 2. All equipment shall be in the proper source trees.
 3. The equipment graphic screens shall contain all source links.
 4. The equipment screens shall have RITs standard override block.
 - ii. There shall be a floor plan graphic screen for each area of the project that contains:
 1. Location and status (color) of every piece of controlled equipment
 2. All space sensors
 3. All room numbers
 4. All remote sensors outside of mechanical rooms.
 5. Weather information and link.
 6. HOA switches on all HVAC equipment graphics.

2. WebCTRL Equipment files naming and use

- a. All file names will begin with the letters **bldg_** followed by a two-digit building number followed by a description followed by an underscore and finally followed by a two-digit instance number. Use two digits for the building number if possible. Including a leading zero if the building number is 9 or less.
- b. On buildings that have more than three digits use the minimum number possible.
- c. If the file corresponds to a single piece of equipment, then the file name should include the equipment name. AHU, VAV, HP, etc.
- d. If the file corresponds to multiple pieces of associated equipment then the file name should be indicative of the system. HW, CHW, Steam, Radiation, etc.
 - i. Examples:
 1. **bldg_01_ahu_02** - serves Building 01 AHU-02 (HC-001-AHU-002)
 2. **bldg_7b_vav** – serves building 7b multiple VAVs (HC-07B-VAV-###)
 3. **bldg_50b_dhw** – serves building 50b domestic hot water
 4. **bldg_400_ahu_10** – serves building 400 AHU-10 (HC-400-AHU-010)
- e. In cases where the program is relevant to multiple buildings the file name will begin with **bldg_00_**.
 - i. Examples
 1. **bldg_00_chw_btu_v2** – serves multiple buildings for calculating chilled water energy data
 2. **bldg_00_hw_hx** – serves multiple buildings for hot water heat exchangers
 3. **bldg_00_vav** - serves multiple buildings for multiple VAVs
- f. If possible use one of the template files below. Verify with RIT Building Controls Dept. for current templates. These files begin with **bldg_00_**.
 - i. **bldg_00_chw_btu_v2** – Chilled water energy meter program.
 - ii. **bldg_00_hw_btu_v2** – Hot water energy meter program.
 - iii. **bldg_00_gas_meter_v2** – Gas meter energy program.
 - iv. **bldg_00_electric_energy_use_v2** – Electrical energy meter program.
 - v. **bldg_00_water_meter_v2** – Water use meter program.
 - vi. **bldg_00_hw_hx** – Building hot water connect heat exchanger program.
 - vii. **bldg_00_irrigation_v2** – Irrigation panel program.
 - viii. More template programs will be added in the future. Please check with the controls department to see if there is a template program to fit your application.

3. WebCTRL View File Naming and Use.

- a. In general, the view file name should match the associated equipment file name. The naming rules are the same. Please refer to the equipment file naming above.
- b. In situations where the view is to be customized for a more-generic building-specific equipment file, then the view file name should include the equipment file name with an added instance number.
 - i. Example
 1. Equipment file name : **bldg_04_vav.equipment**
 2. Matching generic view file : **bldg_04_vav.view**
 3. Equipment specific view: **bldg_04_vav_0305.view**
- c. In situations where the equipment file is not building-specific but the view needs to be equipment-specific, then the view is named specific to the equipment as according to the rules above, even though this does not match the equipment file.
 - i. Example
 1. Equipment file name : **bldg_00_hw_hx.equipment**
 2. Matching generic view file : **bldg_00_hw_hx.view**
 3. Equipment specific view: **bldg_04_hx_02.view**
- d. View file location
 - i. All view files are to be located in a subdirectory of the W:\webroot\rochester_institute_of_tech\views folder. The subfolder name will generally be named **Bldg-#** where # refers to the building number.
 1. Example all view files for building 1 will be stored in **..\views\Bldg-1**
 2. If the file does not belong to a building then it should be located in one of the other subfolders
 - a. **..\views\Campus Summaries**
 - b. **..\views\Energy (Energy Related, such as BTU metes, etc)**
 - c. **..\views\HCP (Heating Cooling Plant)**
 - d. **..\views\graphics**
 - i. Only as a last resort should items be put in the graphics folder. Please check to see if it belongs in a building folder or one of the other folders instead.

4. WebCTRL Reference Name Nomenclature

- a. All geographic reference names are to be absolute names, starting with a #.
- b. In cases where one new piece of equipment is to be added to existing equipment in the building, then the reference name should match the existing reference name style, even if the existing reference naming does not follow the standard set forth here. Consistency is important.
- c. Geographic Reference Names
 - i. Geographic Reference name rules follow the rules set for equipment file names, except generally the bldg portion is left off.
 1. Examples
 - a. #02-ahu-05 - Building 02 AHU-05
 - b. #75-vav-0312 - Building 75, AHU-03, VAV-12
 - c. #99-rtu-11 - Building 99 Rooftop unit -11
 - d. #81-pump-01-02 - Building 81 pumps 01 and 02
 - e. #400-chw - Building 400 CHW System
- d. Network Tree Reference Names
 - i. LGRs
 1. Display name is to be **Router #?? Bldg #??**.
 - a. Example: **Router #38 Building #13**
 2. The reference name is to be the corresponding name from site builder.
 - a. Example: **#router__38_bldg_13**
 - ii. Arcnet
 1. Main building level: **Bldg#?? Arcnet**
 - a. Example **Bldg#75 Arcnet**
 2. AAR
 - a. Building number – AAR – Instance Number
 - b. Example **08-AAR-01** – Building 08 AAR number 01

3. Sub-Arcnet (Arnet on an AAR)
 - a. Building number – Arnet – Instance Number
 - b. Example **08-Arcnet-01** Building 08 Arcnet Number 01
- iii. Single Equipment Controllers
 1. Building Number – Equipment Type – Instance Number – Module Model
 2. Example:
 - a. Display Name: **99-RTU-11-SE6104** – Building 99, RTU-11, Controller SE6104
 - b. Reference Name: **#99-rtu-11-se6104** – Building 99, RTU-11, Controller SE6104
- iv. Multiple Equipment Controllers
 1. Building Number – Equipment Description – Instance Number (if Applicable), Module Model
 2. Example:
 - a. Display Name: **99-HWPlant-ME812U** – Building 99, Hot Water Plant, Controller ME812U
 - b. Reference Name: **#99-hwpant-me812u** – Building 99, Hot Water Plant, Controller ME812U



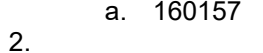
5. Network

- a. Traditional Topology
 - i. Each building will have at least one LGR or approved RIT Building Controls Dept. Gateway router.
 - ii. AARs (Arcnet Routers)
 1. If the building has more than 30 control modules connected to the LGR, then AARs must be used to create sub-Arcnet segments.
 2. Each AAR will be off the main Arcnet segment for the building
 3. There are only three acceptable locations for the AARs
 - a. All of the AARs may be placed in the same panel as the LGR or in a panel next to the LGR. In this way the main Arcnet only has AARs and optionally some other controllers in the same room.
 - i. This method is preferred when each AAR will serve one area of the building, such as a building floor.
 - b. Each AAR may be placed in the panel of the associated AHU.
 - i. In this case the AHU and all of its associated VAVs will be on the secondary side of the AAR. In this situation all of the AHU to VAV communication is all on the secondary side of the AAR.
 - c. An AAR may be placed in a dedicated panel in a mechanical area.
 - i. For instance if there is one AAR serving each floor of a building, then the AARs may be placed on each corresponding floor. It must be placed in an area accessible by the RIT engineering staff, such as a mechanical room or mechanical area. It may not be placed above the ceiling or in some other hidden location. The panel must be clearly labeled xx-AAR-xx (ex 50A-AAR-02 for building 50A AAR #2).
 4. AARs are not to be placed in difficult to reach or difficult to find places.
 5. AARs are not to be powered off from equipment power. Shutting down an AHU or other piece of equipment should never shut down an AAR. A dedicated circuit for controls is required.
- b. Ethernet Controller Topology
 - i. Plant Equipment controllers can be Ethernet controllers such as the ME812u-E.
 1. In this situation these controllers are not using Arcnet, and each controller is located on the campus Ethernet with a dedicated RIT Ethernet jack.
 - ii. AHU controllers can be combination Equipment controllers / LGR such as the ME812u-LGR.
 1. The AHU controller is located directly on the RIT campus Ethernet with a dedicated Ethernet jack.
 2. All of the associated VAV controllers are located on the Arcnet segment that originates with the AHU controller.
- c. Repeaters
 - i. No Repeaters are to be used ever.

- d. Terminations and Biasing
 - i. Locations of all network terminations and/or biasing devices are to be clearly marked on the network riser diagrams and on the network floor plans.
 - ii. BT-485s are to be used at the ends of each and every network segment if possible.
 - iii. In situations where using a BT-485 is not possible, then Network terminating resistors are to be used at each end of the network segment with a DIAG-485 located roughly in the middle of the network segment.
 - 1. The DIAG-485 must be in a panel in a mechanical space.
 - 2. The DIAG-485 must have a dedicated transformer or transformer feed. Turning off the power to any other control device or piece of equipment, must not interrupt power to the DIAG-485. A dedicated circuit is required.
- e. Network Variables
 - i. Outside Air
 - 1. All programs that have a network input for outside air Temperature will use **exp:#oa_conditions/temperature** for the primary temperature value. The secondary value will be set to the local building average outside air temperature if one exists or to the nearest valid outside air temperature sensor if a building average does not exist. The intent is to use the campus average if it is available and use a local temperature sensor if the campus average is not available.
 - 2. Similar to outside air temperature, all programs **exp:#oa_conditions/humidity** for the primary humidity value. The secondary value will be set to the local building average outside air humidity if one exists or to the nearest valid outside air humidity sensor if a building average does not exist.
 - ii. Network values on the same control module
 - 1. If there are multiple programs that are on the same control module and at least one of the programs uses a network input to retrieve the value of one of the other programs then the network input must use the “this” address format. When using “this” format the network input does not use up any network traffic. All communications is retained inside the control module.
 - a. Example: Instead of **exp:#bldg_09_chlr_plant/t4_campus_chws** use **bacnet://this/t4_campus_chws_1**. Both of these refer to the same point, but the second does not use or depend upon network traffic.

6. Network Numbers and Device Instance Numbers

- a. Network numbering
 - i. Network numbers shall be assigned by building number
 - ii. The first network in a building will be the building number followed by 00
 - 1. In the case where the building has a dedicated LGR the __00 network will be connected to the LGR.
 - 2. Example: The first network in building 73 will be 7300 this will be the network that is directly connected to the secondary side of the LGR.
 - iii. The networks will be numbered sequentially after the first.
 - 1. Example: The second network in building 73 will be 7301.
 - iv. The network numbers will correspond to the AAR numbers
 - 1. Example: AAR-02 in building 73 will correspond with Arcnet 7302.
 - v. Exceptions / Clarifications
 - 1. Buildings with multiple LGRs
 - a. The first LGR will directly host network __00
 - b. This first LGR will host AAR numbers 1 to 9 corresponding to networks __01 to __09.
 - c. The second LGR will directly host network __10
 - d. The second LGR will host AAR numbers 11 to 19 corresponding to networks __11 to __19
 - e. There should not be more than 9 AARs on a single LGR
 - 2. Multiple buildings on a single LGR
 - a. Do not put multiple buildings on a single LGR.
 - b. Use at least one LGR per building.
 - 3. Buildings with letters

- a. Network numbers cannot have letters.
- b. Each building with a different letter should have a new LGR.
- c. If an exception is made and there are multiple buildings with different letters on the same LGR then the rules for “Buildings with multiple LGRs” should be followed
 - i. Example: If building 50A, 50B and 50C are on the same LGR then :
 - 1. Network 5000 would be the network number from the LGR connecting all of the AARs
 - 2. Network numbers 5001 to 5009 will be reserved for those networks that are not associated with a particular building letter. For instance if there is a mechanical room AAR that does not belong to a specific building.
 - 3. 50A would have network numbers 5010 to 5029
 - 4. 50B would have network numbers 5030 to 5049
 - 5. 50C would have network numbers 5050 to 5069
 - ii. Example #2 Building 7A and 7B
 - 1. Networks 0700 – 0749 are reserved for 7A
 - 2. Networks 0750 – 0799 are reserved for 7B
- b. Device Instance Numbers
 - i. The device instance number should be the network number followed by the MAC address of the controller
 - ii. Examples
 - 1. Building 81 should have network numbers 8100 to 81__
 - a. The third AAR would have network 8103
 - b. The module with MAC address 25 on the third AAR would have a device instance number 810325
 - iii. In this way it is always possible to determine which building and network a module belongs to simply by decoding the device instance number
 - iv. This will help with coordinating device instance numbers while buildings are under construction before they are connected to the main system.
 - v. Format #1: Building with single digit number
 - 1. Example: Building 02, AAR 05, MAC 16
 - a. 20516
 - 2. 
 - vi. Format #2: Building with Two Digit Number
 - 1. Example: Building 16, AAR 05, MAC 17
 - a. 160157
 - 2. 
 - vii. Format #3: Building with Three Digit Number
 - 1. Example: Building 400, AAR 02, MAC 01
 - a. 4000201
 - 2. 
 - viii. Note: The maximum device instance number will not be able to follow this scheme directly.
 - 1. This means that a building with a three digit number will not be able to follow this scheme directly.
 - 2. Currently there are no buildings connected to the WebCTRL system with a building number larger than 404.
 - 3. If working on a building with a number larger than 418 contact RIT Controls to determine which instance numbers to use.

7. Template Programs

- a. RIT would like to reduce the number of programs in use on our WebCTRL server.

- b. RIT has been developing template programs for certain equipment, contact RIT Building Controls Department personnel for template programs.
- c. If a template program meets the project requirements it shall be used.
- d. If a template program meets most of your project requirements, but not all, contact RIT Building Controls Department personnel to review if the template program can be modified to meet the project requirements while still maintaining compatibility with the existing equipment using the program.
- e. Currently, template programs exist for all types of energy meters.
- f. Other template programs exist for irrigation and HW connects.
- g. As of January 2018, there are about 100 template programs that include VAVs, chilled water connects, hot water connects, coolers, cabinet unit heaters, fan coils, exhaust fans, various meters and various BACNet integration programs.
- h. Template programs for chilled water connects, domestic hot water, heat pumps, RTUs, and chilled beams/inducer are being developed.

8. Program Substructures

- a. **Program Edit Order.** Ensure that logic blocks are in the correct section in the logic builder edit order after any program has been modified.
- b. **Logic Latching Software.** Any latch in software shall be resettable without restarting the controller.
- c. **Alarm differential Low Limit.** Modify the standard logic from ALCs equipment builder for alarms that are offset from a setpoint in such a way that there is a minimum offset above and below the setpoint, in addition to the standard percent above and below the setpoint. This is particularly important for processes that have a setpoint near zero such as return duct static pressure control. This applies to all similar logic. See below for example.

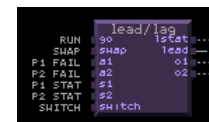


RIT's OCL block 1.61 or 1.63 or later



This output feedback is used to ensure that the PID does not deviate too far from the output when other parameters are affecting the output besides the PID block. These parameters might be a ramp block, limit block, or switches. Use this method whenever possible.

- 1. This can be
 - a. In this example, notice how the final output is used as an input to the PID block.
- 2. Or it can be the BACNet PID included in WebCTRL 5.2 or later.
- 3. Do not use the older RIT Custom PID block, this has been superseded by the RIT OCL PID Block.
- ii. PIDs need to be properly tuned so the equipment does not cycle and the control routines are stable.
- e. Lead/Lag
 - i. Use RIT's custom lead/lag block. Do not use ALCs lead/lag block.
 - 1. This block can be found along with associated logic in the program **lead_lag_with_switch.equipment**
 - a. This program can be used even if there is no select the appropriate subroutine from the
 - b. There are more instructions within the program
- f. Analog Variables for Network Linking
 - i. When an analog value is expected to be referenced by an analog network input from a different program, then a dedicated BACNet Analog Value (BAV) Status block is to be created in the program with the same name as the value with the addition of "Out" to the display name and "_out" to the reference name. In between the logic generating the value and the BAV block there



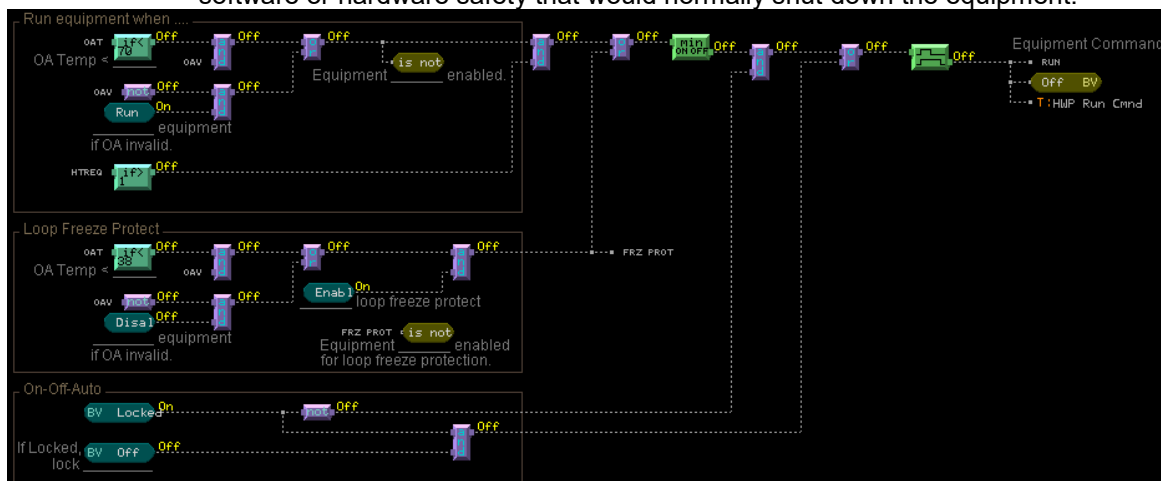
template
 switch,
 program.

is to be logic that prevents the BAV value from changing more than necessary. Typically this time will be 30 seconds to 1 minute.

1. The objective of this logic is to prevent excessive network traffic due to values changing frequently because of improperly set COV settings or because of a fluctuating input value.
2. This can easily be accomplished by using RIT's **AVG/DEL** V1.2 OCL block or RIT's **AVG** V1.1 OCL Block
3. Example: It is known that the kW feedback of a fan will be trended by another program. Therefore, a BAV output is created. An **AVG/DEL** block is inserted in-between the AI and the BAV. The AVG/DEL block is set so that the output only changes once every 30 seconds. In this case, even if the COV of the BAV is set lower then desired, the network traffic will only be triggered at most once every 30 seconds.

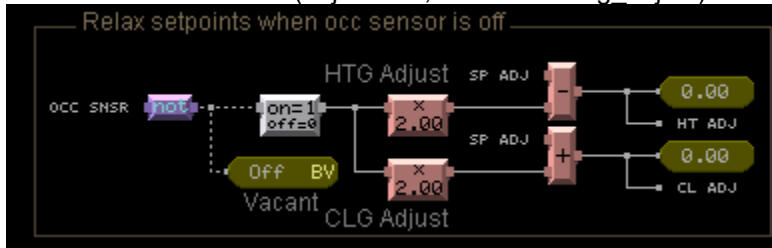


4. In general any value that is related to energy will be referenced by another program through the network.
 - a. Examples: kW, BTU, flow, temperatures associated with flow to calculate BTUs.
 5. Outside Air Conditions are generally referenced by another program and should include a delay out.
 6. Other values that are likely to be referenced remotely are Air Flow and Water Flow values, AHU Discharge Air Temperature, etc.
- g. Program block Reference Names
- i. For any logic block that might be linked to a graphic or linked by network to another program enter a meaningful reference name.
 1. This includes:
 - a. All inputs
 - b. All outputs
 - c. Any type of adjustable setpoint (AV, BV, if Greater/Less then Constant, Constant High/Low limit, etc) that the user is likely to change.
 2. Use reference names that match existing program naming style.
- h. Hand / Off / Auto
- i. All equipment programs are to include logic to support a HOA switch on the graphic screen.
 - ii. The HOA logic will be programmed in such a way that when the HOA is set to Off the equipment will not run regardless of freeze protection or other logic and it will not generate alarms.
 - iii. However, when the HOA switch is set to the On position, the equipment will shut down due to any software or hardware safety that would normally shut down the equipment.



- i. Environmental Index

- i. Every program for equipment that directly conditions an occupied space is to include the ALC Environmental index logic. The environmental index is to have provisions for Temperature, Humidity and/or CO2 depending upon what is controlled by that program.
- ii. Each building will have a master Environmental Index that will roll up the zone EI's in the building.
- j. Occupancy Sensor Logic for zone control
 - i. Zone equipment with occupancy sensors is to have the following logic.
 1. The zone is to go occupied if the schedule is occupied or the occupancy sensor is tripped. (Note that the schedules can be left empty and then the occupancy sensor is the only determination of occupancy)
 2. If the occupancy sensor is, unoccupied then the cooling setpoint is adjusted up by 2°F (adjustable, ref name = clg_adjust).
 3. If the occupancy sensor is unoccupied, then the heating setpoint is adjusted down by 2°F (adjustable, ref name = htg_adjust).

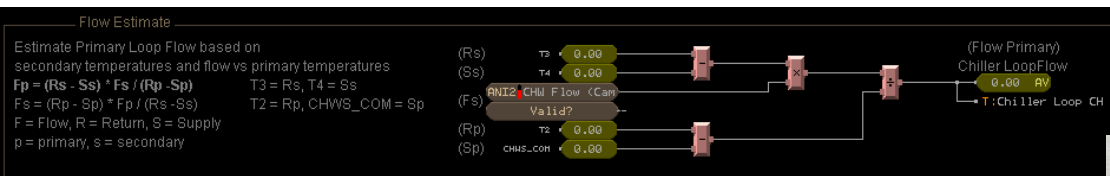


9. Program Documentation

- a. When modifying an existing program, include your initials, date and short description of the changes at the upper right side of the program.

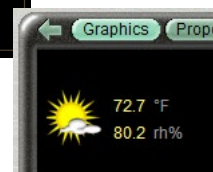
Revisions		
Date	Initials	Description
04/16/09	TMV	Add CW & CHW Flow
05/13/09	MW	Allow User Pump Selection & Pump Ramp Down
08/19/09	TMV	Pump Delay Off
07/01/10	TMV	Flow Calculations
02/15/11	TMV	Flow Meters
07/13/11	TMV	Cond Speed Logic

- b. In sections of a program that are not standard design, include a text description of the program logic so that someone with little knowledge of the programming language can read the description and
- c. Determine what that program section is doing.



10. Graphic Screen Components and Layout

- a. Outside Air Conditions

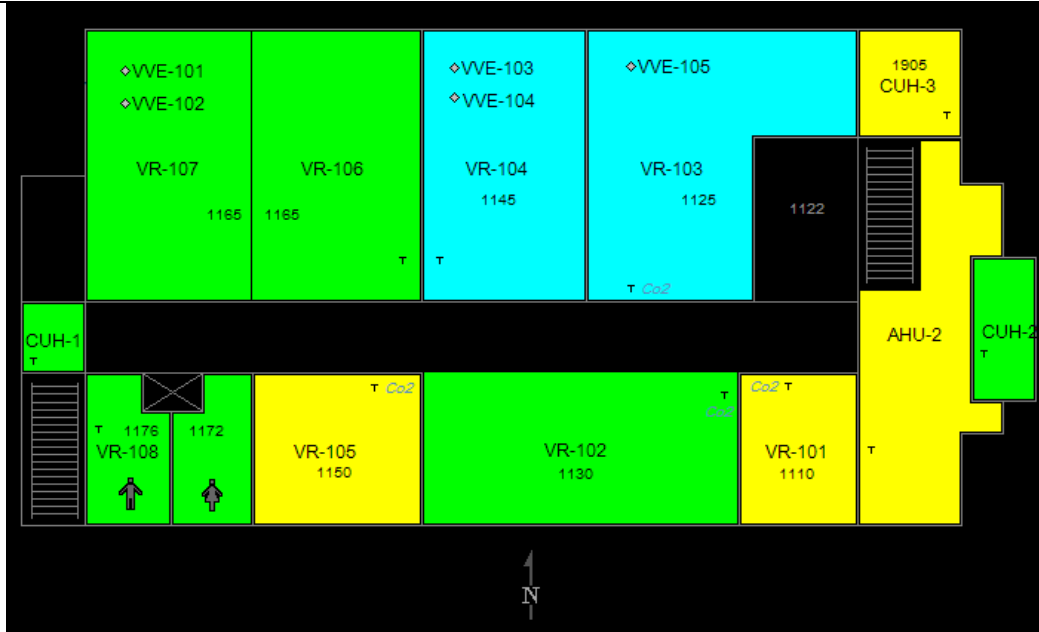


have the outside air temperature and humidity displayed in corner of the page along with a picture of the sun.

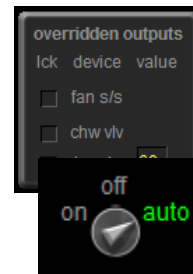
1. The values for outside air temperature and reference the local program if one is available.
 - a. Remember that the local program should be getting its outside air conditions from #oa_conditions if it is setup correctly.
2. If local outside air conditions are not available in the local program, then these values are to reference **exp:#oa_conditions/temperature** for temperature and **exp:#oa_conditions/humidity** for humidity.
3. In either case, clicking on the sun will direct the user to the page associated with **#oa_conditions**.

- b. Floor Plans

- i. All floor plans shall include room numbers.
- ii. All floor plans shall include an accurate location of space temperature, humidity and CO2 sensors.
- iii. All floor plans shall include a North Arrow



- c. Equipment Graphic Screen Locked Values
 - i. All screens that primarily show mechanical equipment that is being controlled by the associated program shall have an HOA block that contains check status of each output and value boxes for the locked the lower left corner of the screen.
 - ii. The locked value is to be hidden unless the value is
- d. Equipment Screens Master Hand/Off/Auto
 - i. All equipment screens are to have master HOA top/middle of the screen.



locked to a value.
 switch located near the

11. Construction Server

- a. RIT maintains multiple WebCTRL Servers. One of the servers, designated the "Construction" server.
- b. All new large scale projects shall be put on the construction server as soon into the project as possible to facilitate coordination between RIT and the contractor and to allow observation of building performance during the construction phase.
- c. While the Construction server is expected to be online the majority of the time, it is also expected and acceptable to have frequent interruptions of service to update controls programming.
- d. When the project is 100% complete, the controls contractor and RIT Building Controls Dept. shall be coordinate the transitioning of the project from the construction server to the appropriate production server.

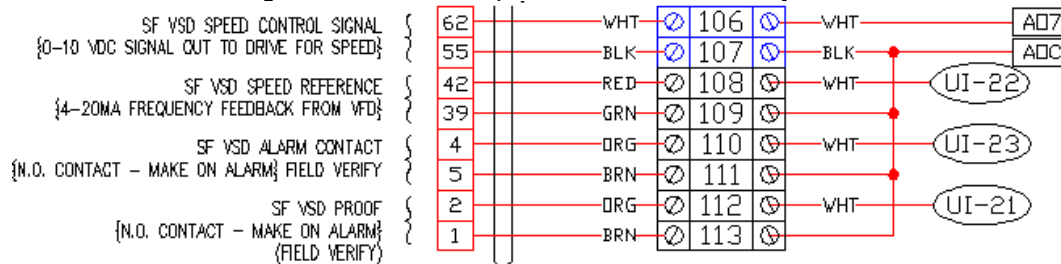
Webctrl03 is

12. Fan Arrays (Fan Wall)

- a. Air moving equipment with Fan Arrays shall be integrated into controls with the following properties:
 - i. There shall be no black box controlling the fan array. This includes devices which speak BACNet and have BACNet integration.
 - 1. Control of the fan array shall be performed directly by the RIT ALC control modules.
 - 2. It is acceptable and encouraged to integrate the VSD BACNet bus into the ALC system for monitoring purposes.
 - ii. The fan array shall have at minimum the following points
 - 1. DI – Status of each Fan
 - 2. DO – Start / Stop of each Fan
 - 3. AO – Speed control of the fan array. A shared AO can be used for all Fans.
 - 4. AI – Speed Feedback for each Fan
 - 5. AI or BACNet – Power use (kW or HP) for each Fan
 - 6. DI – Alarm Status for each Fan

13. Control Panels and Control Panel Drawings

- a. All control panels shall have spring loaded terminal blocks and Panduit.
- b. All control panels must be clearly labeled on the exterior of the panel.
- c. All wires entering or exiting the control panel must be labeled with permanent labels and adhere to the wire coding color standard list in the RIT Electrical Guidelines.
- d. All relays must be labeled with permanent labels.
- e. All work must be neat and tidy.
- f. Panel drawings shall include endpoint terminations on any field device that has wiring designations.



g. Terminal Block Colors

- i. Gray - Inputs
- ii. Red - Power
- iii. Blue - Outputs
- iv. Yellow - Interlocks

h. In Panel Wire Colors

- i. White - Inputs and Outputs signal wire
- ii. Black - Inputs and Outputs common wire
- iii. Red - 24VAC Power
- iv. Blue - 24VAC Common
- v. Orange/Purple - 24VDC Power
- vi. Green - Ground

i. Fan Safety wiring

- i. Each fan safety device shall have a dedicated relay in the control panel with a permanent label indicating which device the relay corresponds with.
 1. Each relay shall have multiple throw sub circuits.
 2. Each relay sub circuit shall be used to interrupt the power or continuity to one critical system.
 - a. Example:
 - i. Throw 1 – Supply Fan Safety Interlock
 1. If the circuit is open the fan will not run
 - ii. Throw 2 – Return Fan Safety Interlock
 1. If the circuit is open the fan will not run
 - iii. Throw 3 – Damper Power
 1. If the circuit is open, then the power to the dampers will be interrupted and the dampers shall use “spring” power to return to the safety position
 - iv. Throw 4 – Valve Power.
 1. If the circuit is open, then the power to the valves will be interrupted and the valves shall use “spring” power to return to the safety position
- ii. Each safety relay shall be energized through the safety devices NC contacts such that the relay coil is energized when the safety device is in the normal (non- alarm) state.
- iii. If a safety device transitions into the alarm state then the corresponding relay shall de-energize.
- iv. The safety circuit shall be wired in series through the NO contacts of all safety relays, such that if any safety device enters the alarm state or is simply disconnected the safety circuit is opened and the fan shall shut down.
- v. The safety circuit shall be wired to the fan or VSD in such a way as it cannot be easily bypassed with user intervention. For example the Hand switch on a VSD shall not allow the fan to run if the safety circuit is in alarm.

14. Riser Drawings

- a. Riser drawings shall show a schematic layout of controller network connections. This is to enable the correct order that the controllers are physically connected. This is to aid with network troubleshooting.
- b. Riser diagrams shall include a dashed line around any controllers that are in a panel with a designation of the panel name and location. If multiple controllers are located in the same panel, then all controllers in that panel shall be inside the same dashed line.
- c. Riser diagrams shall include network addresses, controller models, terminators, and equipment served by each controller.
- d. Riser diagrams shall be integrated with any existing network diagrams that they are to be connected with.

15. Floor Plan Drawings

- a. Building Management/Control drawings shall include:
 - i. The accurate location of each controller and control panel
 - ii. The accurate location of each terminator and network diagram
 - iii. The accurate location of network wires and network terminations
 - iv. The accurate location of any low voltage power panels that are part of the controls.
 - v. The accurate location of field sensors.

16. WebCTRL Trees

- a. Mechanical Rooms
 - i. An area will be setup for each mechanical room. The equipment for this mechanical room shall be included under the area for that mechanical room.
 - ii. The mechanical room area shall show a schematic floor plan layout of the room with approximate equipment locations.
 - iii. Each piece of equipment shall be on the area floor plan with a color indication and a link to the equipment.
- b. Each building shall have an area named "Chilled Water" if it is applicable
 - i. This area will show a schematic representation of all the main chilled water piping and sensors in the building and how it connects to the campus chilled water system.
 - ii. There will be links to each piece of equipment that is related to the chilled water.
 - iii. The intent is to see an overall representation of all the chilled water equipment in one place and to have an easy way to link to the various pieces of equipment which are likely located under mechanical room areas.
- c. Each building shall have an area named "Hot Water" if it is applicable
 - i. See Chilled Water above
- d. Each building shall have an area named "AHUs"
 - i. This shall be a single graphic containing a list of each AHU in the building.
 - ii. The list shall contain all the AHUs regardless of which system the controls are on.
 - iii. The list shall include Name, Location, Color, SF Status, RF Status, DAT, Supply Static, Filter Static 1, Filter Static 2, Filter Status 1, and Filter Status 2 as applicable.
 - iv. The name shall be a link to the equipment program location if applicable.

17. Commissioning

- a. Temporary Server
 - i. All primary commissioning is to be performed on a local copy of WebCTRL or on the RIT Construction server, not on the RIT WebCTRL production server. The local WebCTRL is to be owned and operated by the contractor.
 - ii. Larger projects are typically placed on the RIT Construction server during the commissioning process at the discretion of the RIT Controls department.
 - iii. Prior to moving the project database from the construction server to the RIT production server the following shall be completed. The TC contractor shall review the project installation, confirm all details including but not limited to: DDC panel drawings, wire labels, VFS, disconnect, VAV and thermostat labels are complete and alarms shall be adjusted per Section 17.b.i (See Below)
 - iv. When the project is completed and fully commissioned, the project database shall be moved to the RIT Production server.
- b. Alarms

- i. Commissioning includes analyzing alarms from operating equipment. Through a combination of adjusting alarm parameters and adjusting operating parameters, the commissioning agent is responsible to ensure that the equipment does not produce false, meaningless or un-useful alarms. Every alarm should be relevant and important.
 - c. Point Checkout
 - i. The point checkout properties page shall be used and checked off as part of the commissioning process.
 - ii. All physical points for every controller shall either be checked out on or have a note explaining why it is not checked out on the "IO Points" page.
 - iii. All network points for every controller shall either be checked out on or have a note explaining why it is not checked out on the "Network Points" page.
 - iv. Each operator will be logged into WebCTRL under his/her own name for the point checkout. Do not use a company login.
 - v. All points relevant to airflow or water flow shall be checked out and operational before the balancer is on-site to balance the system.
 - vi. At the completion of the project the contractor shall create a point checkout report for all controls in the project and submit it to FMS controls for review.
 - d. PIDs
 - i. PIDs are to have a deadband.
 - ii. PIDs will be tuned so that the controlled output performs smoothly, without excessive oscillations and within parameters.
 - e. The following "As-Built" documentation is required:
 - i. DDC Control Panel and Base Wide I/O Point Summary List
 - ii. I/O Points Test List
 - iii. Control Schematics
 - iv. Initial Setup Value
 - v. Hardware, software job specific documentation
 - vi. Trend logs including setpoints, operating points, valve positions, etc.
 - vii. As-Built drawings shall be provided in each DDC Cabinet. Drawings shall be at least 11"x17".

18. Sequences

- a. Heating / Cooling Source Trees
 - i. All equipment able to do so is to be setup in the heating and cooling source trees.
 - ii. If a sequence calls for something similar but not exactly the same as the ALC Optimized setpoint, talk to sequence designer about using Heating/Cooling source trees instead. It is easier to work within the intended ALC system than designing your own for each project. It also provides more consistent programming and operation to use the resources provided by ALC.
 - iii. Use RIT mbh logic program and trend for installed hot water and chilled water coils.
- b. Heating Valves
 - i. Heating valves will use one of the two following sequences for unoccupied mode.
 - 1. If the OA is above 45F and it is valid, then close the heating valve. If the OA is below 45F, then open the hot water valve to 50% open.
 - 2. If the OA is above 45F, then the hot water valve is allowed to modulate to maintain the hot water coil leaving air temperature setpoint.
 - a. Use this method if there is a temperature sensor located in close proximity to both the heating coil and cooling coil.
 - ii. Heating valves will be commanded to 50% open on a freezestat trip.
 - 1. Reason #1: Sometimes the direction of the hot water valve becomes reversed from the desired direction. If this valve is commanded to 50% then it does not matter if the valve direction is reversed or normal, in either case the coil will get a significant amount of water.
 - 2. Reason #2: It should not be necessary to direct 100% flow through the hot water coil to prevent freezing. By limiting the valve to 50%, more flow is available for the rest of the hot water system.
 - iii. All PICV valve installations shall include a valve schedule and PICV ring positions as included.
- c. Air Handling Units
 - i. OA Damper on startup

1. As normal when the fan is off, the outside damper will be 0% open. Add in additional sequences so that when the fan first starts, the outside air damper is not allowed to open 100% right away. Instead the OA damper will be allowed to open at most 1% every 6 seconds (adjustable). This delay is only at unit startup.
 - a. The intent is to prevent the freezestat from tripping and to prevent the outside air damper from oscillating.
- ii. HW Valve on startup
 2. If the HW valve is partly or fully open due to an unoccupied sequence, then the HW valve will only be allowed to close down 1% every 6 seconds. This is to prevent the discharge air from getting too cold too quickly and tripping the freezestat or freezing the coil. This delay is only at unit startup.

19. Wiring

- a. General
 - i. Remove all unused wires associated with the project. Do not leave abandoned wiring in the field.
 - ii. If a project description does not include removal of old control wiring and it is known that there will be abandoned control wire, then submit an alternate to remove all the old control wiring at time of bidding.
- b. Network wiring
 - i. Always install ARCNet compatible communication wiring even when connecting to MS/TP devices. Ensure that the network wire is rated for both MS/TP and ARCNet.
 - ii. When removing controllers or wires from the middle of a control network segment do not leave bug connections in the field. Instead pull one new network wire to span the sections that were removed so there is one continuous network wire from one device to the next. Control contractor to leave in operating condition.
 - iii. Jacket Color
 1. Backbone ARCNet – Dark Green
 - a. Backbone is the ARCNet directly connected to the Main Gateway such as the LGR on one end and connected to field gateways and some field devices.
 2. Secondary ARCNet – Light Green or Yellow
 - a. Secondary is the ARCNet originating at a field gateway such as an AAR and connecting to field devices.
 3. Third Party MS/TP - Purple
- c. Network Sensor Wiring (RNet)
 - i. Use 22/4 stranded, plenum rated, non-shielded with orange jacket rated for logistat or RNet use.
 - ii. Conductors
 1. Black – Net –
 2. White –Net +
 3. Red 12V+
 4. Green – Ground
- d. Generic Sensor Wiring (Non-Networked)
 - i. Use 18/2 stranded, shielded, plenum rated wire with white jacket, black and white conductors.
 1. Ground wires should be trimmed from the sensor end of the wire. A piece of tape should wrap the end of the jacket to conceal the remainder of the ground wire and shield.
 2. At the panel end of the sensor wire, leave the ground wire intact and wrap the ground wire around the wire jacket and use electrical tape to conceal the ground wire.
 - a. If there are any sensor issues the ground wire is to be grounded at the panel only.

20. Miscellaneous

- a. WebCTRL shutdowns
 - i. Give 24 to 48 hour advanced notifications for WebCTRL shutdowns.
 - ii. For a shutdown that is expected to last for less than 30 minutes
 1. Broadcast a notification message on WebCTRL 15 minutes ahead of time. “WebCTRL will be shutting down in 15 minutes for maintenance. Expected downtime is XX-XX minutes.”

2. Broadcast a second notification message on WebCTRL one minutes ahead of time.
“WebCTRL will be shutting down in ONE minute for maintenance. Expected downtime is XX-XX minutes.”
- iii. For a shutdown that is expected to last for more than 30 minutes
 1. Send out an e-mail a day before to all RIT engineers and contractors using WebCTRL notifying them of the shutdown.
 2. Additionally, follow the procedure above 15 minutes and 1 minute before the actual shutdown.
- b. Clarifications
 - i. “Zone equipment” refers to the equipment that controls the environment for a zone. For an example, a VAV that controls the environment for one room, that room being a zone. Three rooms controlled by a VAV count as one zone together.

END OF SECTION

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PART 1 – GENERAL

1.1 WORK INCLUDED

Summary:

Provide labor, materials, equipment, services and warranty for complete installation, startup and commissioning of all HVAC equipment controls as required in the Contract Documents.

Provide all control wiring and the conduit as required to connect devices furnished as a part of, or integral to the automatic temperature control system, and for connections to the motor control regardless of the source of supplied power. Control wiring includes the 120 volt and lower voltage wiring as needed to utilize control signals directing the equipment operation.

Control circuits shall be 24VAC in general, and no more than 120 VAC where required, Voltage higher than 30V shall not be directly connected to a control module, but rather through a low voltage interface relay.

Provide wiring in coordination and accordance with the requirements specified in Division 26, "Electrical" of this document, and the National Electrical Code. Unless indicated otherwise, all in-the-wall conduits and mounting boxes, such as the ones used for the Zone Sensors (Thermostats) shall be provided by Division 26.

Provide all devices required for proper system's operation including electrical switches, transformers, disconnect switches, relays, device controllers and control modules, actuators, transducers, sensors, safety devices, power supplies, mode selecting switches, enclosures, circuit breakers and the control software with graphics.

Provide complete wiring, wiring terminations, pneumatic tubing with accessories and cross-flow sensors where required. Provide all assembly, programming and testing of all items as necessary to create a coherent system, encompassing all combined intents of the design, drawings, specifications, addenda, and completed in a true professional quality of work.

- A. RIT has its own TC System Server and adequate Ethernet network; this contract shall provide the equipment to send the data to the Ethernet Server and back to control units where required.
- B. Coordinate all work with Division 26, "Electrical".

1.2 WORK NOT INCLUDED

- Power wiring for motors, motor starters and associated control equipment requiring power, (except in the case of equipment specified to have packaged controls/starters) are included in Division 26, "Electrical," unless otherwise called for in the Project Specific Documentations.

1.3 QUALIFICATIONS

- A. Wiring installed in compliance with all requirements of Division 26, "Electrical."
- B. Control wiring installed in compliance with the NEC, Automated Logic and RIT requirements.
- C. All control wiring within line voltage cabinets to conform to Class 2 wiring standards.

1.4 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with this specification the Automated Logic is the only acceptable product. Additionally, all installed modules, software and control components must be compatible with the most recent version of Automated Logic Control System in use at RIT.

- B. All HVAC equipment provided with the factory-mounted controls will have such controls installed in accordance with this specification.

1.5 BID CLARIFICATIONS

- A. Along with the bid package all Contractors are required to submit minimum scope letter with:
1. Detailed Points Lists as were provided with the bid invitation; those should be filled out with details of control modules types showing clearly the relationships and particular points allocations to each controller including clearly identified spare I/O.
 2. Specification Conformance: State by individual paragraph where your system cannot meet the requirements.
 3. Statement summarizing the warranty period for all control components that are part of this project – including any components that carry a warranty beyond the required 2 year minimum.

1.6 QUALITY ASSURANCE

- A. Acceptable Products: All products shall be proven to be functional and suitable in accordance with this specification for a period of warranty commencing on the day of transfer of the completed project to HVAC Operations and Controls Department Manager at FMS. Demonstration of such warranty may be required prior to the submittal approval.
- B. Contractor Qualifications: The Controls Contractor *called thereafter the TC* shall be factory-authorized by the respective manufacturer to provide pertinent installation and service.
- C. Field Representation: The TC shall staff the project with a field representative project manager that has been factory-trained in the installation, programming and commissioning of the equipment specified. This representative must be in the direct employ of the TC.
- D. Any subcontractors in employ of TC on this project must receive prior approval of HVAC Operations and Controls Department Manager at FMS to be permitted work on this project.
- E. Coordination of Work During Construction:
1. The TC shall protect work installed by other trades.
 2. The TC is to coordinate its work with parallel projects.
 3. The TC shall repair any damage caused by his/her work.
 4. The TC shall promptly correct all the new work that HVAC Operations and Controls Department Manager at FMS finds as defective or not conforming to Contract Documents.
 5. The TC shall bear all costs required to correct the new work found defective as described above, or cost of any restitutions caused in result of the TC performance proven faulty of thereof.
 6. The TC Contractor shall bear all actual, as charged to RIT incidentals; costs resulted from setting the Building Fire Alarm, which afterwards required an unscheduled intervention of Fire Department, where such setting was initiated in direct result of the TC Contractor activities. The cost is defined as one-per-accident charge incurred by RIT.
- F. Satisfaction of User's Needs: The TC shall deliver a complete project, which shall include all the instrumentation added by this project and integral to its control elements and components. The deliverables shall be presented to HVAC Operations and Controls Department Manager at FMS as a

singular graphical_system with any and all listed below functions, and shall be able to achieve as listed below:

1. Project completed according to all current control standards and construction practices published by Automated Logic.
2. WebCTRL Graphical Interface (GI) based on the current operating Windows Platform running on the campus.
3. GI depicting all added instrumentation by this project allowing its monitoring and control.
4. GI equipped to navigate to any and all added equipment, integral to, and matching the central navigation system already in place, including matching existing system's nomenclature, object names, file names, directory structures, etc.
5. Local access to GI from the multiple locations communicating with a dedicated central server, networked to each group of control devices utilizing RIT-owned IP network.
6. Prior to commissioning the system server shall commence an automated, 24 hour/day monitoring and trending of the entire system added by this project.
7. Automated Alarm Monitoring allowing alarm Acknowledgment and Logging to file.
8. Event Alarms generated with multiple classes of importance.
9. Operator Generated Change (or adjustment) recorded and stored in the GI Event Logging.
10. Global Scheduling of equipment, available from each viewing location.
11. Calendar Functions supporting holiday, day-of-the-week and special time-triggered schedule exemptions.
12. Group Scheduling of Equipment S/S.
13. User's Log on Screen.
14. GI Control System accessible exclusively on recognition of authorized user, his individual password and assigned level of privileges.
15. System shall recognize Multiple Levels of User Privileges.
16. System shall include Graphical Data Trending, capable to be updated at operator-defined intervals and capable to zoom-in of trend sections for more detailed examination.
17. Tuning trend package integrated with system to adjust all PID parameters of analog outputs.
18. Global Data Base Updates, where a change of parameter entered through any authorized viewing station is instantly projected to the rest of the authorized viewing stations that may be on line at the same time.
19. On-line programming, download, upload and automated error correction of field control devices from each authorized Windows Station, where a change of program can be entered remotely through any authorized station, with effect on designated controller, and without a need to manually connect in the field to such controller.
20. Server-based data collection, error corrections and distribution of data to terminal devices.

21. Multi-level Secure Access to server.
22. Encryption between the server and client for Web transmission.
23. Errors-free system operation and its communication free of system timeouts.
24. Navigation to each controlled device from multiple viewing stations in real time.
25. Logic represented in a real-time, interactive diagram of graphical logic blocks.

1.7 SHOP DRAWINGS AND SUBMITTALS

- A. Product Data: Submit for approval the manufacturer's technical product data for each component furnished as part of control system. Data shall include dimensions, capacities, performance characteristics, electrical requirements, and material finishes. Data shall also include installation, start-up requirements and operational instructions.
- B. Shop Drawings: Submit for approval control drawings detailing the following:
 1. Network Block Diagrams and System Riser Diagrams: These diagrams shall depict all DDC components that make up the network. They shall provide specific detail on network terminations, and panel power requirements, including breaker allocation. Each DDC panel within the diagram shall list all the control equipment that it part of such panel.
 2. Point-to-point Termination Detail: These drawings shall be created for each unique control application type. Drawings that are typical for similar application shall state the application and quantity of that what they represent and the specifics for each. All wiring and piping required to install and operate the system shall be represented in these details. For terminations that are unknown at the time of submittal, or introduced over the course of project, properly designate these as "Field Determined Terminations," and include in the As-built Drawings after completion. All wiring and piping shall be either number or color-coded on the drawings.
 3. Provide individual details for each control type, as described in the Sequence of Operation.
 4. Provide spreadsheets of schedules for dampers, valves, wiring, fans and other miscellaneous components if they are part of this control contract showing sizes, characteristics, model numbers and specific locations.
 5. For prefabricated control panels, provide panel's interior and exterior layout details. These details shall depict the equipment layout and shall detail the panel wiring and piping.
- C. Database Information: The submittal package shall contain detailed information on the point naming convention that is to be used. Consult HVAC Operations and Controls Department Manager at FMS for currently used nomenclature for equipment and database points and utilize it in the project.
- D. Provide documentation for all sequences of operation of any equipment added by this project.
- E. Provide documentation for all sequences of operation that cannot be performed by stand-alone controllers and require non-controller-resident programs, or programs requiring retransmission to be effective on the controller's output.
- F. Provide a schedule of module allocations for each segment of control equipment to be approved by the HVAC Operations and Controls Department Manager at FMS. Provide specifics for equipment that will be served by multiple modules.
- G. Provide the Project Points List in the standard FMS spreadsheet form, annotated with assignment of

control modules as appropriate to execute the required control function.

1.8 OPERATION AND MAINTENANCE MANUALS PROVIDED AT PROJECT COMPLETION

- A. Upon completion of installation and prior to the training, provide manuals containing the following information:
1. Installation O&M and Service Manuals for all products and components.
 2. Calibration and Troubleshooting Procedures for all installed equipment and components that have built in calibration futures.
 3. List of location of all control enclosures, controllers, sensors, transformers and other components as specified above.
 4. As built control floorplan(s) clearly showing the equipment on the mechanical floorplan. Drawing must show the exact location of all controls including panels, modules, thermostats, field located sensors, network devices, field located power supplies, etc. Drawings must also accurately show the exact and correct location of the network and thermostat, sensor wiring (along with any other field wiring).
 5. As-built Control Drawings as specified above with all modifications, changes and wiring details that depict actual installation.
 6. Sequence of operation – Describing in detail the operation of every piece of equipment subject to control by the DDC system. Each section of the sequence should contain the following:
 - a) Overview – describes what the intent is, what components are involved and provides a concise description of the piece of equipment to be described.
 - b) Occupied Mode – Describes the operation of this system during occupied periods.
 - c) Unoccupied Mode – Describes the operation of this system during unoccupied periods.
 - d) Alarm Mode - Describes operation of the system in the event of alarm condition and steps to restore system to normal operation. List all anticipated alarm conditions.
 - e) Each Component's individual Sequence - Describes the detailed operation of each component and how it interacts with the entire system.
 - f) List of all external interlocks and condition of their response and reset.
 - g) List of all tests required to check interlock responses.
 7. Listing of all DDC controllers with details of points, point's functions and controlled equipment.
 8. Provide spreadsheets of schedules for enclosures, control modules, dampers, valves, wiring, fans, well, tap and other miscellaneous components if they are part of this control contract showing sizes, characteristics, model numbers and specific locations.
- B. Provide laminated control diagrams and points list in each control panel showing wiring details of each piece of equipment whose controller(s) resides in the enclosure.
- C. CD backup disk(s) to be delivered to HVAC Operations and Controls Department Manager at FMS that will allow FMS to fully restore the entire ALC System, including programming point database, configuration, graphic screens and all libraries of typically composed objects, and details supporting the

navigation, screens and graphics.

- D. Within five working days from the time of the final system commissioning, two (2) sets of Operation and Maintenance Manuals shall be turned directly to Manager HVAC Controls Department at FMS – coordinate with mechanical contract for exact number also provide electronic copies.
1. A Programmer's Manual shall be provided with graphic and text descriptions of all functions required for software modifications and developments. This can be provided in the form of the CD received from the factory, containing latest release of help manuals and other technical bulletins.
 2. Section for each Major Piece of equipment – Contains the cut-sheets for the controllers, custom programs, and relevant information pertaining to that piece of equipment. (IE: schedules for VAV boxes or AHUs showing RIT specific Equipment Tag, Controller address, serial #, airflow, and pertinent engineering units like MBH, GPM, etc.). (See RIT Building System Design and Best Practice Guidelines)
 3. Wiring Details – Contains 8-1/2" x 11" drawings of all the wiring details shown throughout the set of drawings.
 4. Instrumentation Cut Sheets – Contains the Manufacturer's original cut sheets for all the instrumentation used on the job. (IE: Well sensor, transformers, enclosures, pressure sensors, etc.).
 5. Equipment Cut Sheets – Contains the Manufacturer's original cut sheets for all the equipment that was supplied for this job. (IE: VAV Box, Control valves, damper actuators, etc.).
 6. AutoCAD Drawings – All drawings shall be provided in Auto CAD format (IE: each file format should have the "dwg" extension), made as set of both, a set 11"x17" black and white and a set of 24"x36" (1 color set and 3 black and white sets). Drawing Sets consists of the following:
 - a) System Description Drawing – Shows the overview of the job and what is being controlled.
 - b) Network Riser Drawings – Shows how the network is connected between all the devices on the job. This drawing is to show the network connections in the order they are installed in the field.
 - c) Detail Drawing(s) – Shows all the wiring and piping details for the entire job – all other drawings refer to these drawings.
 - d) Individual Control panel drawings & Schematics (1 or 2 drawings per piece of equipment) Shows the exact wiring and layout of each control panel. Also shows the schematic representation of the system that is being controlled. (IE: AHU, HW Plant, CHW Plant, VAV Box, Heat pump, etc.).
 - e) Controls Floor Plan page for entire building showing thermo graphic status of building zone temperatures.
 - f) Controls Floor Plans (at least 1 for each floor) – Shows the exact location of the control panels, thermostats, equipment, network wiring, thermostat wiring and any specific controls required for the job. All this information is overlaid on top of the mechanical floor plan showing the architectural layout (wall and room numbers).
- E. All above should be copied to a CD, and/or flash drive and released to HVAC Operations and Controls Department Manager at FMS. All the electronic documentation shall be shown in paper format for the O&M, plus any relevant information or tools used during commissioning

1.9 SYSTEM COMMISSIONING

- A. The Owner will provide to the TC Contractor a Commissioning Check List Form according to which the Commissioning process will be completed.
- B. The Owner will conduct a commissioning. No final payment can be approved prior to a successful completion of the commissioning.
- C. TC shall complete Pre-Commissioning to assure operational readiness of equipment prior to conducting of commissioning.
- D. All points connected to the EMS shall operate fully in accordance with this specification before the final completion is determined.
- E. Equipment Start-up: Upon completion of installation, all equipment being controlled shall be initially started and tested on site, using the contractor-provided temporary PC or Laptop; upon completion of this process whole content of the temporary PC should be reloaded to the RIT owned Windows Server, which thereafter should continue to operate in a manner required by this specification. Such reload shall be done by insertion rather than by override of entire existing database. Additionally perform the following:
 - 1. Measure, calibrate and adjust all analog inputs.
 - 2. Stroke all analog outputs at 5 different points 0%, 25%, 50%, 75%, 100% and verify that all linkage adjustments are set properly, valves travel full stroke, VSDs control a full range, etc.
 - 3. Valves and Dampers shall fully close and provide reasonably tight shut-off.
 - 4. Verify that all digital outputs are properly energizing the controlled device.
 - 5. Adjust setpoints so that equipment operates properly. Tune all PID control loops to avoid unnecessary cycling of control equipment, overheating, sub-cooling, and tripping the Freezestat and other limit switches and safeties. Create the trends and print trend results to verify a correct tuning operation.
 - 6. Adjust all alarm parameters so that nuisance alarms are eliminated, no alarms shall remain disabled.
 - 7. Enable all trendable points and historians. Remove point assignments of unused points.
 - 8. Provide reasonable control and operational assistance to the balancing personnel as needed to achieve reliable and energy-efficient system operation.
 - 9. RIT personnel will conduct its own commissioning to which the TC shall provide assistance;
 - a) RIT Project Coordinator will complete Project Ready Checklist and TC shall assure that all items on the list are completed.
 - b) All questions arising in a course of commissioning shall be answered by TC as part of this project.
- F. Communication Network Start-up: Verify from a host computer that all configured controllers are engaged in proper communication passing all configured points to viewing stations without time-outs.
 - 1. Monitor and review all network alarms during the commissioning process for dead module and COV alarms. Take correction action to eliminate any nuisance alarms.

2. Enable all trendable and historian points and construct a multi-point trend containing all relevant points within the same graphics. Enable trendable wired and networked points related to equipment operation with analog points at 5 minute sample intervals and digital points at COV. Historian shall be enables on all trendable points at the FMS 10,000 day default. Verify operation and PID tuning of all controlled devices and demonstrate at RIT Building Controls Department project turnover.
- G. Software Verification: All programs and software functions shall be verified for proper sequence of operation.
- H. TC shall, during the ensuing four seasons (one year), conduct periodical inspections to fine-tune all dynamic elements of the system.
- I. TC shall --at no additional cost to RIT-- dedicate one full day in each of the four subsequent seasons (total of 4 days), during which all necessary tuning of dynamic parameters shall be conducted in the field. Coordinate with HVAC Operations and Controls Department Manager at FMS the dates for this activity.
- J. Coordination: Work with the air-balancing contractor, ventilation contractor, piping contractor and electrical contractor to provide proper and obstruction-free component location, and a complete system commissioning.
- K. As built Drawings: All drawings shall be reviewed after the final installation is completed and corrected to provide accurate, as-built representation of the complete system.
- L. Commissioning Report: This report shall detail who and when the TC performed the individual startups mentioned above.
- M. Project commissioning is considered completed only if a physical walk-through of the project, together by TC and HVAC Operations and Controls Department Manager at FMS was concluded and the complete set of required documentation and software has been transferred to HVAC Operations and Controls Department Manager at FMS. HVAC Operations and Controls Department Manager at FMS has the right to refuse or delay a scheduled walk through. The Walk-through shall be rescheduled with HVAC Operations and Controls Department Manager.
- N. Contractor shall provide detailed spreadsheet of all added points to match the existing point summary archived at RIT Building Systems Control Room.

1.10 TRAINING

After commissioning is completed, the TC shall provide on-site session detailing the layout of the EMS. This shall include network wiring routes, control panel locations, transformer locations, etc., and;

- A. The TC shall then provide on-site session to review the entire Operations and Maintenance manual(s) with HVAC Operations and Controls Department Manager at FMS. This session shall also include but not be limited to:
 1. Fundamental operation of the system
 2. Training on set points adjustment and scheduling modifications
 3. Operation and sequencing of control loops for all mechanical equipment being controlled
 4. Understanding of interlocks and the test routine to verify them.
- B. Throughout the warranty period provide telephone support to answer system related questions and concerns.

1.11 WARRANTY

- A. Warranty for the entire control system shall commence upon completion of the system commissioning as specified. The warranty includes fine-tuning of all dynamic elements of control system to achieve reasonable, efficient and equipment-protective mode of operation.
- B. Provide a two-year warranty on the DDC system including all associated field equipment. Contract is to include 24-hour support including parts and service. Any exclusion of this condition should be submitted prior to or included in bid documents.
- C. Disclose to HVAC Operations and Controls Department Manager at FMS and accommodate longer warranty periods if such are provided by components manufactured at the time of purchasing.
- D. Provide Warranty Declaration Summary containing starting and ending dates of warranty for the entire (added by this project) system, its subsystems and particular hardware. Obtain RIT consent for those dates.
- E. During the warranty period RIT may request setting to manual control for all affected controls until system is repaired. Define specific cases or condition where such activity would void the warranty or its part, should RIT attempt to manually control the system until it is repaired by the TC.
- F. During the warranty, RIT reserves its rights to make a tuning, scaling, range, and zero adjustments on devices found out of calibration, even if such activity would result in breaking factory seals, if lack of such action could result in the equipment damage, safety or freeze hazard, or severe discomfort to the occupants. Such action shall in no way void, decrease, or in any other way result in a detriment of the warranty. The TC may request postponement of such action if he or she guarantees an effective service response in no more than 3 hours from the initial repair request. To be considered, such reservation should be stated on the Warranty Declaration Summary.

PART 2 – PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. General Requirements
 - 1. A distributed logic control system, complete with Direct Digital Control (DDC) and Direct Analog Control (DAC) software shall be provided. System shall be based on ANSI/ASHRAE Standard 135-1995, BACnet. This system is to control all mechanical equipment specified in the contract documents, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc. and all air handlers, boilers, chillers, and any other listed equipment using native BACnet-compliant components.
 - 2. The system shall use BACnet protocols and LAN types throughout and exclusively.
 - 3. The TC shall provide system software based on server-client architecture, designed around the open standards of web technology. The TC server shall communicate using ASHRAE BACnet/IP protocol. Server shall be accessed using a web browser over RIT's intranet and remotely over the Internet.
 - 4. The TC shall assume complete responsibility for the entire controls system as a single source, providing installation, program debugging and service of all portions of logic control system. This shall include designated server, operator's terminal, global controllers, routers, terminal unit controllers, sensors and all other sections of the system.
 - 5. The web browser GUI shall provide a completely interactive user interface and must offer the following features as a minimum:

- a) Trending
- b) Scheduling
- c) Real time 'live' Graphic Programs
- d) Tree Navigation
- e) Parameter display, change and change of properties
- f) Setpoints adjustments
- g) Alarm / Event information
- h) Configuration of control mode including HOA manipulation with display of current HOA state on graphic page
- i) Execution of global commands
- j) All standard functions provided by WebCTRL.
- k) Graphical representation of program with live data display in pertinent nodes of program

B. Basic System Features

1. Zone-by-zone direct digital logic control of space temperature, scheduling, optimum start, equipment alarm reporting and override devices for unoccupied mode of operation. A zone is the area served by one HVAC logic controller unit, such as a heat pump, VAV box, etc., utilizing common control sequence to achieve singular conditioning results at all control points, all at the same time.
2. Operator's terminal software shall run under Microsoft Windows platform operating system. The HVAC controls application program shall be written to communicate utilizing BACnet protocols. Software shall be multi-tasking, capable of executing and displaying multiple instances in individual windows while running concurrently with other Windows programs such as word processors or database programs. Software shall support Windows Active X interface. Software shall strictly follow Microsoft Windows API guidelines. Systems using proprietary software or operating systems other than that described above are strictly prohibited. Operation of the terminal software shall be simple and intuitive.
3. Operator's terminal software shall contain capability to allow configuration of system-wide BACnet native controllers, including management and display of the controller programming.
4. During construction, if needed, at least one terminal shall be equipped to act as a system server. This system server shall store copies of all installed software for all field components and shall be capable of automatic or manual reloading of such software into the field components as required. The system server shall also gather and archive system-operating data, such as trends, energy logs, and other historical operating data.
5. Complete energy management firmware, including self-adjusting optimum start, demand limiting, global control strategies and logging routines for use with total control systems shall be supplied. All energy management firmware shall be resident in field hardware and shall not be dependent on the operator's terminal for operation. Operator's terminal software is to be used for access to field-based energy management control firmware only. All schedules shall be module resident and shall not be affected in case of interruption network transport between the module and the

host station.

6. Upon completion of the project, the Contractor shall integrate new field controllers into an existing server used by RIT.
7. Priority password security systems shall prevent unauthorized use. Each user shall have an individual password. The user shall only be given access to the system functions required for individual job performance.
8. Equipment monitoring, alarm functions and help files including information for diagnosing equipment problems shall be included with the system.
9. The complete system, including, but not limited to terminal unit controllers, higher level controllers and operator's terminals shall auto-restart, without operator intervention, on resumption of power after a power failure. Database stored in any controller's memory shall reside error free for a minimum of 1 year.
10. System design shall be modular and have proven reliability.
11. All software and/or firmware interface equipment for connection to remote monitoring station from field hardware or the operator's terminal shall be provided.
12. System shall be capable of equipment runtime totalization of fans, heaters, boilers, etc. and capable of alarm generation and alarm dial-out.
13. System shall be able to respond to RIT energy demand input and adjust the setpoints accordingly, or provide a total unit shutdown as centrally commanded.
14. *System shall be linked to and shall provide the Emergency Shutdown when Campus Emergency Shutdown is executed.*
15. Room sensors shall be provided with digital readout that allows the user to view room temperature, adjust equipment operating schedule, room setpoints, etc.
16. All controllers shall communicate using protocol as recommended by Automated Logic Control System as described in ALC documentations.
17. All hardware shall be Listed Underwriters Laboratory for Open Energy Management Equipment (PAZX) under the UL Standard for Safety 916 in both the US and Canada, with integral labels showing rating.
18. All hardware shall be in compliance with FCC Part 15, Subpart J, Class A.

C. Graphical Interface (GI)

Each GI page depicting the floor in a building shall, in addition to the scaled down floor plan with room numbers and the North Arrow, have the following minimum features: thermo graphic zone scales and statuses, zone equipment and sensor distribution, the list of all room numbers on the floorplans, where each zone serves as a link to its zone equipment, and the links to other floors, sub floors, and if applicable, the roof of the same building.

Each GI page depicting particular piece of equipment shall have, in addition to the schematic of the equipment, the following data points linked to and representing actual state of the equipment, and possessing all futures as listed below:

1. Complete set of graphical representation of all associated with the depicted equipment points, such as Analog Inputs, Analog Outputs, Digital Inputs and Digital Outputs, including each respective current State or Value, Units of State or Value, the Hand-Off-Auto Manipulation Block, the State of the Schedule, Alarm State for all alarms requiring manual reset, Alarm Reset for all software resets, and other pertinent information as applicable.
2. Positioning of above elements shall be easily identified with particular control component.
3. Each page shall have adequate number of Manipulation Blocks functioning as overrides for each Outputs. Such Manipulation Blocks shall be designed to execute the operator-entered Change of the State Requests such as the Hand-Off-Auto, On/Off, Start/Stop, Open/Closed, etc., or other specific requests like Change of Speed, Percent of Open Valve or Damper, etc. Coordinate with Manager of Controls for current examples.
4. There are cases when installing such graphical controls may increase possibility of damage to the unit due to an unacceptable violation of sequence. Such cases should be identified, coordinated and approved for installation, or removed from the main operating graphic pages in accordance with approval of HVAC Operations and Controls Department Manager at FMS.
5. While it is desired to have a maximum of information on the same page, it may be practical to add additional pages, especially, if should such information would be difficult to fit on a singular page.
6. Complete set of Navigation Buttons, which, without the need to use the Navigation Tree, shall link the equipment to its sources of Heating, Cooling, Ventilation, Refrigeration, Exhaust, Heat Rejection Equipment, Pumps, Water Loops Control, Steam Generating Equipment, Filtering Stations, Fire Alarm Controllers, Compressors, Condensing Units, Heat Exchangers, Boilers, Generators, Fire Suppression Systems, light controls and other supporting equipment.
7. Provide dedicated chilled water page for systems that have more than one chilled water equipment entries. This page will show the accurate schematic of the entire chilled water system for the building and tie in to the campus chilled water loop. The schematic will include piping, valves, pumps, sensors and associated equipment. The page will have links to each piece of equipment shown on the page. This page is not required on projects that do not involve the chilled water system.
8. Provide dedicated hot water page for systems that have more than one hot water equipment entries. This page will show the accurate schematic of the entire hot water system for the building and tie in to the campus hot water loop. The schematic will include piping, valves, pumps, sensors and associated equipment. The page will have links to each piece of equipment shown on the page. This page is not required on projects that do not involve the hot water system.
9. Information on current Outside Temperature and Humidity. Such information shall be placed consistently in the upper left corner of the page.
10. Provide navigation tree linking to all controlled equipment. Such tree should be presented in logical structure of unit allocations in the building, building's floor, mechanical room, roof, etc.

D. Reference Standards

The latest edition of the following standards and codes in effect and amended as of supplier's proposal date and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:

1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
2. ANSI/ASHRAE Standard 135-2016, BACNet

3. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US
4. National Electrical Code (NEC)
5. FCC Part 15, Subpart B, Class A
6. EMC Directive 89/336/EEC
7. City, county, state, and federal regulations and codes in effect as of contract date
8. Occupational Safety and Health Act (OSHA)
9. National Fire Code
10. Uniform Plumbing Code
11. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

2.2 TEMPERATURE SENSORS

- A. General Use Temperature Sensors shall be Thermistor 10,000 ohm at 77°F with Precon type-2 material. Accuracy shall be +/-0.36°F.
 1. Room Sensors
 - a) The room sensor shall incorporate an on-board 10K Thermistor for room temperature sensing. Range 35 to 140°F.
 - b) The room sensor shall provide a slide switch to allow the occupant to offset the programmed temperature setpoint of the unit controller by a programmable amount.
 - c) The unit controller shall monitor a push-button switch located on the room sensor. The status of the switch shall be usable in a supervisory control logic or algorithm or to override to an occupied mode for a programmable amount of time.
 - d) For monitoring only, use an encapsulated temperature sensor installed in a secure wall mounted housing. Range 35 to 140°F.
 - e) Room sensor item shall display sensor temperature. Room sensor installed in occupied spaces shall be Primary ZS Pro, in unoccupied spaces shall be ZS Base.
 - f) Approved manufacturer: Automated Logic, Precon Corp.
 2. Duct Sensors
 - a) Single point duct mounted sensors shall have a minimum 9" rigid probe and be used when the duct size is less than 24". Temperature range: -30 to 160°F. Unit to include handy box housing.
 - b) Averaging duct-mounted sensors shall have a minimum 12.5' long averaging element for all ducts larger than 4 square feet. Use a 20.0' long averaging sensor for duct larger than 15 square feet. Temperature range: -30 to 160°F. Unit to include handy box housing.
 - c) Approved manufacturer: Automated Logic, Precon Corp.
 3. Well Sensors

- a) Liquid immersion sensors shall have a stainless steel probe and stainless steel well. Length of the sensor well shall be selected based on the diameter of the pipe to provide accurate, reliable sensing of the liquid temperature. Temperature range: 10 to 230°F.
 - b) All liquid immersion sensors shall be installed with thermal compound appropriate for selected sensor and the temperature conditions.
 - c) Approved manufacturer: Automated Logic, Precon Corp, BAPI.
4. Outside Sensors
- a) The sensing element shall be a Precon ST-R-R sensor installed in ventilated aluminum housing with a Stainless Steel sunshield to minimize the radiant energy and wind effects. Temperature range: -30 to 230°F.
 - b) Approved manufacturer: Automated Logic, Precon Corp.
 - c) Make sure that the sensors are located away from any exhaust air outlets, or a location that in any way may be detrimental to the proper representation of ambient condition of air.
5. Averaging Sensors
- a) The sensing element shall be long as needed to make a complete “Z”-shape traverse across entire measured area. Sensing probe shall be properly fastened and separated from any metal parts utilizing plastic grommets or other fasteners and separators.
- B. Utility Temperature Sensors
1. Utility temperature sensors include any sensor that is to be used in conjunction with a flow meter with the intent of metering the amount of thermal usage.
 - a) Typical examples include, but are not limited to:
 - (1) Heat Exchanger MTHW supply and temperatures
 - (2) Boiler loop supply and return temperatures
 - (3) Chiller loop supply and return temperatures
 - (4) Building connect supply and return temperatures
 - (5) Central plant loop supply and return temperatures
 2. Medium Temperature Hot Water Temperature (MTHW)
 - a) Any immersion temperature sensor that is connected to the Medium Temperature Hot Water (MTHW) system is considered to be a MTHW sensor.
 - b) These sensors shall have the following characteristics:
 - (1) 1K Ω Platinum @ 0 °C, 3.85 $\Omega/^\circ\text{C}$ temp. coefficient.
 - (2) Designed to accommodate 250°F temperature water media continuously.
 - (3) Come with integrated calibrated transmitter with range: 50-250°F
 - (4) Transmitter is to be calibrated at 3 points 125°F, 200°F and 240°F
 - (5) Come with CE Declaration of Conformity letter
 - (6) Acceptable models
 - (a) Sensor – BAPI - BA/1K[2]-I-4"-WP
 - (b) Transmitter – BAPI - BA/T1K[50 TO 250F]-XOR-BB-TS
 - (c) Enclosure – BAPI Box (BB)

3. Chilled Water Temperature
 - a) Any immersion temperature connected to chilled water piping with an associated flow meter is considered to be a Chilled Water Utility Temperature sensor.
 - b) These sensors shall have the following characteristics:
 - (1) Precon Type II Thermister, 10,000 Ohms at 77°F
 - (2) accuracy of ± 0.1 °C throughout the commercial temperature range of 0 to 70 °C
 - (3) Acceptable models:
 - (a) BA/10K-2[XP]-I-4"-BB
 - (b) Enclosure – BAPI Box (BB)

2.3 CURRENT SENSORS

- A. Low voltage, single phase:
 1. Sized to monitor and control small motors.
 2. Approved for installation in the following environmental conditions:
 - a) 0-95% relative humidity, non-condensing.
 - b) -15° to 60° C.
 3. Approved manufacturers: Veris Hawkeye Series, RIB or RIT approved equal.
- B. High voltage, three phase:
 1. Clamp on style with positive closure, no external wrap or taping allowed.
 2. Factory programmed to detect belt loss on belt driven equipment.
 3. External indication of trip by LED.
 4. Approved for installation in the following environmental conditions:
 - a) 0-95% relative humidity, non-condensing.
 - b) -15° to 60° C
 5. Approved manufacturers: Veris Hawkeye Series, RIB or RIT approved equal.

2.4 HUMIDITY TRANSMITTERS

- A. Transmitters shall be of 2-wire, 4-20 mA output type with a resistance or capacitance element having an accuracy of $\pm 2\%$ between 20-95% Rh. Transmitter shall include protection against reverse polarity and supply voltage transients. An accuracy adjustment shall be provided with each transmitter to allow for recalibration as necessary.
 1. Duct Mounted
 - a) Sensor shall have a minimum 4" to 6" rigid probe with a durable enclosure.
 2. Wall Mounted
 - a) The room sensor cover shall be provided with screws.
 3. Outside Mounted
 - a) The sensing element shall be mounted inside a ventilated, treated, plastic PCV sun shield to minimize the radiant energy and wind effects.

- b) The enclosure shall be pressure cast aluminum, weatherproof box with a gasket cover, or high quality UV rated Polycarbonate plastic with water tight NEMA-4 rating
- c) Make sure that the sensors are located away from any exhaust air outlets, or a location that in any way may be detrimental to the proper representation of ambient condition of air.

2.5 PRESSURE TRANSMITTERS

- A. Pressure transmitters shall be of 2-wire, 4-20 mA output type with a capacitance element having an accuracy of +/- 1% over the entire range. Transmitter shall include protection against reverse polarity and supply voltage transients. Accuracy and zero span adjustment shall be provided with each transmitter to allow for recalibration as necessary.
 - 1. Duct Static Pressure
 - a) To be very low differential pressure, 0 to 1.0", 0 to 2.5" WC, 0 to 5" WC or engineers approved range.
 - b) LCD Display with live pressure reading.
 - c) Approved Manufacturers: Setra, Veris or RIT approved equal.
 - 2. Filter Pressure
 - a) Pressure range 0-2" accuracy +/-2% of full scale.
 - b) LCD or analog display indicating live pressure reading.
 - c) 4-20ma output
 - d) Aluminum or copper tubing from sensor to pressure pickups
 - e) Pressure tubing to be terminated with appropriate pressure pickups to penetrate the side of the unit.
 - f) Separate pressure sensors for each filter section.
 - g) Approved Manufacturers: Setra-2671-2R5-W-11-XX-X-D, Dwyer-605
 - 3. Building Differential Pressure
 - a) Maximum safe momentary overpressure shall be eight (8) times the pressure range.
 - b) Pressure transmitter shall be of solid-state design.
 - c) Approved Manufacturer: Setra Model 264 or equivalent
 - d) Typical Range: 0 to 0.1" W.C. with at least 0.001" increment readings.
 - e) LCD Display indicating live pressure reading.
 - 3. Liquid Differential Pressure
 - a) The operating range shall be -40.0 to 176.0 Deg. F.
 - b) Maximum safe overpressure shall be 150% of the rated pressure.
 - c) Shall be contained in an aluminum NEMA-1 enclosure.

- d) Shall be provided with the appropriate factory manifold with the ability to bleed air from the system without disconnecting fittings.
 - f) LCD Display indicating live pressure reading.
 - g) Approved Manufacturer: Setra 231G-MSX-3V-D with manifold or RIT approved equal.
 - h) Be sure to take into account total system pressure when selecting the differential pressure range.
4. Liquid or Steam Pressure
- a) Stainless steel pressure transmitter housing.
 - b) 316 Stainless Steel wetted parts.
 - c) Wide range of pressure ranges: 0 to 30, 0 to 50, 0 to 100, and 0 to 200 psig.
 - d) High overpressure capability: 3 to 5 times range.
 - e) Approved Manufacturer: Johnson Model PSS2 series or RIT approved equal.

2.6 FLOW TRANSMITTERS

A. Airflow

1. The sensor shall be a 4-20 mA output type with the accuracy of +/- 1% with flow straighteners in circular duct applications. In rectangular duct applications, the accuracy shall be +/- 2% with flow straighteners.
2. Velocity range of 100 to 10,000 FPM air at S.T.P.
3. Flow station shall be constructed of steel with flanged face for easy mounting. The flow straighteners shall be constructed of aluminum or steel.
4. LCD Display indicating live flow value.
5. Approved manufacturer: Paragon, Ebtron

B. Liquid Flow

1. The sensor shall be a 4-20 mA output type with the repeatability of +/-0.1% of value.
2. Temperature limits: -20.0 to 850.0 Deg. F.
3. LCD Display indicating live flow value.
4. Material is dependent upon that of the size and type of pipe material. Approved manufacturer: GE Panaflow DF-868.

C. Duct Mounted Air Flow Stations:

1. Rectangular: 16 gauge galvanized casing 8 in. deep with formed 1 ½ in integral 90° connecting flanges.
2. Oval: 18 gauge galvanized casing, 8 in. long between beads with 1 in. connecting sleeve on each end (10 inch. Overall length). Actual O.D. dimensions are ¼ in. less that specified duct I.D. dimensions.

3. Accuracy: Within 2% throughout the velocity range of 600 FPM and over, when installed in accordance with published recommendations.
 4. Temperature: 350°F continuous operation, 400°F intermittent operation.
 5. Humidity: 0-100% continuous operation
 6. Corrosion Resistance: Good salt air, excellent solvent and aromatic hydrocarbon resistance.
 7. Element Material: 6063-T5 anodized aluminum.
 8. Make: Ebtron or Thermal Dispersion
- D. Fan Inlet Air Flow Stations:
1. Material: 6063-T5 anodized aluminum, galvanized mounting brackets.
 2. Accuracy: Within 2% throughout the velocity range of 600 FPM and over, when installed in accordance with published recommendations.
 3. Temperature: 350°F continuous operation, 400°F intermittent operation.
 4. Humidity: 0-100% continuous operation
 5. Connection Fittings: ¼ in. compression, suitable for use with thermoplastic or copper tube.
 6. Corrosion Resistance: Good salt air and mild acid resistance, excellent solvent and aromatic resistance.
 7. Make: Ebtron or Thermal Dispersion
- E. Outside Air Flow Station:
1. Material: Element 6063-T5 anodized aluminum and casing 16 gauge G90 galvanized steel
 2. Accuracy: Within $\pm 0.5\%$ of actual flow through the velocity range of 200 to 1,200 fpm when installed in accordance with published recommendation and within $\pm 5\%$ at a velocity of 100 fpm. Operating velocity range 100 to 2,800 fpm.
 3. Temperature: 350°F continuous operation and 400°F intermittent operation.
 4. Humidity: 0 to 100%
 5. Make: Ebtron or Thermal Dispersion
- F. Air Volume/Velocity Transducers for Duct Outside Air:
1. The transducer shall be a combination differential pressure transmitter, square rod extractor, scaling multiplier and output filter with process indication, complete in a single package.
 2. The measured air volume shall be locally indicated on a door mounted LED display meter scaled in CFM.
 3. The transducer package shall be factory calibrated for the flow-measuring element being served.
 4. A transducer shall be provided for each individual air flow station.
 5. Accuracy shall be plus or minus 0.25%
 6. An output signal of 0-10 VDC or 4-20 mA shall be generated for monitoring by DDC system.
 7. Make: Ebtron or Thermal Dispersion

2.7 AIR QUALITY TRANSMITTERS

- A. The sensor shall be a 4-20 mA / 1-5 VDC output type and designed to monitor IAQ/CO2 levels in accordance with ASHRAE Standard 62.1-2016.

2.8 FREEZESTATS

- A. Shall be heavy-duty temperature controls that incorporate a vapor charged sensing element. 20 ft. long.
- B. The low temperature cutout must be adjustable. 35 to 45 °F.
- C. The sensor shall SPDT open low contact.
- D. Manual reset.
- E. Approved manufacturer: Johnson Controls.

2.9 SMOKE DETECTORS

- A. Provided and installed by Div. 26.
- B. Auxiliary relay in BAS panel for monitoring.

2.10 AIR PROVING SWITCHES

- A. The air proving switches shall have an operating range of 0.15 - 0.5" WC and have a setpoint adjustment.
- B. Wiring connections shall be 3-screw type, common, normally open and normally closed.
- C. Approved manufacturer: Dwyer 1900 series or approved equal.

2.11 LIQUID PROVING SWITCHES

- A. The proving switch shall measure the difference in pressure exerted upon its sensing elements and operate an SPDT switch at the differential pressure setpoint.
- B. Or a paddle switch mounted in a 1 ¼ inch FNPT fitting.
- C. The differential pressure setpoint must be adjustable between the ranges of 8 - 60 psig and the switch differential shall be 1.5 psi. Paddle switch to have adjustability over a wide range of flows.
- D. Approved manufacturer: Differential Pressure - Penn a-74 series or approved equal. Paddle – McDonnell & Miller FS7-4S or FS7-4SW.

2.12 DAMPER POSITION SWITCHES

- A. Shall be crank mounted and provide two snap-action SPDT contacts.
- B. Approved manufacturer: Barber-Colman AM-321 or equivalent.
- C. Mercury switches are not permitted in DPS or any other hardware designated for RIT.

2.13 PNEUMATIC TRANSDUCERS

- A. I/P transducers shall not be used without prior approval from HVAC Operations and Controls Department Manager.

2.14 ACTUATORS

- A. Pneumatic: (not to be used without prior approval from HVAC Operations and Controls Department Manager).
- B. Electronic:
 - 1. Electronic actuators shall be driven directly by 0-10 VDC, Supply power: 24 VAC, as acceptable to its controller, and provide adequate torque to meet the application.
 - a) Actuators shall be direct-coupled type.
 - b) Actuators to have fail safe return capacity where required.

- c) Approved Manufacturer: Belimo
- d) Dampers and valves must be spring return for fail safe positioning. Assure execution of the fail-safe position in case of the Freezestat trip, loss of signal or power loss.
- e) Provide actuator with necessary torque to assure fail safe position.

2.15 ENCLOSURES

- A. Each controller shall be housed in the Enclosure.
- B. Enclosures shall be NEMA-12 rated steel, painted gray, finished to control oxidation in a highly humid atmosphere.
- C. Each enclosure shall have a hinged door with latch handle. Shall be Johnson Controls M8100 series or better or Hoffman.
- D. Shall provide 40% of free space for future expansion of the system.
- E. Shall be equipped with laminated wiring diagram showing all terminations, modules, relays, switches, reset and push buttons, indicating lights, inputs and outputs, power supplies, network connections, etc.
- F. Each enclosure shall be equipped with internal 120VAC dual receptacle and ON/OFF switch to terminate power to the panel for the service repairs.
- G. All penetrations shall be sealed with mechanical bushing or knockout filler, protected with water sealing compound.
- H. All exterior enclosures shall be equipped with adequate thermostatically controlled fan and drip and insect screen protected vents, if internal temperature could increase in excess of permitted operating range of equipment housed in the enclosure.
- I. Each enclosure shall be equipped with a back plate firmly secured and grounded to the enclosure.
- J. Each enclosure shall be fitted with the Emergency Power (EM) fed from the nearest EM panel; TC is responsible for providing the EM power, unless this requirement was specifically excluded from the bid by the TC, HVAC Operations and Controls Department Manager at FMS or design engineer by including it in the Division 26 of the specification. On all new construction projects this requirement shall be included in and coordinated with the Division 26.
- K. All metal filings and debris shall be vacuumed from each enclosure prior to mounting the hardware.
- L. Magnetic enclosures for Heat Pump controllers are acceptable.

2.16 CONTROL VALVES

- A. Provide factory fabricated control valves with operators as required by this specification. Provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with specified maximum pressure drop across control valve. Equipment control valves with heavy duty actuators, with proper shut off rating for each individual application.
- B. All HVAC water valves to be pressure independent control valves sized for the proper flow of the HVAC device.
- C. Steam Service Valves: Linear characteristics for 90% of closing stroke and equal percentage for final 10 percent with range of 30 to 1, and maximum full flow of 80% of inlet pressure for low pressure systems, and 42% for high pressure systems. Two-position valves shall be line size.

- D. Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on “top and bottom” guided plugs.
- E. Valve Trim and Stems: Polished stainless steel.
- F. Packing: Spring-loaded Teflon, self-adjusting.
- G. Bodies, 2" and Smaller: Bronze with screwed end connections, replaceable brass seat. 125 psig rated, minimum.
- H. Bodies, 2 1/2" and Larger: Cast iron with flanged end connections, replaceable brass seat. 125 psig rated, minimum.
- I. Approved manufacturer: Belimo, VSI, Danfoss.
- J. Control valves will be setup so that 0% control signal causes the valve to be fully closed.
- K. The valves will be tested at 0% signal =fully closed, 10% signal = partly open, 50% signal = mid position, 90% signal = almost but not fully open, 100% control signal = fully open valve. All positions are to be tested from both opening and closed directions.

2.17 DAMPERS

- A. Provide automatic control dampers as indicated. All dampers shall be low leakage airfoil blade types (Johnson Controls or approved equal).
 - 1. Construction:
 - i. Frames: Extruded aluminum hat channel, 0.125" minimum thickness.
 - ii. Blades: Extruded aluminum airfoil type, 6" maximum blade width.
 - iii. Hardware: Molded synthetic bearings. Zinc plated steel axles, linkage brackets, connecting rods, and mounting bolts.
 - iv. Seals: Flexible metal compression seals on frame at blade end; extruded vinyl inflatable blade edge seals.
 - 2. Leakage: Not more than 6 CFM per square foot damper area at differential pressure of 4 inches with applied torque at damper of 50 inch-pounds.
 - 3. Operating Limits:
 - Temperature: -20 to 200° F
 - Pressure: 6 inches WG differential
 - Velocity: Up to 4000 FPM
 - 4. Select opposed blade dampers for proportional service. Parallel blade dampers may be used for two-position service, or in mixed air application which promotes air mixing.
 - 5. Damper sizes shall be provided as indicated or defined in specifications. Damper sizes may be provided different from those indicated on the drawings if improved performance can be demonstrated with calculations.
 - 6. Approved manufacturer: Johnson Equipment.
- B. Generator dampers shall be monitored by BAS. Generator and Generator Room dampers shall be controlled by the generator. Generator shall have Modbus Communications.
- C. Combination Fire/Smoke Dampers: Dampers are furnished under the work of Division 23 Section, “Fire and Smoke Dampers.” Refer to that section for operator type.

2.18 UTILITY METERING

- A. General Requirements:
 - 1. The following meters shall be included in this system:
 - i. All Electric Meters
 - ii. Gas Meters
 - iii. Water Meters
 - 1. Gas and domestic water meters shall be pulse outputs to a dedicated metering controller.
 - 2. ALC controller shall be SE563A, single program units with NOT be accepted.

2.19 SOLAR SENSOR

- A. Solar compensator consist of a black anodized aluminum collector contained in a sealed transparent enclosure designed to accept a cybertronic nickel wired sensing element. Compensator shall be Model M-2500 and sensor shall be Model TE-1900.
- B. Ambient temperature limits of -40°F to 120°F.
- C. Approved manufacturer: Johnson Controls

PART 3 - EXECUTION

3.1 WIRING

- A. Unless noted otherwise, all electrical wiring required to interconnect the components of the control system, including all terminations, splices, shield management, proper sizing and tests shall be furnished and installed by the TC. Perform all wiring in accordance with the requirements listed below, code requirements and Division 26.
- B. Power wiring required for controllers and control panels shall be furnished and installed by Division 26. Power for these components shall be dedicated power circuits for the express use of the individual controller or control panel. Circuits shall be furnished and selected by the Electrical Contractor. All circuit breakers and other electrical components required providing this dedicated circuit shall be the responsibility of the Electrical Contractor. Refer to Project Specific Requirements for additional information.
- C. Power wiring required for the Area Controller shall also be dedicated as specified above, and if available in the building, shall be on the emergency power circuit.
- D. All line voltage wiring shall be installed within EMT conduit. Conduit shall be adequately supported in accordance with local codes and Division 26.
- E. All low voltage (Class 2) wiring shall be installed within EMT conduit, except when run above dropped ceiling spaces, which shall be jacketed wiring. Low voltage wiring installed in ceiling spaces must be plenum rated wiring in accordance with all local codes. All wiring in ceiling spaces must be properly supported in cable trays or ring runs, on 3 foot centers, and fastened to the building so as not to droop on the suspended ceiling and other appliances installed nearby. Install wiring as close to the deck as possible to avoid damage from other trades, materials, construction and service activities.
- F. Low voltage (Class 2) control wiring under 50V shall not be used in line-voltage enclosures or locations, otherwise wiring to be THHN wire. No communication wiring to be run in high voltage enclosures.
- G. All low voltage wiring shall be installed with additional lengths formed in organized loops to allow moving large objects in and out of the wire vicinity. Identification of such object is done by examination of construction drawings. Contractor should make a reasonable effort to comply with this requirement.

- H. All conduit and wiring shall be installed in parallel lines to the building structure, its corridors, and hallways.
- I. Communication network wiring shall be clearly marked with a specific color code. Communication wiring shall not be installed near a noise producing equipment, such as ballasts, magnetic starters, etc. Communication wiring shall comply with the optimum requirements necessary to assure good communication of the control system.
1. All communications wiring shall follow standard best practices for the manufacturer.
 2. Exceptions:
 - a) In addition, RIT has a design standard that is more stringent than the manufacturer's best practice. Reference "RIT Controls Design Standard" on the RIT FMS website.
 - b) Do not use repeaters.
 - c) When using Arcnet to Arcnet Routers (AARs) the equipment associated with the AAR should be related to each other.
 - (1) Example: An AHU and its associated VAVs
 - (2) Example: A floor of heat pumps.
 - d) Network devices, such as AARs shall be located in easily accessible areas, such as a control panel in a mechanical room. They shall not be located above a ceiling or other difficult to access area.
- J. All controls input and output wiring shall be done by a single and continuous set of shielded stranded wire with plenum rated jacket, foil shield and drain. Such wire should be connected in the manner where:
1. Only one splice of the pair between the input or output and the termination on the control module were included.
 2. Where going through the compartments and walls, no additional transitions of pin connectors or pin bushings, etc. are permitted.
 3. All analog input and output wire shall be connected using individually separated and individually shielded (with drain) pairs of wires. Exception: All control wire connected to a dedicated piece of hardware can utilize a multi conductor cable with a common shield and drain wire; examples of the above rules are VSDs and actuators.
 4. The shield should have only one ground at the terminal board ground receiving fastener, and network one ground connection at designated communication device, unless specified otherwise by manufacturer of the equipment.
- K. Unless stated otherwise, all signals shall be wired using 18 gauge stranded wire as follows:
1. Comtran, 4859, Plenum rated, White Jacket wire, Foil shield with drain wire, 8 conductors, or
 2. Comtran, 4857, Plenum rated, White Jacket wire, Foil shield with drain wire, 6 conductors, or
 3. Comtran, 4855, Plenum rated, White Jacket wire, Foil shield with drain wire, 4 conductors, or
 4. Comtran, 4853, Plenum rated, White Jacket wire, Foil shield with drain wire, 2 conductors.

- L. All control wire shall be protected from pulling by utilizing fastening bushings at all knockouts crossed by the wire.
- M. No control wire should be directly fastened to the threaded rod or other sharp objects.
- N. All wiring in mechanical rooms or occupied spaces shall be installed in EMT conduit. The conduit should be sized to allow no more than 60% fill factor measured with all wiring installed in such conduit. ¾" conduit minimum.
- O. In addition to the above requirements, HVAC Operations and Controls Department Manager at FMS has established the following standards for wiring:
 - 1. DDC Control Panels – (Class 2 wiring)
 - Stranded Hookup wire (MTW), 18 AWG (Simcona or Kele):
 - Red – 24VAC power
 - Blue – 24VAC common
 - White – Analog Inputs / Outputs
 - Black – Common
 - Orange/Purple – 24VDC power
 - Misc. – Misc. wiring connections (Digital Outputs, etc.)
 - 2. Cabling – Plenum Rated Stranded Shielded (run separately from all line voltage wiring). All single pair black and white shall be wired with the white as positive.
 - 18/2 (Black/White) – Duct, Well, Status
 - 18/2 (Red/Black) – 24VAC Power (VAV boxes, etc.)
 - 18/3 (Red/Black/White) – 3 wire devices and devices w/ switched 24VAC power
 - 18/4 (Red/Green/Black/White) – Actuators & Control Valves,
 - 18224 (Green/Black/White/Red) Orange jacket – Zone Sensors
 - 18/12 (Brn/Org/Blu/Yel/Red/Green/Black/White/Pur/Grey/Pink/Tan) – VFD Drives.
 - Variable Speed Drive DDC wiring color allocations:
 - Red/Green – Speed Feedback
 - Blue/Yellow – Start/Stop
 - Orange/Brown – Proof
 - Black/White – Speed Command
 - Purple/Grey – KW feedback
 - Pink/Tan – Alarm (fault)
 - The TC shall submit their wire requirements for approval.
 - 3. Terminal Blocks
 - a) No wires shall land directly on controller but rather shall be connected controller through DIN rail mounted termination strip.
 - b) All terminals shall be identified with a terminal number corresponding to the same termination number posted on control drawing.
 - c) All terminal blocks shall be provided with a removable fuse for any power wiring landing on terminal block.
 - d) All wires leaving the terminals to the field devices must be labeled with descriptive text generated by a professional quality wire label maker.
 - e) Provide spare terminal blocks corresponding to spare controller I/O.

- f) All terminal blocks to be spring loaded. No screw terminals shall be installed.
4. Groups of terminals shall be separated as necessary utilizing the following color scheme.. (inputs / interlocks / outputs)
- Grey – Inputs / Network
 - Blue – Outputs
 - Red – Power (24VAC, 24vdc)
 - Yellow – Interlocks
 - Black – 120VAC Hot
 - White – 120VAC Neutral
 - Green – 120VAC Ground
5. Power Supply
- a) Each new panel shall be equipped with its own 24 VAC Power Source with On/Off Switch, Convenience Outlet and Circuit Breaker. To achieve all above use Kele T-PB 303-0 Panel Mount, Class 3 Power Source. Overcurrent Protection shall be provided on 24 VAC to DDC controller and filed power supply shall be separately protected.
 - b) Provide dedicated 120V circuit for DDC panels.
 - c) Transformers – Each of the following w/ low voltage fuse holder/disconnect.
 - (1) DDC controller & DC power supply
 - (2) All field wiring (24VAC leaving panel – switched in field)
 - (3) Valves
 - (4) Dampers
 - d) DC Power Supply for 4-20ma devices must meet Class 2 wiring standards. Only provide UPS power when required and/or approved by RIT Building Controls Department.
6. Convenience Outlet –
- a) Dedicated circuit for 120VAC combination outlet w/ switch to turn off 120VAC to panel.
 - b) Switched 120VAC to panel is fused before transformers (after outlet).
7. Din Rail (the following devices are din rail mounted)
- a) Terminal strips (inputs, outputs, network, and power).
 - b) Fuse Holders.
 - c) Interface Relays.
8. Wiring Panduit
- a) Wire ducts around exterior of panel for cables entering panel to be 3” to allow for wiring to be neatly run.
 - b) Wire ducts as necessary on interior of panel to route hookup wires from terminals to controllers and other devices.
9. Panel Construction (sized to provide 40% future expansion w/ removable back panel)
- a) Indoors – Johnson M8100 series or Hoffman (Nema 12 or better)

- b) Outdoors – Hoffman fiberglass Nema 4x
- 10. Relays –
 - a) Din Rail mounted
 - b) Track mounted
- 11. Panel lights for local annunciation –
 - a) Provide LED type push to test all panel lights, 24VAC as needed.
 - b) Provide selector switches and pushbuttons as required.
 - c) Provide mechanically engraved descriptive panel labels for each device mounted on the face of the panel (light, switch & button) utilizing white letters on the black background.
- 12. All panels shall be named and labeled –
 - a) Each panel shall have a reference name on the face of the panel describing its association with the services. Example: *## - Hot Water Plant-##, ## - Chiller Plant-##, ##-Hot Water Pumps-##, ##-Air Handler 01, Corridor Lights- A. Level*, etc. The face plate should also include the panel number. Contact Manager HVAC Controls for official panel name and number.
 - b) Each panel shall be clearly labeled with the breaker panel and breaker number. This may be part of the front label or it may be labeled on the panel power supply.
 - c) Panel's reference name shall be reflected on the drawings.
 - d) All panel-controlled equipment shall be listed on labels on face of the panel near the reference name or near a cluster of controls related to particular equipment.
 - e) Face mounted control knobs, switches and monitoring lights shall be coordinated with the labeling system so that there is no ambiguity of controls association with the equipment. Such coordination shall result in creating clearly distinct control clusters, separated from each other by adequate space, or by including embracing frames, plates, etc, bearing the common labeling engravings.
 - f) Labels should be made on black plastic material with white-engraved letters. Labels shall be neatly mounted with adhesive material providing strong bond with the face of panel.
 - g) Each individual panel labeling scheme shall be approved by HVAC Operations and Controls Department Manager at FMS.

3.2 DDC EQUIPMENT

- A. All components shall be installed in protective enclosures. All wiring within the DDC enclosure shall be either number coded or color-coded. Both the enclosure and the controller shall be properly grounded in accordance with manufacturer's recommendation.
- B. Documentation shall be firmly attached to the enclosure within a plastic envelope. Documentation shall state point-to-point termination detail, description of each individual point, location of power source for the controller and ID number or address within the network. Examples of drawings are included at the end of the specification.
- C. All DDC Controllers shall be mounted in enclosures installed on walls within equipment rooms, custodial closets or electrical rooms. Only application-specific controllers for VAV boxes, heat pumps, unit ventilators, rooftop units or package units may be mounted on the equipment.

- D. Stand-alone Controllers shall be microprocessor-based with a minimum word size of 16 bits. They shall also be multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification.
- E. Each DDC Controller shall have sufficient memory, a minimum of 1 megabyte, to support its own operating system and databases, including:
1. Control processes
 2. Energy management applications
 3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 4. Historical/trend data for points specified
 5. Maintenance support applications
 6. Custom processes
 7. Operator I/O
 8. Dial-up communications
 9. Manual override monitoring
- F. Each DDC Controller shall support:
1. Monitoring of the following types of inputs, without the addition of equipment outside the DDC Controller cabinet:
 - a) Analog inputs
 - (1) 4-20 mA
 - (2) 0-5 or 0-10 VDC
 - (3) Thermistor
 - b) Digital inputs
 - (1) Dry contact closure
 - (2) Pulse Accumulator
 - (3) Voltage Sensing
 2. Direct control of pneumatic and electronic actuators and control devices. Each DDC Controller shall be capable of providing the following control outputs without the addition of equipment outside the DDC Controller cabinet:
 - a) Digital outputs
 - (1) Contact closure
 - b) Analog outputs
 - (1) 0-20 psi
 - (2) 4-20 mA
 - (3) 0-10 VDC
- G. Each DDC Controller shall have a minimum of 10 per cent spare capacity for future point connection. The type of spares shall be in the same proportion as the implemented I/O functions of the panel, but in no case shall there be less than two spares of each implemented I/O type. Provide all processors, power supplies and communication controllers complete so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
1. Provide sufficient internal memory for the specified control sequences and have at least 25% of the memory available for future use.
 2. DDC Controller types shall be approved by HVAC Operations and Controls Department Manager at FMS. Whenever the number of required points exceeds capacity of basic controller, expanders should be utilized. No SE/SP controllers will be accepted.
- H. Utilization of multiple modules for the same equipment -- where equal functionality can be achieved by a singular module with expanders-- is not permitted, unless specifically approved by HVAC Operations and

Controls Department Manager at FMS.

- I. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
- J. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standards 587-1980.
- K. OFBBC or OFBBC-NR controllers and expanders shall be DC powered.
- L. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
 - 1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
 - 2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via a network or local laptop PC.
- M. Provide a separate DDC Controller for each AHU, RTU or other HVAC system. It is intended that each unique system be provided with its own DDC Controller.

3.3 CONTROL WIRE PROTECTION

- A. Provide conduit protection for all control wiring between the floor and the ceiling space. Where there is no ceiling installed, provide conduit to protect wiring up to 9 feet AFF.
- B. The end, unsupported section of conduit connecting to field hardware shall be made of seal-tight flexible conduit with vinyl jacket and the drip proof fittings.
- C. Provide reasonable wire protection from all sharp elements that may get in contact with the wire jacket. This includes conduit outlets, junction boxes and devices supporting the wire.
- D. Run wire clear of any access doors, removable components, space expected to be used for lifting suspended objects, hot pipe, pipe hangers, threaded rods, objects in motion, sharp edges, etc.
- E. All control wiring shall be protected and neatly bundled with plastic tie wraps and properly supported and fastened to solid objects. Supporting the wire on the ceiling, ceiling's light fixtures, etc. is not permitted.
- F. Control wiring shall comply with its class of insulation as per NEC code. Control wiring entering objects where higher class is enforced shall be protected accordingly. If change of wiring class require termination of two different wires, such termination shall be done in a separate enclosure or junction box, complete with a removable cover or access door.
- G. Provide Initial Resistance Test for all installed Control and Network Wiring, including resistance between each member of cable set and the ground with identification of tested parts.

3.4 DDC CONTROLLER RESIDENT SOFTWARE FEATURES

- A. General:
 - 1. All necessary software to form a complete operating system as described in this specification shall be provided.
 - 2. The software programs specified in this Section shall be provided as an integral part of DDC Controllers and shall not be dependent upon any higher level computer for execution.
- B. Control Software Description:

1. The DDC Controllers shall have the ability to perform the following pre-tested control algorithms:
 - a) Two-position control
 - b) Proportional control
 - c) Proportional plus integral control
 - d) Proportional, integral, plus derivative control
 - e) PID Deadband
 - f) Control loop tuning
 - g) Input selections
 - h) Load shed offset of control setpoint
 - i) Intuitive learning
 - j) Control from remote input connected via the network
 - k) Controlling remote points via the network
 - l) Value broadcast via the network
 2. Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
 3. The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
 4. Upon the resumption of normal power, each DDC Controller shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operations.
- C. DDC Controllers shall have the ability to perform any or all the following energy management routines:
1. Time-of-day scheduling
 2. Calendar-based scheduling
 3. Holiday scheduling
 4. Temporary schedule overrides
 5. Start-Stop Time Optimization
 6. Automatic Daylight Savings Time Switchover
 7. Night setback control
 8. Enthalpy switchover (economizer)
 9. Peak demand limiting
 10. Temperature-compensated duty cycling
 11. Fan speed/CFM control
 12. Heating/cooling interlock
 13. Hot water reset
 14. Chilled water reset
 15. Condenser water reset
 16. Chiller sequencing
 17. Adaptive learning sequencer of multi stages
- D. All programs shall be executed automatically without the need for operator intervention and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described in the Sequence of Operations.
- E. As much as possible use the same program for similar types of equipment in the same building and across campus.
1. In cases where one piece of equipment requires an extra control routine, but is otherwise similar to other equipment in the project, then create one program that has the ability to turn that feature on and off, so the same program can be used on equipment with that feature and on equipment without that feature.
- F. If possible use one of the standardized RIT programs.
1. This library is continually expanding. Check with HVAC Operations and Controls Department Manager to see if there is a program in the library to meet the needs of the project.

- G. Refer to “RIT Design Guideline and Best Practices” located on the RIT FMS website for program names and other program features.
- H. DDC Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
1. A single process shall be able to incorporate measured or calculated data from any and all other DDC Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC Controllers on the network.
 2. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.
 3. The custom control programming feature shall be documented via English language descriptors.
 4. Process shall synchronize values entered locally from remote access pad and project new value on all access sites.
- A. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.
1. All alarm or point change reports shall include the point’s English language description and the time and date of occurrence.
 2. Each alarm shall have the event-alarm message followed by the event-restore message when the alarm conditions has restored to normal operation.
 3. Alarm set and restore setpoints should be easily accessible.
 4. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, DDC Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each DDC Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
 5. Alarm reports and messages will be directed to a user-defined list of operator devices or PCs.
 6. In addition to the point’s descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.
 - a) Each DDC Controller shall be capable of storing a library of at least 50 alarm messages. Each message may be assignable to any number of points in the Controller.
 7. In dial-up applications, operator-selected alarms shall initiate a call to a remote operator device.
- B. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.
1. DDC Controllers shall store point history data for selected analog and digital inputs and outputs:
 - a) Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of 1 minute to 7 days shall be provided.
 2. Trend data shall be stored at the DDC Controllers and uploaded to the workstation when retrieval is desired. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers are full. All trend data shall be available for use in 3rd party personal computer applications.

3. DDC Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and manual loop tuning algorithms shall be provided for operator-selected PID control loops as identified in the point I/O summary. Provide capability to view or print trend and tuning reports.
- C. DDC Controllers shall automatically accumulate and store run-time hours for digital input and output points as specified in the point I/O summary.
 1. The totalization routine shall have a sampling resolution of one minute or less.
 2. The user shall have the ability to define a warning limit for run-time totalization. Unique, user-specified messages shall be generated when the limit is reached.
- D. DDC Controllers shall automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for user-selected analog and digital pulse input type points as specified in the point I/O summary.
 1. Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g., KWH, gallons, BTU, tons, etc.).
 2. The totalization routine shall have a sampling resolution of one minute or less.
 3. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.
- E. DDC Controllers shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly or monthly basis for points as specified in the point I/O summary.
 1. The event totalization feature shall be able to store the records associated with a minimum of 9,999.9 events before reset.
 2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.
- F. When applicable, the DDC Controllers shall provide recalculation of percentage of Outside Air entering the air handler, based on the algorithm, taking into consideration current OA, RA and MA condition. The computed result shall be distinctly posted on the Graphical Page alongside with the OA Damper position value.

3.5 SERVER/PC WORKSTATION

- A. The permanent Server assigned to Automated Logic Control System is in place at RIT;
- B. Provide fully configured database, graphics, reports, alarm/events trend and scheduling management and merge it with existing in server control system and provide matching navigation system to all added elements, pages, etc.
- C. Provide daily management of all alarms generated as result of the construction cycle; Excessive alarms shall be maintained as needed without affecting other alarms on the server.
- D. All control systems provided in this contract shall be connected to the existing campus-wide Ethernet system.

3.6 COLOR GRAPHIC SOFTWARE (CGS)

- A. Provide graphic screens depicting the actual layout for all major equipment, including but not limited to:
 1. Air Handling Equipment
 2. VAV Boxes, Unit Heaters and other Zone Terminal Equipment
 3. Central Plant Equipment

- B. Provide graphic representation of the building, including building floor plans. Provide common information and status within these screens, such as zone temperature, equipment status, etc. Graphics shall use non-intrusive colors and close proximity color associations.
- C. Graphics shall allow manipulation of adjustable setpoints and show all pertinent dynamic data reasonably required to accurately representing system status and its functionality.
- D. Coordinate with the Engineer and HVAC Operations and Controls Department Manager at FMS prior to loading and testing.
- E. All graphic pages shall allow for the direct manipulation of all digital and analog outputs directly from the graphic screen through Hand-Off-Auto operators.
- F. As much as possible use the same graphic for similar types of equipment in the same building and across campus.
 - 1. In cases where one piece of equipment requires a graphic element, but is otherwise similar to other equipment in the project, then create one graphic that has the ability to turn that feature on and off, so the same graphic can be used on equipment with that feature and on equipment without that feature.
- G. If possible use one of the standardized RIT programs.
 - 1. This library is continually expanding. Check with HVAC Operations and Controls Department Manager to see if there is a graphic in the library to meet the needs of the project.
- H. Refer to “RIT Design Guidelines and Best Practices” located on the RIT FMS website for graphic names, locations and other graphic features.

3.7 SENSING DEVICE INSTALLATION

- A. Freezestat: Provide on every unit that has outside air intake where indicated by the contract documents. Locate on the downstream side of the hot water coil, upstream side of the chilled water coil or after the supply fan if the unit has no coils but there are downstream coils to be protected. Serpentine the element across the face of the coil and fasten using support rods.
- B. Space Sensors/Transmitters: Provide as required according to the contract documents. Mount at 48 inches AFF to center – unless otherwise directed by ADA requirements. Wire to respective control system to provide control. Provide a label on the sensor for reference to the equipment served.
- C. Duct Mounted Sensors/Transmitters: Provide as required according to the contract documents. Averaging type sensors shall be supplied for all mixed air and discharge air locations. Serpentine across the duct opening at even increments and provide proper fastening.
- D. Each terminal unit, VAV, heat pump, fan coil, etc., must have one monitored duct mounted sensor located on discharge side of the unit.
- E. Liquid Immersion Sensor/Transmitter: Provide as required by the contract documents. The piping contractor shall provide and install all thread-o-lets for wells and other liquid sensors. Coordinate locations so that sensors are properly installed in an acceptable location. Actual sensors shall be provided and installed by the TC using thermal conductive compound. Strap on sensors are not acceptable, except for aqua-stats, or if specifically approved by Manager HVAC Controls Department at FMS.
- F. Each building shall have an individual Outdoor Air Station Program that will **read** outside air temperature, outside air humidity and outside air enthalpy. The averaging program will automatically ignore any sensor

that is in failure or reads 10° (adjustable) out of range. In case that such value is above or below the average, an alarm shall be generated to indicate that a problem exists with the sensor in question.

- G. The building outside air station program shall read the outside air conditions from the campus outside air program through the network and use the campus outside air values for its status values. In the event that the building outside air program cannot communicate with the campus outside air program then the building outside air program will use the average of the outside air sensors inside the buildings network. Also as part of the outside air conditions is an Ambient Light Photo-Sensor that shall be used to control any of the building's exterior or interior lights based upon the amount of light outside. The photo-sensor shall read an analog signal representing the amount of light currently outside – not a 2 position switch photocell.
- H. Outdoor lighting shall not be controlled by ALC system controller. All Outdoor lighting shall be controlled by a photocell.
- I. Each unit that requires the outside air temperature, humidity or enthalpy shall first use the global campus average values with a 10 minute update time. Should the unit fail to receive an outside air temperature, humidity or enthalpy value the unit shall revert back to its local sensor(s) if it has them or the building average if it does not. Should both the local sensor and the global update values fail, the unit should default to a worst case scenario and assume the outside air is 0°F until either the local sensor or the global broadcast works again. In any case an alarm shall be generated to indicate a problem with this particular unit's outside air source.

3.8 CONTROLLED DEVICES

- A. Dampers: Provide as required by the contract documents – installed by the sheet metal contractor. The TC shall mount all damper control devices and any associated linkage assemblies. Dampers shall operate smoothly throughout their entire stroke.
- B. Valves: Provide as required by the contract documents – installed by the piping contractor. Coordinate locations so that valves are piped properly and installed in an acceptable location. Valves shall provide proper shut-off as specified in this section. Valves shall be wired by the control contractor.
- C. Actuators: TC shall install all actuators, unless specified otherwise. All wiring to the devices shall be the responsibility of the TC.

PART 4 – TYPICAL PROJECT REQUIREMENTS

The purpose of this section is to clarify and highlight those parts of contract requirements that may require additional clarifications, or are slightly different or in contrast with the rest of the specification, or needs to be purposely emphasized because of additional importance or safety considerations.

- A. Provide all control points as listed in the Building Bid Request Points list.
- B. Provide new control panels as per schedule in the points list.
- C. For each piece of equipment provide singular panel. If multiple panels are required, this should be approved by the Owner.
- D. Provide new control modules to operate each controlled unit as per schedule (separate module for each piece of equipment).
- E. Provide schedule of new module assignments for approval.
- F. Control panels shall be either Johnson Style M8100-xx-xx Extruded aluminum type or Hoffman metal enclosures with back panel. All controls panels to have a minimum rating of Nema-12. Any panels mounted outdoors shall be a NEMA-4X fiberglass.
- G. All control panels shall be sized to provide 40% extra space for future expansion. Manager HVAC Controls Department at FMS shall approve type, size and location of each enclosure. Please, note that some enclosures shall be furnished with surface mounted indicator lights and switches as called for in the sequence of operation.
- H. In order to minimize negative impact on building environment during the system transition, switchover needs to be coordinated with Manager HVAC Controls Department at FMS

- I. The switchover shall be done in such a way, that no interruptions of building services should be required. If needed, the TC will provide manual control of the equipment and will provide adequate labor to complete this task.
- J. TC Contractor shall assume liability for and provide adequate protection of the points which, when triggered in result of the TC Contractor's activities, may result in setting off the fire alarm.
- K. Mount new enclosures as directed by the Owner.
- L. Replace all field temperature sensors with Precon type II. Provide factory calibration data for all installed sensors. (Exception: MTHW sensors shall be RTD with transmitter, Plant MTHW sensors shall be RTD with integrated factory calibrated and certified transmitter)
- M. Provide averaging temperature sensors for all MA & coil locations. Provide adequate sensor's length to assure reasonable averaging of MA temperature.
- N. For all air handlers provide Freezestat Alarm indicating light.
- O. For all air handlers provide Fire Alarm Relay and Fire Alarm indicating light.
- P. Fire Alarm Contact Received shall be a separate command for each unit controlled.
- Q. All safety relay devices shall be tied in series through the terminal strips within the ALC control panel. Examples of safeties wired in series that can shut down the Fans are: Freezestat, Smoke Dampers, HIGH/Low Static Pressure switches on AHUs and BAS Safety. Each safety shutting down a VFD should also generate a corresponding input to the ALC system, and also be indicated on the "push-to-test" light on the face of the control panel.
- R. All lighted pushbuttons shall be low voltage (24 VAC) and incorporate 2 sets of contacts (1 N.O. and 1 N.C.) wired such, that the "push to test" function is incorporated to test integrity of the light and the system. The N.C. contact shall be wired to the control point (freeze stat, high limit, etc.) and the N.O. contact shall be wired to a constant power source such, that when the lighted pushbutton is depressed the light will come on, independent of the control source. Bulbs will be LED.
- S. VFD Shutdown shall be initiated by the fire alarm fan relay directly to the VFD interlock circuit. Fire Alarm relay to have a second alarm contact to the DDC panel. *All safety devices shall be hardwired through relays within the control panel, and work independently of the ALC controller.* The interlock circuit should also fail off with no power to the control panel.
- T. All low voltage transformers shall be mounted within an enclosure (same or adjacent) and have a DIN rail mounted combination fused disconnect for fuse protection and means of disconnect. (see Kele Catalog #M10/16SFL or approved equal)
- U. Control panels shall have transformer dedicated for individual usage – (Examples include 1 for DDC controllers, 1 for all 24VAC power leaving the control panel, 1 for valves, 1 for dampers, 1 for all panel equipment (DC power supplies, panel lights) etc. Size each transformer as to allow 20% margin of safety in total VA load of each.
- V. Within each control enclosure, the modules shall have a minimum of 10% spare I/O (of the total) with no less than 2 spare inputs of any type on each module. All bids shall include a list of the free I/O per panel & module.
- W. Each control panel will contain spare terminal blocks corresponding to the required 10% (minimum 2 each type) spare IO.
- X. Within each enclosure provide convenience outlet with a light toggle switch (double gang box with cover) so that the control components and transformers can be independently de-energized separate from the outlet. To achieve all above use Kele T-PB 303-0 Panel Mount, Class 3 Power Source.
- Y. Control panels shall be designed with power entering on the bottom portion of the panel and control terminations in the top and sides unless obstructions prevent doing so.
- Z. Control panels shall be designed using wiring duct to section off different sections of the panel. Example: (transformers, relays, AHU-1, AHU-2, HW plant, terminals would all have their own section. The outside duct shall be oversized to allow for future expansion and to provide for a neat appearance without being cramped. Recommend using 3" duct on perimeter of panel. Kele T1-3030 or Horizon Fduct Wh6.
- AA. Panel relays shall be Idec blade style relays with DIN rail sockets. Kele: RH-2B or RH-4B with SH2B-05 or SH-4B-05
- BB. All control signal wiring should be plenum rated and provided with foil shield and drain. Analog inputs and outputs shall be additionally composed of separately shielded pairs of wires, complete with shield and drain wire. The drain wire shall be long enough to be grounded if required for future in the control panel. Wiring not conforming to those criteria shall not be approved as completed, until corrected to meet above requirements.
- CC. Remove unused control wiring and components on equipment and spaces being modified.

- DD. All control modules shall have overcurrent protection.
- EE. Do not cut LIVE control and/or network wiring. If cut, contractor is responsible for replacing and reconnecting wiring, leaving in perfect operating condition.
- FF. Contact RIT Building Control when encountering unknown wiring. Do not cut or disconnect, unless otherwise noted.
- GG. Provide requested sequence of operation and test its performance including test of all interlocks and safeties. Consult with HVAC Operations and Controls Department Manager at FMS before proceeding with any test involving the MTHW or Steam.
- HH. Provide for approval two submittals for equipment and hardware utilized on this project.
- II. Provide functional commissioning of system including testing all active inputs and outputs. Include system testing, PID tuning and safety testing. Support your work with actual trend data.
- JJ. Demonstrate to HVAC Operations and Controls Department Manager at FMS effect of commissioning by conducting this process with the presence of authorized representative of HVAC Operations and Controls Department Manager at FMS.
- KK. Provide standard RIT documentation, CAD drawings, wiring details, equipment cut sheets and Point Summaries, detailed sequence of operation for each piece of installed equipment controls; this should be provided both, in text version and block of program drawing. All drawings shall be provided additionally on a CD disk. Simulated CAD drawings completed using the Visio software is not an acceptable substitute for a professional quality CAD drawings.
- LL. Merge this project's work with the existing WebCTRL system, update all links and tree directory. Test completeness of WebCTRL graphical interface and correct all errors and inconsistency of equipment operation resulting from faulty programming, incomplete sequence of operation, etc.
- MM. Provide 3-hour training seminar for RIT HVAC Operations and Controls Department personnel.
- NN. Provide 2-year warranty on labor and materials installed in this project.
- OO. It is expected that during the warranty period, the TC will occasionally review all equipment added by this projects with the intent of system improvements, tuning, adjustments and corrections, as needed to provide most efficient and accurate operation of equipment. In each case such corrections shall have a prior approval of Manager HVAC Controls Department at FMS. Such activity shall be done in the best interest of project outcome and will not require additional compensation from RIT.
- PP. All graphics shall conform to the RIT standard and retain consistency with other buildings on campus. They should contain H-O-A operators for all equipment, Room numbers & zone numbers on floor plans..
- QQ. Contractor Rules. Contractors shall follow all RIT regulations concerning but not limited to:
 - a) Parking
 - b) Keys
 - c) Shutdowns
 - d) Fire alarms
 - e) Safety
 - f) Lock and Tag
- RR. Contractor shall be fully responsible for implementing and adhering to the above regulations including reimbursement of RIT with required compensations for fees and fines resulting from his or her, or their team and, or their subcontractors performances at RIT.
- SS. Refer to "RIT Controls Design Standard Guidelines and Best Practices" located on the RIT FMS website for:
 - 1. Program Standards
 - 2. Graphic Standards
 - 3. Preferred Network topology
 - 4. Preferred WebCTRL configuration
- TT. The TC shall return to site at the three (3) weeks and six (6) months after substantial completion. The TC shall provide eight (8) hours of onsite system review and adjustment for each visit. All work performed shall be documented and submitted to RIT.

END OF SECTION

DIVISION 26 – ELECTRICAL**26 01 00 – Operation and Maintenance of Electrical Systems**

1. Fire stopping shall be performed by Electrical Contractor if the work is only electrical. For new buildings, fire stopping shall be performed by one fire stopping contractor for all trades (check with GC or CM).
2. When performing demolition work, all conduit and wire not being re-used shall be removed back to the source.
3. Do not use motorized shades.
4. Lighting is not to be controlled by Building Automation Systems, unless approved by the Director of Building Operation and Maintenance. Lighting control systems are to be kept as simple as possible, code compliant, and shall be reviewed by the Director of Building Operation and Maintenance.
5. In new construction, addition, or major renovation, provide a closet in project for a lamp cart, new and waste lamp (Universal Waste) storage.
6. All panelboards must be in a location accessible by electrical staff (FA key).
7. Emergency power gensets are to be located inside a room within the building. Exterior and roof mounted gensets are not acceptable.
8. Gensets to be natural gas Kohler, Onan, or Generac with a two (2) year warranty.
9. On genset muffler and piping drain(s), provide ball valve and piping to within 12 inches of floor or nearby floor drain. ¾" copper minimum size.
10. All new buildings, additions, major renovations, and new panelboard installations must have short circuit and coordination study work performed with results submitted to the Electrical Department. In addition, an Arc Flash analysis must be performed and labels made. Results and labels are to be submitted to the RIT Director of Engineering before contractor applies labels to panels.
11. Building Entrance
 - a. An electric push-button power-assist actuator (manufacturer: LCN) and card reader shall be mounted on an aluminum 4 inch x 4 inch x 50 inch height light pole (powder coat black finish) mounted to an 18 inch diameter (four feet deep, two inch reveal) cast concrete base (Kistner Uni-base using pole manufacturers anchor bolts) at the main entrance of the building (see 26 05 00 – Devices for device heights). RIT can provide detail drawing.
 - b. If Code or local building department regulations require unlocked roof access exits, then any such exits shall be normally held electrically locked, have a by-pass key switch, and be released by the fire alarm system during an activation. The doors shall be posted indicating exit for emergency use only.
 - c. At least two lighting fixtures at each building entrance shall be powered by the Life Safety (Emergency) power circuit.
12. Fire Alarm
 - a. Refer to Division 28 – Electronic Safety and Security for fire alarm system guidelines.
 - b. Refer to Division 21 – Fire Suppression for fire suppression and protection guidelines.
 - c. Place Fire Alarm systems on separate dedicated sheets in drawing set (not on the "Systems" sheets with the rest of the systems i.e. tele/data). As-built Fire Alarm drawings to show conduit routing, devices, address for each device, battery calculations, panel information, conductor quantity, types, and sizes. Drawings to be black and white only, no color, and electronic on a CD in AutoCAD .dwg format.
 - d. Smoke detectors shall be a minimum of 3 feet from HVAC Diffusers.
 - e. Smoke detectors shall be installed in all rooms designated for student occupancy.
 - f. All fire alarm system wiring shall be installed in RED EMT conduit, no free air wiring even if existing is free air.

26 05 00 – Common Work Results for Electrical

1. Conduits and Boxes
 - a. **No conduit less than ¾ inch without Owner approval.**
 - b. Do not run conduits in or under concrete slabs or floors.
 - c. Conduit for Back Up and/or Life Safety Power circuits shall be GREEN EMT. Panelboards for Back Up and/or Life Safety Power circuits shall be painted GREEN. Junction boxes and covers on Back Up and/or Life Safety Power circuits shall be painted Orange/Green for 277/480 volt circuits or Blue/Green for 120/208 volt circuits.
 - d. Junction boxes and covers on Fire Alarm circuits shall be painted Red.
 - e. Junction boxes and covers on 277/480 volt circuits shall be painted Orange.
 - f. Junction boxes and covers on 120/208 volt circuits shall be painted Blue.
 - g. Conduit colors to be used on all work:
 - i. **RED** Fire Alarm

- | | | |
|------|----------------------|-----------------------------------|
| ii. | GREEN | Stand by and/or Life Safety Power |
| iii. | BLUE | 120/208 volts |
| iv. | ORANGE | 277/480 volts |
| v. | YELLOW | Telecom |
| vi. | PURPLE/VIOLET | HVAC Controls. |
- h. Include 120 volt circuits for HVAC control panels and to each VAV box with a toggle switch (regular light switch) in a single gang box mounted at each DDC panel and VAV box.
 - i. Include ¾ inch EMT conduit and single gang box in wall for HVAC temperature sensor.
 - j. Use only Scotch 33+ tape.
 - k. Use Ideal or 3M performance plus (but not 3M Scotch Lok) wire nuts.
 - l. In areas where free air wiring (Telecom/Data) pass over non-accessible ceiling (GWB), install those wires in conduit pathway so that future wires may be added or deleted.
 - m. No horizontal conduit runs in walls.
 - n. All runs in walls shall be vertical and have a 4" x 4" junction box at the top of the run in the ceiling area above the ACT ceiling. Do not use LB conduit fittings. Use deep 4" x 4" boxes in hallways.
 - o. All equipment shall have a lockable local disconnect (for LOTO) regardless of panelboard location.
 - p. Install toggle switch in single gang handy box at each 120 VAC operated smoke damper. This makes for a means disconnect when changing a damper motor.
 - q. Hand dryers in restrooms require dedicated 120 volt 20A circuit to each dryer.
 - r. Coordinate 120 volt duplex outlets with furniture layout. Advise Owner of any problems.
 - s. Pitch pockets shall NOT be used for roof penetrations for conduit or piping. Cones or "Witches Hats" with a stainless steel "radiator hose" style clamp (with stainless steel worm screw) shall be used. For multiple or large conduits, a "dog house" box shall be used with conduits exiting the side wall of the box.
 - t. Telecom pathways:
 - i. 1 inch EMT conduit from double gang boxes with single gang raised cover mud ring to be stubbed up above ceiling.
 - ii. Use a minimum of 1 inch sleeved pathways into spaces from main hallways.
 - iii. Review electrical contractor responsibility for Telecom with RIT Project Manager.
 - u. All conduits (Telecom, low voltage (600v) or medium voltage (12Kv)) entering a building shall be pitched away from the building and shall immediately enter a pullbox in the building. Conduits leaving the pull box shall be higher so that any water entering the pull box via the exterior conduits cannot flow to conduits or equipment inside the building.
 - v. Include ¾ inch EMT conduit and single gang box for card reader at building entrance.
 - w. Use Liquidtight Flexible Metallic Conduit (LFMC) for outdoor and damp area applications (motors, rooftop units, lights, etc.). Do not use Liquidtight Flexible Nonmetallic Conduit (LFNC).
 - x. Wiremold series 4000 or 5400 shall be used for surface raceway. Other surface raceway systems must be approved by Planning and Design and the Director of Building Operation and Maintenance.
 - y. Provide grounded conductor at line powered light switches per NEC 404.
 - z. Boxes and ¾ inch EMT conduit shall be provided for all light switches (class 1 or CAT.5 cables). Conduit shall extend to above ceiling as a minimum.
 - aa. No conduits are to be mounted tight to the roof deck.
2. Devices
- a. Provide at least one 120 volt electrical outlet connected to emergency power genset in every mechanical, boiler, and electrical room.
 - b. Device covers shall be unbreakable nylon. Color TBD for each project.
 - c. Construction of new buildings shall include an exterior 120VAC GFCI duplex outlet at each entrance and one outlet on each face of the exterior.
 - d. Device and Equipment mounting heights (AFF measured from finished floor to device centerline unless noted as otherwise:
 - i. Toggle switches (up is "on") 46 inch.
 - ii. Receptacles (ground pin up or to the left) 18 inch.
 - iii. Receptacles above counters 8 inch.
 - iv. Receptacles above hot water baseboard heat 30 inch.
 - v. Receptacles in hazardous areas, or for refrigerators 48 inch.
 - vi. Receptacles, weatherproof, above grade 24 inch.
 - vii. Telephone/data outlets 18 inch.
 - viii. Telephone outlets, wall mounted 46 inch.
 - ix. Fire Alarm Pull Stations 46 inch.

- x. Fire Alarm horns and strobes (match existing or) 80 inch to bottom of device
 - xi. Distribution Panels (to top of back box) 72 inch.
 - xii. Terminal cabinets (to top of back box) 72 inch.
 - xiii. Disconnect switches, motor starters, enclosed breakers 48 inch.
 - xiv. Temperature sensors 54 inch.
 - xv. ADA door operator push buttons 40 inch.
 - xvi. Card reader 40 inch.
 - xvii. Outdoor pedestal for card reader and ADA door button 50 inch total height.
- e. Provide circuit information (panel number and breaker number) on the front of all outlet and switch covers using printed label tape.
 - f. Duplex outlets on 120 volt circuit shall be 20A and equal to Pass and Seymour Industrial Spec. Grade #5362 (Warning: Device manufacturers do not use the same terms to describe similar device grades). #5362-AL or #5362-A or equal.
 - g. Duplex outlets that are included with furniture shall comply with the device requirements in these guidelines.
 - h. Pig tail duplex outlets on all circuits so that neutral and hot conductors are maintained when changing duplex device. Second duplex in quad box need not be pig tailed, daisy chain from 1st duplex.
 - i. Provide GFCI 120v service outlets on roof.
 - j. Provide weather resistant GFCI outlets for outside GFCI outlets, or outlets subjected to water spray.
 - k. Doorbell strobes to be mounted at least 6 feet away from nearest Fire Alarm strobe. Doorbell strobes for offices shall have "auto three flash", residence hall doorbell strobes shall be "push and hold".

26 05 33 – Raceway and Boxes for Electrical Systems

1. Floor Boxes
 - a. Basis of Design: Legrand Evolution Series 4" Poke-Thru; confirm device plates and cover assemblies with Owner.

26 10 00 – Medium-Voltage Electrical Distribution (15Kv)

1. Use liquid filled transformers on all 12kv service and place inside electrical transformer vault inside building. The use of pad mount transformers is to be avoided and requires the approval of the Director of Building Operation and Maintenance.
2. Use single-phase liquid filled transformers on 12kv service of 150kva and higher.
3. Provide containment for oil spills in transformer vault.
4. Transformers to have HV connections on rear side, LV on top.
5. Transformers to have oil sample port, oil fill port, oil level indicator, oil temperature (with max) indicator, oil vac/pressure indicator on opposite side from HV Connections. Removable top.
6. Transformers to be covered by 5 year warranty.
7. Use type SM-5, or SMU-20 type fuses in 15kv metal clad switchgear inside electrical secondary switchgear room.
8. 15kv cable shall be General Cable, Kerite, Perelli (Prysmian), or Okonite and shall be 500Kcmil between manholes.
9. 15kv cable shall be EPR 133% insulation level (220 mil), MV-105, with 5 mil copper tape with a minimum of 20% overlap, and with flame retardant, moisture and sunlight resistant PVC jacket.
10. Use only Elastimold Series 600 Deadbreak bolt-together tee type splices in 12kv manholes.
11. For underground conduits, use 5 inch Schedule 40 PVC conduit. Transition to RGS sweeping elbow when rising above grade or entering building. Encase with 6 inch of concrete on all four sides. Provide 4 feet of cover by backfilling in 12 inch lifts with compaction between lifts. Provide 12 inch of top soil in lawn areas.
12. No medium voltage equipment is to be placed against building walls, minimum spacing from wall shall be 24 inches.
13. All medium voltage wiring used for connections between transformers (feeds and interconnections) and switchgear shall be a shielded type.
14. Load Interrupters shall be located in a separate room from the transformers (locate load interrupters in secondary switchgear room). Load Interrupters shall have IR inspection windows.
15. Always install double the number of conduits needed for 12kv service (if 4 are required, install 8 conduits).
16. Use only fiberglass and stainless steel hardware on 12kv wire racking materials in manholes.

26 20 00 – Low-Voltage Electrical Distribution

1. Class 1 (50-600 volts)
 - a. No shared neutrals (unless in plug mold and approved by Owner).

- b. Properly sized grounding conductor shall be run with power conductors in all conduits.
 - c. No conduit less than $\frac{3}{4}$ inch without Owner approval.
 - d. No cast fittings for conduit.
 - e. Use acceptable Manufacturers list for electrical products (Contact RIT for latest list).
 - f. MC cable or flex shall not be used in new or renovation work except for light fixture whips no longer than 6 feet in length. MC cable may be used with Electrical Department Manager or Director for approval in old work.
 - g. For new buildings, additions, or major renovations, install Square-D power logic electric meter (tie-in to Square-D server system, use Belden 3107A E34972 2pr 22ga shielded cable with drain wire). Do not use split core CTs, check phasing, direction, and verify accuracy at installation.
 - h. No secondary switchboards shall be placed against building walls, minimum spacing from wall shall be 24 inches.
 - i. Provide at least one 120v duplex outlet on e-power in each mechanical, electrical, and boiler room.
 - j. Use stranded copper wire on all sizes.
 - k. Use terminals on #14 wire when used for low voltage (Class II) control work.
 - l. Transformers shall be floor mounted on a 4 inch concrete housekeeping pad. Exceptions to floor mounting require Owner approval.
 - m. Include enough 120 VAC 20A single pole breakers in panels for HVAC Control Panels.
 - n. Include enough space on mechanical room walls for HVAC Control Panels.
 - o. Do not use electric in-sink disposal units – require owner approval to be considered.
 - p. Provide ball valve(s) on genset muffler drain(s), run to within 12 inches of floor or run to nearest floor drain. Use $\frac{3}{4}$ " copper minimum size.
 - q. Do not use aluminum conductors.
2. Class 2 (0-50 volts including Fire Alarm Systems)
 - a. Use plenum rated wiring for all low voltage applications not in metal conduit.

26 24 16 – Panelboards

1. Panelboard schedules on drawings shall include loads in terms of Horse Power and Amps with total load for the panel indicated per phase.
2. Design firm shall include fuse/ breaker coordination study, Arc Flash study information, and labels in close out documents to Owner in both hardcopy and electronic form.
3. Use only bolt-in breakers in panel boards (plug in breakers require approval from Owner).
4. All panelboards shall have lockable door-in-door hinged trim.
5. No panelboards shall be directly surface mounted to walls in mechanical or electrical rooms. Panelboards shall be spaced from the wall using Kindorf (vertically mounted) such that water running down wall will not affect panel.
6. Installing contractor shall provide Owner with panelboard directories in MS Word format on a CD.
7. Rotation shall be clockwise at main distribution panel (and marked on outside of MDP) and at all panelboards.
8. Panelboards shall have copper busses.
9. Use De-Ox or equal on conductors to panelboards 100A and higher.
10. Panelboards shall be Square D, Cutler Hammer, or Siemens.
11. Do not put panelboards in custodial closets.
12. Add (3) empty $\frac{3}{4}$ " conduits and (6) empty 1" conduits to flush mounted panelboards.
13. No stuffing two conductors on single pole breakers.
14. Consult with Electrical Manager for panel nomenclature.

26 27 13 – Electricity Metering

1. Do not use Split CT without Owners Approval.
2. Run both CT leads to shorting switch – **DO NOT** common any leads.
3. Meters shall be Square-D 5563 with external display.
4. Consult with owner for metering enclosure and 9 pole switch. (SQ.D 9761c05k0a0a7)

26 29 23 – Variable Frequency Motor Controllers (VSD)

1. Do not mount any disconnects or motor starters above the ceiling unless approved by Owner.
2. Motor controls shall use LED lamps.
3. VSDs approved for use on campus:
 - a. Danfoss HVAC Class, such as the FC102
 - b. ABB ACH550 series
 - c. Square-D E-Flex

- i. Square-D S-Flex are unacceptable for any application at RIT.
 - ii. S-Flex drives that are installed shall be removed and replaced with an approved drive at the contractor's expense.
4. All VSDs shall be supplied with BACNet capability (BACNet/MSTP or BACNet/ARCNet)
 - i. It is acceptable to use an add-in module for the BACNet capability, but the module shall be provided with the drive and the module cost shall be included with the contractor's bid or quote.
 - ii. If a VSD is installed without BACNet capability, the contractor is responsible to add the BACNet capability at no additional cost to RIT.
5. All VSDs shall have capability for the following hard wired control points:
 - a. AI VSD Speed Control Signal (0-10V or 0-5V)
 - b. AO VSD Speed Feedback Signal (0-10V or 0-5V)
 - c. DI VSD Start/Stop (to External Dry Contact)
 - d. DI VSD Safety Interlock (to External Dry Contact)
 - e. DO VSD Run Status (Dry Contact)
 - f. DO VSD Alarm Status (Dry Contact)
 - g. It is acceptable to use an add-in module for the IO Point capability, but the module shall be provided with the drive and the module cost shall be included with the contractor's bid or quote.
 - h. If a VSD is installed without the above IO capability, the contractor is responsible to add the IO capability at no additional cost to RIT.
6. VSDs shall be stand-alone, not incorporated into a Motor Control Centre.
7. Start-up of new VSDs shall be performed by the drive manufacturer or their designated representative. Start-up personnel shall supply Owner wiring diagram showing connections of all auxiliary inputs, outputs, and optional cards (communications, i/o) specific to that installation. Start-up personnel shall also supply Owner with a printout and software copy of attributes programmed into drive.
8. A list of values (other than default) programmed into a VSD shall be supplied to the Owner.
9. Use output chokes (load reactors) on VSD where distance between VSD and motor is greater than 50 feet.
10. VSD shall have removable LCD programming module/display that also stores drive attributes.

26 50 00 – Lighting

1. Switching of lighting, and lighting controls, shall be designed with flexibility of operation, maintenance, and energy conservation as primary goals. Lights on life safety circuits shall be on 24/7 (no Bodine style relays may be used).
2. Exit Signs
 - a. No batteries in exit lights or emergency lights (except for emergency light by emergency genset).
 - b. Approved exit signs shall be LED Exitronic 450, AC Only, Red Letters, Brushed Aluminum face and trim.
3. Decorative exterior wall sconces to be: Shaper, 695-WP Series w/LED; half pyramid with direct illumination (consult with Owner).
4. Install occupancy sensors in corridors for corridor lighting control along with wall switches.
5. Install timer switches on light switches for all closets, mechanical, and electrical rooms.
6. For larger mechanical, electrical, or boiler rooms, provide at least one night light (on 24/7) on emergency power circuit near door.
7. Do not use fluorescent lighting fixtures requiring U-tubes, T-12 lamps, or T-5 lamps.
8. Disposal of waste lamps and ballasts
 - a. Lamps removed from existing fixtures are to be placed in boxes (30 lamps max size) supplied by Owner. Apply tape to the bottom of the boxes to protect from opening. Boxes must be labeled with "Universal Waste - Lamps" (labels supplied by Owner) and dated by writing on the preprinted label. Indicate lamp type: fluorescent, HID, LED tubes, etc. Pack different lamp types in separate boxes. When a box of waste lamps is full, close the flaps and seal with tape. Labeled and sealed boxes of used/waste lamps shall be delivered to Facilities Management Services (Building 99); coordinate arrangements with the Project Manager.
 - b. Old ballasts with cloth covered wires or old ballasts that do not have "No PCBs" on the label are to be boxed only with like kind and returned to Owner at Building 99 (call Project Manager to make arrangements). Boxes are to be labeled with RIT Project Number, RIT building number, and Contractor Name. Magnetic ballasts marked with "No PCBs" on the label are to be boxed only with like kind (no PCBs) and returned to Owner at Building 99 (Facilities Management Services). Call Project Manager to make arrangements. Ballasts labeled "Electronic" are to be boxed only with like kind (Electronic) and returned to Owner at Building 99 (Facilities Management Services). Call Project Manager to make arrangements. Boxes are to be labeled with RIT Project Number, RIT building number, and Contractor Name. Boxes are supplied by contractor and shall hold no more than 12 ballasts.

9. New fluorescent light ballasts shall be Programmed Start (Rapid Start) type.
10. Lighting fixtures of any length other than four feet must be approved by Director of Building Operation and Maintenance.
11. Coordinate light fixture locations with fixed furniture to allow access for lamp replacement.
12. Do not mount light fixtures in high areas where lamp replacement requires more than an 8 foot step ladder. Any fixtures that must be higher require Owner approval.
13. Classroom lighting to include:
 - a. Locate 3-way light switches for all lighting circuits near teaching station and room entry. If dimmers are used, place dimmer(s) at teaching station only.
 - b. First row of fixtures nearest white board shall have all three lamps on dimmer. Balance of fixtures to be inboard/outboard switched, no dimming.
 - c. Use appropriate window covering for redirection of ambient light when needed.
 - d. Occupancy sensor with extra set of contacts for BAS system.
14. Classroom Podium information
 - a. No lighting or up/down screen control in podium (check with owner); must use wall switches
 - b. Location and installation by ETC (after telecom and AV integrator completed).
 - c. Provide 3 conduits from podium to projector (through floor (except slab on grade), up wall, above ceiling):
 - i. One 1 inch conduit for power to feed a 20 amp duplex outlet, same leg as projector, on floor under podium.
 - ii. One 2 inch conduit for Telecom** – 2 live Ethernet, 1 classroom voice line, and 1 CATV line at standard signal level (terminated in standard telecom box with jack and labels).
 - iii. One 2 inch for AV cables to/from projector and wall speakers – will be terminated in RIT standard patch plate/panel box on floor by AV integrator.
 - iv. Projector coordinates with telecom – must be wired terminated, labeled, and activated before podium installation.
15. Occupancy/Vacancy sensors shall be Wattstopper digital LM series. Use of any other occupancy sensor requires Owner approval.
16. Vacancy sensors shall be used in offices, conference rooms, and other non-public areas where an occupancy sensor has been traditionally used (except hallways, see above).
17. Install switchpacks or lighting control modules for Vacancy or Occupancy sensors on wall in accessible ceiling location above associated wall switch (not on the deck or more than 10 feet AFF).
18. Provide an HVAC set of contacts on each Vacancy and Occupancy Sensor (OS). Temperature Controls Contractor to tie-in (provide wiring and programming) HVAC OS contacts with VAV for the area served.
19. MC cable may only be used in accessible areas on whips for light fixtures and may not exceed 6 feet in length.
20. Tie-off points shall be provided for compliance with OSHA Fall Protection for servicing any rooftop mounted lighting or other electrical or mechanical equipment.
21. Occupancy and Vacancy sensors shall be set for 10 minutes.
22. Place an adhesive Green Dot on the ceiling grid at each light fixture that is connected to genset power. For fixtures not grid mounted, place dot on fixture as per Owner direction.
23. Avoid the use of dimming systems. Dimming systems require approval from the Director of Building Operation and Maintenance.
24. Use of Bodine relay (or equal) requires Director of Building Operation and Maintenance approval, and must only be installed in the fixture it serves (label fixture).
25. Use twist-lock connectors on each fixture in large assembly areas (gym, etc.) or high bay applications.
26. All fluorescent or LED lamps installed shall be 4100K.
27. Do not use any ballasts manufactured by Triad.
28. Do not use LED can fixtures; use can fixtures that accept an Edison base A-19 LED lamp.
29. For fixtures using 4 foot LED retrofit lamps, mark power tombstone using a black Sharpie pen with the voltage being supplied.
30. Do not use low voltage (12 volt) track lighting systems or MR-16 lamps.
31. Track lighting to be 120 volt by Halo. No multi-circuit tracks.
32. Do not use integrated LED fixtures other than 2x2 or 2x4 fixtures. Contact RIT Director of Utilities with questions.
33. Coordinate furniture and light fixture location to provide for lamp changes in light fixtures.
34. Retrofit LED lamps to be line voltage direct wire type, where applicable.

26 55 00 – Special Purpose Lighting

1. Indoor Blue light phone light fixture shall be RAB Lighting VX1F26-3/4, VX100D6, or VBR200DG/F26277.

END OF DIVISION 26

DIVISION 27 – COMMUNICATIONS

27 01 00 – Operation and Maintenance of Communications Systems

1. Contacts
 - a. James Shanks
 ITS Network Communications Team
 585-475-5560
 - b. Angel Male
 ITS Network Communications Team
 585-475-5844

27 05 00 – Common Work Results for Communications

1. Introduction
 - a. This document's objective is to provide Architects and other designers with a design requirements and guidelines document that will help plan the telecommunications facilities for the RIT campus including the information necessary to design and specify a Structured Cabling System for projects supporting a wide range of communication systems. These guidelines concentrate on new building environments and existing buildings under construction for renovations. The document also defines minimum requirements but allows for customization to enhance future opportunities to meet future requirements in the categories of voice, data, audiovisual, and security systems. It is a design guide and is not a project specifications document.
 - b. See Appendix 3 for qualified bidders list.
2. Common Requirements for Communications Installation / Regulations and Code Compliance
 - a. All work shall be performed neatly and professionally.
 - b. Comply with current Rochester Institute of Technology Design and Construction Guidelines
 - c. All work included under this heading is subject to the bidding requirements.
 - d. All materials and equipment provided under this contract shall be new except where otherwise noted.
 - e. Comply with NECA, NFPA, and OSHA requirements.
 - f. The Contractor shall comply with the NEC and all other federal, state, local and laws, codes, and ordinances.
 - g. The Contractor shall be responsible for the placement of outside plant cables within RIT-provided pathways without splices.
 - h. For all work in manholes and cable vaults, the Contractor shall be responsible for ensuring that safe operating procedures are followed; work equipment is adequate and personnel have received proper training. Safety equipment shall be inspected and approved by an authorized representative of the Owner.
 - i. The Contractor shall provide the Owner with applicable warranty certification at the time of bid proposal response.
 - j. The Contractor shall be responsible for measuring required cable distances and shall not exceed appropriate cable length standards.
 - k. Product/Materials substitutions require written Owner approval at the time of Proposal response.
 - l. The Contractor shall provide the Owner with a copy of his asbestos insurance before work begins.
 - m. The Contractor shall provide the Owner with a copy of his Confined Spaces Permit.
 - n. The Contractor shall be courteous to all personnel on the project, including students and other contractors.
 - o. Documentation shall be required for all categories and will be specified in the Specific Execution sections of the bid document. Generally, documentation shall be required for all backbone pathway usage, cable pair counts, and building entrance details. Documentation shall be required for horizontal wiring jack numbers, redlined blueprints indicating final locations, and jack numbers. Test results as specified under the testing subsection in this document and shall be required for all categories.
 - p. Subcontractors shall not be accepted without Owner approval. The proposed use of subcontractors shall be indicated as part of the Proposal.
 - q. During construction, the contractor will maintain utilities without any interruption. Should it be necessary to interrupt a utility service the contractor should seek permission for University Staff at least 3 business days in advance and be approved by the RIT project manager.
 - r. All equipment of the same type and capacity shall be by the same manufacturer.
 - s. The locations of switches, receptacles, lights, motors, etc. outlets shown are approximate. The contractor shall use good judgment in placing the preceding items to eliminate all interference with ducts, piping, etc.

The contractor shall check all door swings so that light switches are not located behind doors. Relocate switches as required, with approval from the RIT designated design professional. The University Project Manager may direct relocation of outlets before installation, up to five (5) feet from the position indicated on the original project drawings, without additional cost

- t. The Contractor must read the entire specifications of all divisions because he/she will be responsible for all work described.
 - u. Remove and dispose of dirt and debris, and keep premises clean. During the progress of work, remove equipment and unused material. Put communication spaces in neat and clean condition, and do cleaning and washing required to provide acceptable appearance and operation of equipment, to the satisfaction of the cable plant owner or device owner.
 - v. The contractor is responsible for the cleanup of debris daily. Cost of cleanup is the responsibility of the Contractor
3. Products / Cable Plant Overview
- a. Backbone Copper Cabling Products
 - i. RUS/REA specification PE-89 building entrance cable and/or have the Bell standard designation AFMW
 - ii. Circa Tel Building Entrance Terminals
 - 1. Circa Tel 1900A1-100
 - 2. Circa Tel 1880ECT1/NSC-XXX
 - 3. Circa Tel 4B1E gas tube protector module
 - 4. Circa Tel 4B1FS-240 solid-state protector modules
 - 5. Bell standard designation ARMM type riser cable fire-rated or approved equivalent
 - b. Backbone/Riser Fiber Optic Cable
 - i. Fiber Cable
 - 1. BerkTek PDP Premise Distribution Fiber Plenum Rated
 - 2. Corning Cable Systems MIC OFNP or OFNR
 - 3. Approved alternate for backbone applications
 - ii. Panduit or Corning Cable Systems LC and SC connectors
 - iii. Fiber Optic LIU Enclosures
 - 1. Panduit Opticom Rack Mount Enclosures: FRME4
 - 2. Corning Cable Systems Closet Connector Housings
 - 3. Corning Cable Systems Edge Housings
 - iv. Horizontal Wiring
 - 1. CAT 6A UTP copper for data applications, plenum rated, the color yellow
 - a. Belden 10GXS13, BerkTek LM-RDT Cat 6A, CommScope Systimax GigaSPEED X10D or General 10 MTP
 - 2. CAT 6A Outside Plant Cables
 - a. Berk-Tek LANmarkTM-10G Cat 6A OSP
 - 3. Panduit wired outlet assemblies
 - a. Jack: # CJ5E88TGIW or CJ688TGIW (white)for voice applications
 - b. Jack # CJ6X88TGYL (yellow) for Cat 6A wired applications
 - c. CATV F-connectors # CMFAIW
 - d. Blank module: #CMBIW-X
 - e. Faceplates: Panduit Classic Series
 - i. Duplex 2 port CFPE2IW
 - ii. Quad 4 port CFPE4IW
 - iii. Six-Port CFPE6IW
 - iv. 2 Port surface box CBX2IW-AY
 - v. 4 Port surface box CBX4IW-AY
 - 4. Panduit Angled patch panels for voice and data: CPPA48FMWBL(WH)
 - 5. Panduit PatchRunner High Capacity Vertical Management: PR2VD10(WH)
 - 6. Panduit Horizontal Management: NMF2(WH)
 - 7. American Time AP cage 14" X 14" X 13"D: G2006-J08 (Anixter)
 - 8. 19" x 7' equipment rack:
 - a. Panduit R2P(WH)
 - b. Equivalent with approval from Owner (RIT ITS Division)
 - c. Panduit hinged wall mount bracket: WBH3
 - v. Miscellaneous

1. The duct sealant system shall be designed to seal the area between the cable and conduit to ensure a watertight seal. The duct sealant system shall be Raychem Telecommunications or Electrical duct sealing system Series TDUX or RDSS.
 2. The pull rope for empty conduits or inner ducts shall be polyester woven Dandy-line by Arnco or equal.
 3. Empty conduit and inner duct plugs shall be nonmetallic, provide watertight seals, and have provisions to tie off a pull rope in the conduit. The acceptable manufacturer shall be Carlon, MAEPG series.
 4. Interduct types shall be Flexible Engineered Fabric Interduct by MaxCell.
4. Warranty
- a. The Contractor warrants that all services performed under this agreement shall be performed thoroughly and professionally in conformance with the standards of the industry. The Contractor shall correct, at his expense, all defects or deficiencies in the work, which result from the material furnished by the Contractor, workmanship, or failure to follow the plans, drawings, or other specifications made part of this contract. Those defects or deficiencies discovered within five (5) years from the date of acceptance (acceptance of the work by the Owner shall not constitute a waiver of such defects or deficiencies) may be remedied by the Owner and the Contractor shall pay the Owner the cost of making such corrections.
 - b. All fiber optic materials and work shall be covered under the applicable manufacturer's warranty. A certificate of project registration shall be on file at the start of work.
 - c. All horizontal copper wiring materials and work shall be covered under the Panduit Network Systems Certification Plus System Warranty Program (<https://www.panduit.com/en/legal-information/Certification-Plus-System-Warranty.html>). A certificate of Project Registration shall be on file at the start of work.
 - d. The Owner will work with the successful bidder to obtain necessary warranty participation from the manufacturers.
 - e. All copper backbone materials and work shall be under warranty for five (5) full years from the date of final acceptance.
 - f. All copper horizontal wire materials and work shall be under warranty for five (5) full years from the date of final acceptance.
 - g. All other materials and work shall be under warranty for five (5) full years from the date of final acceptance.
5. Restrictions
- a. Access to communication spaces should be directly from hallways or service corridors not through classrooms, offices, or other dedicated spaces.
 - b. The communication space must not be located in any place that may be subject to water, steam, humidity, heat, or any other corrosive atmospheric or environmental substance.
 - c. The communication space must not share space in boiler rooms, washrooms, janitorial closets, storage rooms, or any such space.
 - d. Equipment and piping not related directly to the support of the telecommunications function shall not be installed in, pass through, pass overhead, or enter the telecommunications space. Pipes for sprinkler heads located within the room shall not be located directly above electronic equipment racks and/or cabinets.
 - e. Communications space should not be used as a passageway to other equipment rooms, power transformers, custodial equipment, or any other function that would require access for reasons other than service and maintenance of the communications equipment and cabling they house.
6. Design Requirements
- a. Telecommunications Spaces shall be:
 - i. Located above water level and not in a place subject to any corrosive atmospheric or environmental conditions
 - ii. Avoid locations that limit expansion such as structural steel, stairwells, elevator shafts, outside walls, or other fixed building walls.
 - iii. Unlisted building entrance cables shall not be longer than 50-feet once they exit the incoming conduit.
 - iv. The locations and size of the building entrance shall be appropriate for the application and placed no farther than 50 feet from the primary communications space for copper cabling.
 - v. Have easy access to distribution cable pathways
 - vi. Must be a rectangular room with no obstructions or protrusions (beams, columns, etc.) that decrease the usable square footage available in the room.
 - vii. The Owner shall have clear access to the building entrance at all times.

b. Communications Room Guidelines

- i. Enclosing Walls
 1. Walls shall extend to the structural ceiling above.
 2. All codes listed in Quality Assurance shall apply; space shall be fire-stopped compliant with all codes.
 3. A twelve-inch wide ladder rack should be mounted on the same wall(s) as the plywood backboards.
 4. The walls shall be finished and painted drywall or sealed concrete.
 5. The back wall of the Communications Room, behind the equipment racks, shall be dedicated to low voltage equipment.
- ii. Ceiling
 1. A suspended, false, lay-in or hard lid ceiling shall not be installed over any communications space.
 2. The minimum ceiling height shall be 10 feet.
- iii. Floor
 1. Do not design raised floor systems.
 2. The floor should be floor slab, no raised or false floor.
 3. The floor finish should be smooth, dust-free, and not susceptible to static electricity build-up. Acceptable finishes are low static composition tile, static dissipating tile (SDT), or sealed concrete to avoid dust.
 4. Minimum load rating of 50 lb / sq. ft.
 5. Minimum distributed load rating of 100 lb / sq. ft. and a minimum concentrated load rating of at least 2000 lb / sq. ft.
- iv. Door
 1. A minimum of a 36" x 80" door opening shall be provided, the door shall open outward and be keyed to a key specified by the Owner.
 2. The door shall be fire-rated as dictated by local code requirements.
- v. Windows
 1. Communication spaces shall not have windows.
- vi. Water Infiltration
 1. Measures must be taken to prevent water intrusion
 2. Avoid water, sewer, chemical, or drain piping through communication space
- vii. Sprinkler System
 1. Comply with RIT Division 21 guidelines
 2. Sprinkler piping should not be installed directly above equipment racks
- viii. Wall Plywood Sheeting
 1. Plywood backboard shall be painted with two coats of nonconductive, fire retardant paint of a light color.
 2. A minimum of two walls shall be covered with ¾" fire-rated plywood (8' x 4') vertically oriented located to ensure maximum usable space for mounting hardware.
- ix. Pathways
 1. Pathways entering the space shall enter above or near the plywood backboard.
 2. Pathways entering through the floor shall not protrude more than 2" above finished floor height.
 3. Conduits shall be installed in a clean, neat, and organized fashion.
 4. All open space in the pathway system and empty pathways shall be plugged with a rubber conduit plug, water plug, or duct sealer (appropriate for application).
 5. A ¾" metallic conduit for primary building ground wires, from the entrance location to the primary building ground location, shall be provided.
- x. Lighting
 1. A minimum of (fifty) 50foot candles of light shall be provided; avoid fluorescent lighting.
 2. Lighted areas should include the front and back of all equipment racks in the communications space.
 3. Lighting shall not receive power from the same electrical distribution panel breaker as the telecommunications equipment.
- xi. Electrical
 1. One (1) dedicated 15 amp, 110-volt, ac duplex electrical outlets on separate circuits shall be provided and located on each data rack.

2. One (1) dedicated 30 amp, 208-volt, ac electrical outlet on a separate Emergency circuit shall be provided and located on each data rack. A single quad box per data rack is acceptable.
 3. One (1) dedicated 30 amp, 208-volt, ac electrical outlet on separate shall be provided on the separate non-emergency circuit and located on each data rack. A single quad box per data rack is acceptable.
 4. A minimum of one (1) 15 amp, 110-volt wall-mounted convenience outlet shall be provided on each wall in each space.
 5. Sub-panels shall be provided for dedicated electrical service for all communication spaces. The estimated electrical load for the telecommunications space shall not exceed 80% of the panel capacity. No power outlets outside the communication space shall be serviced by this panel.
- xii. Cooling and Ventilation
1. Proper cooling and ventilation shall be provided 24 hours a day, 365 days a year
 2. HVAC may be tied into the building system.
 3. Must comply with RIT design and construction guidelines division 23.
 4. Temperature shall be maintained in the range of 68 deg F to 78 deg F
 5. Humidity shall be non-condensing.
 6. HVAC should provide for a minimum of 1 air change per hour
- c. Communication Space Sizing Guidelines
- i. The communication space shall provide enough space for all planned termination, electronic equipment, and cables installed.
 - ii. The space should be sized with enough length so that a single row of racks is sufficient to house all equipment and cabling.
 - iii. During schematic design, a minimum of 100 square feet of space per floor up to 10,000 square feet shall be provided. A minimum of 70 square feet of space shall be provided for every additional 5000 square feet of space. Final communication space size shall be determined during the design development phase and verified after the communications requirements are known using ITS-approved rack capacities and clearances.
 - iv. Allow a minimum of 36 inches (36") of clear working space in front and 42 inches (42") at the rear of equipment racks measured from the front and rear wire managers.
 - v. Allow for an 8-inch depth off the wall for wall-mounted equipment.
 - vi. If multiple equipment rack rows are required, provide a minimum 36-inch aisle between each row of racks measured from the face of the equipment installed in the racks. In multiple rows, the fronts of each rack shall face each other.
 - vii. A minimum aisle clearance of 36-inches is required at one end of an equipment rack row.
 - viii. Communications spaces shall be located in the central area of a building, vertically aligned if possible, dedicated to telecommunications functions, secured, and provisioned for every 10,000 square feet of the area; ensuring that no wired outlet run exceeds on average 50 meters with a maximum of 100 meters.
- d. Equipment racks, Patch Panels, Fiber Panels, Cable Management design considerations
- i. A 7' tall, 10" wide, double-sided vertical cable manager shall be placed between racks and at the ends of each rack row. Wider vertical wire managers can be utilized if required to accommodate more incoming cabling or patch cord containment and management.
 - ii. 2RU, 48-port angled patch panels shall be used for horizontal cabling.
 - iii. A 2RU horizontal cable manager shall be placed at the top of each rack and another placed lower leaving a 12RU space between them.
 - iv. There will be a minimum of two 2 post 45U racks in each communication room supporting horizontal cabling. The 1st rack shall be used for backbone/riser fiber optic cable and copper cross-over cables that extend between the patch panel in the rack and the wall-mounted 110 blocks. The 2nd rack shall be used for horizontal cabling and switch mounting only. Additional horizontal cabling racks may be required depending on the cable density required.
 - v. The backbone rack left edge with cable management shall be mounted close to the plywood wall that still allows the door on the wire manager to open fully. The rack shall be placed so that when loaded, there will be a 36" clearance between the wall and rack system. From the wall to the rack face, the dimension should be a minimum of 42". To maintain a 36" clearance on the backside of the rack, the distance between the rear wall and the front of the rack shall be a minimum of 60". This makes the minimum depth of the communications room is 102" to maintain a 3' clearance

- around the rack. The horizontal cable rack shall be placed in line with the backbone racks so that the same clearances are maintained. The horizontal cable racks shall contain no more than 288 horizontal cables.
- vi. The minimum width of a communications room shall be determined as follows. A communications room shall have a minimum of 2 racks with a minimum 36" clearance required on all 3 sides. To enable future growth, for every installed horizontal cable rack, space for an additional future rack shall be required. Therefore the minimum width of a single row 2 rack communications room shall be 133". For every additional rack installed shall require 58" of additional width.
 - vii. Racks shall be securely attached to the concrete floor using a minimum of 3/8" hardware or as required by local codes.
 - viii. All racks shall be grounded to the telecommunications ground busbar.
 - ix. Rackmount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
 - x. Wall-mounted termination block fields shall be mounted on 4' x 8' x .75" void-free plywood. The plywood shall be mounted vertically, 12" above the finished floor. The plywood shall be painted with two coats of white, fire-retardant paint.

27 05 26 - Grounding and Bonding for Communication Systems

1. General

- a. Comply with current Rochester Institute of Technology Design and Construction Guidelines Division 26.
- b. The Telecommunications Bonding Backbone (TBB) shall be designed and/or approved by a qualified PE, licensed in New York State or the state where the work is to be performed. The TBB shall adhere to the recommendations of the TIA/EIA-607 C standard, and shall be installed following best industry practice.
- c. The telecommunications entrance facility's main grounding busbar shall be connected back to earth ground in the electrical entrance facility and building steel as required.
- d. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.
- e. The TBB Grounding Conductors shall be bare or insulated copper, minimum conductor size #6 AWG and sized at 2kcmil per linear foot up to a maximum size of 750kcmil and where uninsulated should be identified with green tape at termination location.
- f. Bonding conductors should be continuous and routed in the shortest possible straight-line path, avoiding changes in elevation and sharp bends.
- g. Primary Bonding Busbar(PBB) shall be located in the entrance facility, near the electrical panel to which it will be bonded but installed to maintain clearances required by applicable electrical codes.
- h. The grounding busbar should be a 4-inch or larger bus bar as defined by NEC (National Electrical Code).
- i. The Busbar must be mounted on plywood and placed to not interfere with communication equipment or pathways.
- j. All metallic conduits, racks, cabinets, patch panels, and any other associated device must be bonded to the ground busbar.
- k. Each busbar shall be labeled with the following information.
 - i. Busbar name
 - ii. Source of Ground
 - iii. Room being serviced
 - iv. Standard Warning
- l. When a rack or cabinet supports active equipment or any type of shielded cable or cable termination device requiring a ground connection, add a rack-mount horizontal or vertical busbar or ground bar to the rack or cabinet. The rackmount busbar or ground bar provides multiple bonding points on the rack for rack and rack-mount equipment.
- m. The Contractor shall bond metallic cable trays to vertical metallic conduit and the primary building ground.

27 05 28 - Pathway for Communication Systems

1. General

- a. Quality Assurance
 - i. Strictly adhere to all Building Industry Consulting Service International (BICSI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.

- ii. All cable and equipment shall be installed in a neat and workmanlike manner.
2. Products
- a. Telecom Outlets
 - i. Where ceilings are accessible, the raceway and entrance-end fitting shall extend above the ceiling and the conduits installed above the ceiling in the room to the nearest hallway distribution system.
 - ii. Where ceilings are partially accessible, or if the drawings and/or specifications indicate installation of access panels, the raceway shall extend above the ceiling and the conduits installed above the ceiling in the room to the nearest hallway distribution system.
 - iii. Where ceilings are inaccessible or no ceilings exist, the raceway shall extend up as close to the ceiling as practical to allow installation of conduits as high as possible to the nearest hallway distribution system.
 - iv. Non-continuous pathways shall keep hallway crossover to a minimum. Pathways shall be routed to follow logical paths parallel and perpendicular to the building structure. Diagonal pathways are unacceptable.
 - b. Horizontal Distribution System
 - i. Corridor Cable Tray System
 - 1. All conduits shall be installed stacked and attached to walls unless conditions exist which prohibit this type of installation.
 - 2. Install entire cable tray system following manufacturer's minimum installation practices and all local governing codes.
 - 3. Coordinate installation of cable tray with other trades to allow a minimum of 12" above, 12" in front, and 12" below of clearance from piping, conduits, ductwork, etc. Allowance must be provided for access to the tray with reasonable room to work. Obstructions to the tray must be minimized and cannot block more than 6 feet of the tray at any point in the run.
 - 4. The cable tray shall not be loaded beyond 60% of the manufacturer's recommended load capacity.
 - 5. Where a new cable tray distribution system encounters a wall, install sufficient 4" EMT sleeves through the wall so cabling does not exceed 20% fill.
 - 6. Install cable tray dropouts where large quantities of cables exit the distribution system.
 - 7. Route cable tray a minimum of 5" clearance from fluorescent light fixtures, 12" clearance from electrically operated equipment, and all wiring at 120 or more volts and 4 ft. from transformers or large motors.
 - 8. Install cable tray a minimum of 3-inches above accessible ceiling T-bars. If possible, install 6- inches above accessible ceiling T-bars.
 - 9. Install cable tray with 12-inches of open space above and to one side of the tray to allow access for installing and maintaining cable.
 - 10. Install cable tray level and straight unless noted on the construction drawings.
 - 11. All cable trays shall be a minimum of 12 inches wide.
 - 12. Power poles must be 1' in diameter, separate from the electric, stubbed at the ceiling, and provisioned for mounting communications wired-outlet assemblies.
 - 13. All interior, horizontal pathways shall be fire-stopped-compliant with all applicable codes.
 - ii. All open pathways/trays shall be installed a minimum of six (6) inches away from any light fixture or other source of EMI (Electromagnetic Interference).
 - iii. All communications horizontal pathways shall be rigid, metallic, and/or PVC compliant with applicable codes; flex pathway is not compliant with code.
 - iv. All communications pathways shall be adequately supported, sized for the application, provisioned for future growth, and in compliance with return air plenum codes.
 - c. Vertical Wired Outlet
 - i. Shall be a minimum of 1' rigid galvanized conduit, installed from the wired outlet box, stubbed above ceiling tiles, finished smooth at both ends with bushings, and visible at the ceiling and outlet-box location.
 - ii. Shall be installed with a pull wire that is accessible and visible at the ceiling and outlet box location.
 - iii. Vertical wired outlet pathways shall be provisioned with a minimum 4" x 4" outlet box; 2.5" deep, with cutouts at the back and a mud-ring to accommodate single duplex outlets.
 - d. All pathways shall be grounded per NEC Article 250.

- e. Station Conduits
 - i. Provide measured pull line in 12" increments in each empty conduit to the hallway distribution system.
 - ii. The use of 90-degree electrical pulling elbows is prohibited.
 - iii. Do not include more than two 90-degree bends between pulling points when installing station conduit runs. If the path of the station conduits requires more than 180 degrees of total bends, installation of an appropriate sized junction box is required.
 - iv. Place an appropriate sized junction box in each station conduit run that exceeds 100 feet in length.
 - v. 1" conduit runs to station outlet locations will contain no more than 3 horizontal station cables regardless of category specification.
 - vi. 1.25" conduit runs to station outlet locations will contain 4-8 horizontal station cables regardless of category specification.
 - vii. There will be one 4" penetration for every 83 station cables passing through a wall, ceiling, or floor.
 - viii. Backbone and horizontal station cabling will not share penetrations or installed conduit paths.
 - ix. Wired outlet pathways shall comply with EIA/TIA standards and use no floor cores.
- f. Service Entrance Conduits
 - i. On exterior wall penetrations, seal both sides of the wall around the outside of the conduit with hydraulic cement to prevent water from entering the building. Seal the inside of the conduit on both sides with conduit plugs, water plugs, or duct sealers to prevent water, vapors, or gasses from entering the building.
- g. Exterior Communications Pathway
 - i. All exterior communications pathways shall be rigid metallic and/or PVC (not flex), adequately supported, reamed at each end, clean, dry, and free of debris.
 - ii. All exterior communications pathways shall be placed at a minimum depth of 36".
 - iii. All exterior communications pathways shall be sized appropriately for the application, with provisions for future growth. Each must be installed with a non-corrosive pulling wire, with a minimum pulling strength of 200 pounds, which is left in all pathway runs.
 - iv. All exterior communications pathways shall have a tracer wire installed end to end and can be reached with entry to the space.
 - v. All exterior communications pathways shall have a maximum of two (2) 90-degree bends between pulling points.
 - vi. All exterior communications pathways shall protrude no more than 2" into the floor of the building entrance or other communications spaces.
 - vii. All exterior communications pathways shall be bonded/grounded compliant with all codes listed in the Quality Assurance section.
- h. All conduits shall be installed stacked and attached to walls unless conditions exist which prohibit this type of installation.
- i. All pathways shall be grounded per NEC Article 250.
- j. Install cable tray level and straight unless noted on the construction drawings
- k. Indelibly mark station conduit at hallway distribution end with Room # that conduit serves.
- l. The use of 90-degree electrical pulling elbows is prohibited.
- m. Pathways will be accessible for future moves, adds, and changes.
- n. Pathways will be planned assuming a horizontal station cable will have an approximate diameter of .30 inches and no more than a 67% fill ratio.
- o. Cable hooks (J-hooks) are a suitable alternative to cable trays ONLY when the planned capacity of the pathway system is fifty (50) cables or fewer and J-hook fill capacity shall not exceed 70%.
- p. All hangers and support material shall be galvanized or stainless steel, rust-free material.

27 10 00 - Structured Cabling

1. General

- a. To ensure that the installed structure cabling solution meets or exceeds the required performance it must be tested and certified.
- b. System Testing and Documentation
 - i. The calibration and software on all test equipment shall be current.
 - ii. Copper Cabling System Testing
 - 1. Copper cabling shall be tested and certified after the installation as follows and as

- required for the cable manufacturer's warranty.
 - 2. All existing structured cabling that will be moved or terminated at either the closet or station end, shall be tested using the appropriate cabling category specification.
 - 3. Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity, and pair-reversals crossed pairs and split pairs. Any faults in wiring shall be corrected and cable re-tested before final acceptance.
 - 4. Each installed cable link shall be tested for installed length using a TDR-type device.
 - 5. The cable length shall conform to maximum distances outlined in ANSI/TIA-568-C standards and all other applicable standards
 - 6. Test reports for all factory testing and field test reports for copper cabling installation shall be submitted to the Owner's Representative and manufacturer before commissioning the voice and data system and final contract payment
 - iii. Optic Fiber Cable Testing
 - 1. Optical fiber cabling shall be tested and certified after the installation as described below and as required for the cable manufacturer's warranty.
 - c. Labeling of Copper and Fiber Optic Horizontal Cables
 - i. Labeling of all wires and terminations shall be in a manner specified by the Owner at the start of work.
 - ii. Wired outlet assemblies shall be labeled as follows:
 - 1. BB-CC-RRRR-J
 - a. BB 2 or 3 digit building number
 - b. CC 2 character BDF/IDF number
 - c. RRRR 4 character room number
 - d. J 1-3 digit jack number
2. Products
- a. Fiber Connectors
 - i. The connector shall be a duplex-type LC connector on a single-mode fiber optic pigtail.
 - ii. The average insertion loss shall be 0.2dB with a maximum of 0.75dB for a mated pair.
 - b. Fiber Connector Panels
 - i. The cabinets shall be capable of being mounted in a standard 19" rack utilizing four units of standard height
 - ii. Connectors shall be shuttered duplex 'LC' unless otherwise noted on Drawings.
 - c. Fiber Cabinets
 - i. The cabinets shall be capable of being mounted in a standard 19" rack utilizing one, two, three, or four units of standard height (1.75 inch EIA hole spacing).
 - ii. The cabinets shall utilize a modular connector plate to allow for versatile connector configuration, with panels for LC connectors
 - iii. The unit shall utilize a slide-out drawer assembly.
 - d. Fiber Cabling
 - i. Fiber optic cables shall be free of material and manufacturing defects and free of dimensional non-uniformities that would seriously impair the functionality of the cables. The fiber optic cables shall also be free from surface imperfections and internal defects that would prevent them from meeting the mechanical and transmission requirements of this Specification.
 - ii. Cables shall be provided in continuous lengths, without splices, from termination to termination.
 - iii. The cable shall be carefully inspected for sheath defects or other irregularities, as it is pulled out from the reel. If defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the discretion of the Owner. A system of communications, visual or otherwise, shall be maintained between pulling and feed locations so that pulling can be stopped instantly, if necessary.
 - e. Cat6A Unshielded Twisted Pair
 - i. RIT ITS requires Category 6a UTP, 4 pair horizontal distribution cables shall extend between the device location and designated network access closet. It shall consist of 4 pairs, 23 gauge, UTP and shall terminate all conductors onto an 8 pin modular jack provided at each outlet.
 - f. Equipment Racks
 - i. Each communication space shall be equipped with a 19" Aluminum Rack System to the house.
 - ii. Should be manufactured from extruded aluminum. Finish shall be flat black, post dimensions to be 84" tall x 20" wide x 3" deep with anchor plates at the top and bottom.
 - iii. The rack should be a free-standing data rack.

- iv. The floor should be anchored with a minimum of four (4) floor anchors, anchor top of the rack to either ladder racking/cable tray above rack or backboard using angle iron or uni-strut.
- g. Category 6a Patch Panels
 - i. Patch panels shall be constructed of high-strength steel with satin chrome finish and designed for wall or 19-inch rack mounting.
 - ii. Panels shall be available in 24-port and 48-port configurations, with a height of 1 Rack Unit (RU) of 44.5 millimeters (1.75 inches) for each group of 24 ports.

27 13 13 - Communication Copper Backbone Cabling

1. General

- a. All cable and equipment shall be installed in a neat and workmanlike manner.
- b. Strictly adhere to all Building Industry Consulting Service International (BICSI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- c. The cable shall meet the requirement of ANSI/TIA-568 series Standards for Category 3 performance.
- d. Voice backbone cables shall have a minimum 10-foot service loop when terminated in the communication space, and at any splice points in telecommunications manholes.
- e. All Outside Plant Backbone shall terminate on primary protection (per the NEC) upon entering the building.
- f. Adequate care shall be exercised when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed. Before placing cable, the Contractor shall verify the structural integrity and clear passage (water, silt) of each conduit by passing a squeeze and slug, test mandrel, or owner-approved projectile through each length, where applicable. All obstructed ducts shall be reported to the Owner immediately.
- g. Immediately after cable placement, temporary tags with the cable number and pair count shall be attached to each end of each cable section.
- h. The Owner shall determine conduit assignments as determined before work starts. As a rule, cables having high-pair counts shall be placed in the lowermost corner of the duct bank.
- i. The Contractor shall not splice any outside cables without the approval of the Owner.
- j. Backbone Cable Testing
 - i. Complete end-to-end test results for all copper UTP cables installed are required.
 - ii. The owner is to be notified at least 24 hours before testing.
 - iii. All pairs in backbone copper cables shall be tested for continuity and wire-map.
 - iv. All test results shall be submitted to the Owner.
- k. Cable Support
 - i. Provide cable supports and clamps to attach cables to backboards and walls.
 - ii. Attach horizontal and vertical backbone cables at 2-foot intervals using Owner approved supports.
 - iii. Attach cables to manhole racks using Owner approved methods.
 - iv. Backbone cabling shall be secured to the cable/ladder tray following manufacturer-recommended procedures, and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ)
 - v. Metallic supports and fasteners shall be hot-dipped galvanized steel in manholes and vaults having metallic cable racks and shall be non-metallic material in manholes and cable vaults having non-metallic cable racks. All cables and equipment installed in exterior locations shall be secured so that they cannot be dislodged or damaged by winds of up to 125 miles per hour.
 - vi. Caution shall be used when bending cables to avoid kinks or other damage to the sheath. The bend radius shall be as large as possible with a minimum of not less than 10 times the outer diameter of the cable. Minimum radii shall be increased when necessary to meet the cable manufacturer's recommendations. Bending operations in manholes and vaults shall be performed per the procedures and instructions of the manufacturer. Cable bending shoes shall be used in duct or conduit ends when bending cable exiting a duct or conduit. The bending shoes shall remain in place until racking, splicing, and tying is complete. Cables shall not rest against the edge of the duct or conduit mouth.
 - vii. Un-terminated cable ends shall be cleared, capped, and sealed. The lubricant shall be compatible with and intended for use with our specified Essex cables. Soap and grease lubricants are prohibited.

l. Splicing

- i. The Contractor shall provide all labor, materials, and equipment to splice cables at termination points within buildings. The Contractor shall provide splice enclosures, cable connectors, splice supports, tape, cleaning materials, cable ties, and other items required for complete installation. All metallic cable shields shall be bonded and connected to building grounds at all termination points.
- ii. All cable splices shall be protected from damage at sheath openings by mechanically protecting all conductors using 3M KandB Building Vault and Riser closures or equivalent, which shall be approved by the Owner.
- iii. All cables shall be thoroughly cleaned and scuffed appropriately to ensure a good mechanical bond when splicing. 3M Scotchcast Brand 4435 non-conductive aluminum oxide abrasive strip or Owner-approved equivalent shall be used. All cable shall be thoroughly cleaned with a non-toxic, environmentally safe solvent, 3M Brand 4414, 4415, or Owner-approved equivalent.
- iv. All cable splices shall be supported by a minimum of two cable hooks or brackets. Where vertical racking is not present, horizontal racking for support may be used utilizing 3M Brand RC-100 rack adapters or Owner-approved equivalent.
- v. Underground cable splicing shall use 3M 710 Series or 3M-MS2-4000 series supermini modular connectors. This modular splicing shall be used in all splice enclosures. The Contractor shall mark or tag the cable pair counts spliced on the cable splice enclosure.
- vi. Splicing of cross-connect terminals and secondary cable access stubs not in line, or straight splice or diminis/taper splice locations shall use Scotchlock - ULG splicing connectors or Owner-approved equivalent.
- vii. All metallic cable shields shall be grounded by a #6AWG minimum ground wire to a low-resistance ground, in compliance with EIA/TIA 607 current standards. The Contractor in each closet shall provide connections to new grounding buss bars. The grounding bus bar shall be connected back to the main grounding busbar in the telecommunications entrance facility, grounded to an earth ground in the electrical entrance facility, and building steel on each floor as required.

27 13 23 - Communication Optical Fiber Backbone Cabling

1. General

- a. Personnel who have had at least three (3) years' experience in placing cables in conduit, cable trays, and underground duct systems shall perform Cable installation work
- b. Cables shall be designed for Point to Point applications and shall provide a high level of protection for optical fiber installed in building applications.
- c. Higher optical fiber counts shall utilize a sub-united design with color-coded subunits for easy identification.
- d. The contractor shall comply with applicable codes, standards and with all local codes and requirements.
- e. Provide all necessary products for installation of Fiber Backbone cabling.
- f. Backbone cable shall be installed following industry standards practices.
- g. The contractor shall not exceed the maximum pulling tension or the minimum bending radius for fiber cables per the manufacturer's specifications.
- h. Backbone cables shall be installed separately from horizontal distribution cables.
- i. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cables installed in any conduit.
- j. Where cables are installed in an air-return plenum, riser-rated cable shall be installed in a metallic conduit.
- k. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- l. The fiber optic cables shall be terminated into rack-mounted fiber optic patch panels. The final fiber optic patch panel shall consist of the applicable fibers field terminated onto pre-connectorized fiber assemblies (pigtailed). Each connector shall exhibit an insertion loss of 0.5 dB or less and a return loss of .30dB or better.
- m. Caution shall be used when bending cable to avoid kinks or other damage to the sheath. The bend radius shall be as large as possible with a minimum of ten (10) inches. The minimum radius shall be increased when necessary to meet the cable manufacturer's recommendation.
- n. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- o. A maximum of 12 strands of fiber shall be spliced in each tray.
- p. All installments shall comply with:

- i. ANSI/TIA-568 Series Commercial Building Telecommunications Cabling Standard
- ii. ANSI-TIA-569 Telecommunications Pathways and Spaces
- iii. ANSI/TIA-606 Administration Standard for the Telecommunications Infrastructure
- iv. ANSI-J-STD-607 Joint Standard for Commercial Building Grounding(Earthing) and Bonding Requirements for Telecommunications
- v. BICSI Telecommunications Distribution Methods Manual
- vi. NFPA 70 National Electrical Code
- q. Backbone Cable Testing
 - i. Complete end-to-end test results for all Fiber Optic cables installed are required.
 - ii. All fiber optic cables must be visually inspected and optically tested on the reel upon delivery to the installation site.
- r. Cable Support
 - i. Provide cable supports and clamps to attach cables to backboards and walls.
 - ii. Attach horizontal and vertical backbone cables at 2-foot intervals using Owner approved supports.
 - iii. Attach cables to manhole racks using Owner approved methods
 - iv. Backbone cabling shall be secured to the cable/ladder tray following the manufacturer's recommended procedures and appropriate installation hardware and methods defined by local code.
 - v. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.
 - vi. Vertical runs of the cable shall be supported to messenger strand, cable ladder, or another method to provide proper support for the weight of the cable.
 - vii. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
 - viii. All backbone cables shall be securely fastened to the sidewall of the TR on each floor.
 - ix. Utilizing Panduit J-Mod System (j-hook) or equivalent (no bridal rings) and velcro cable ties shall be used as necessary to properly secure the cable. Exposed cable runs in communications closets shall be protected with inner-duct and secured to walls, cable trays, and racks.

2. Products

- a. Intra Building Backbone (ISP)
 - i. Indoor Cables - All cable shall be listed for use indoors per the National Electrical Code (NFPA-70) and shall meet one of the following:
 - 1. Indoor Rise Rated Tight Buffer
 - 2. Indoor Plenum Rated Tight Buffer
 - 3. Indoor Low Smoke/ Zero Halogen Riser-Rated Tight Buffer
 - 4. Indoor Armored Riser-Rated Tight Buffer
 - 5. Indoor Armored Plenum-Rated Tight Buffer
- b. Inter Building Stranded Backbone (OSP)
 - i. All cable shall be manufactured and constructed for use in the Outside Plant Environment and shall meet one of the following:
 - 1. Outside Plant (OSP) loose tube all-dielectric
 - 2. Outside Plant (OSP) loose tube metallic sheath.
 - ii. Buffer tubes and optical fibers
 - 1. Industry-standard buffer tubes are stranded around a central strength member and compatible with standard hardware, cable routing, and fan-out kits.
 - 2. Optical fibers shall be industry-standard color-coded and separated into 12-fiber color-coded binder groups surrounded by plastic core tubes
 - 3. Water blocking
 - iii. OSP Fiber Cables should be either fully dry or dry core with gel in the buffer tubes.
- c. OS2 Single-mode 8.3 Micrometer Fiber Specification
 - i. The OS2 optical fiberglass shall be manufactured from ultra-pure synthetic silica glass. Single-mode fibers manufactured from natural quartz will not be accepted.

27 15 13 - Communication Copper Horizontal Cabling

1. General

- a. Horizontal cable shall consist of Category 6A copper cable for all Data and Voice Applications.
- b. At campus facilities, horizontal cabling to typical work area outlets (including offices, cubicles, and

- conference rooms) shall consist of two Category 6A cables serving each outlet.
- c. Outlets for wireless access points (APs) shall consist of one Category 6A cable as a minimum.
 - d. All cable and equipment shall be installed in a neat and workmanlike manner.
 - e. Strictly adhere to all Building Industry Consulting Service International (BISI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
 - f. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
 - i. ANSI/TIA-568 - Series Commercial Building Telecommunications Cabling Standard
 - ii. ANSI/TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard
 - iii. ANSI/TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling
 - iv. ANSI/TIA-569 - Telecommunications Pathways and Spaces
 - v. ANSI/TIA-606 - Administration Standard for the Telecommunications Infrastructure
 - vi. ANSI-J-STD - Joint Standard for Commercial Building Grounding (Earthing)
 - g. Horizontal cabling shall be installed from the work area outlet location to the nearest Telecommunications Space with no splicing.
 - h. Horizontal cabling shall be terminated on a patch panel in the telecommunication space.
 - i. The contractor shall not exceed the maximum pulling tension or the minimum bending radius for twisted pair cables per manufacturer specifications.
 - j. The contractor shall test all horizontal links per the ANSI/TIA-568 requirements.
 - k. Horizontal cables shall not be spliced, nor shall these cables contain manufacturer splices.
 - l. The maximum total length of horizontal cables from end to end should not exceed 295 ft; 328 ft including patch cords.
 - m. The minimum amount of slack shall be 6 inches for UTP cables and 36 inches for fiber optic cables.
 - n. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.
 - o. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cables installed in any conduit.
 - p. Cable raceways shall not be filled greater than the TIA/EIA-569-A maximum fill for the particular raceway type or 40%.
 - q. Work Area Outlets
 - i. Power receptacles shall be installed near WAO locations. Install WAO at the same height as the power receptacles.
 - ii. For office areas, provide maximum flexibility for change within the work area (i.e. on opposing walls).
 - iii. Wall-mounted courtesy telephony devices shall be mounted per ADA requirements.
 - iv. The wire outlet assemblies shall be a 4' x 4" box with mud ring to reduce the presentation to a single gang box and with a 1" rigid conduit stubbed at the ceiling with a pulling wire.
 - v. If the walls cannot be fished, the wire shall be installed in an approved surface raceway following special guidelines for raceway usage.
 - vi. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius.
 - vii. In hollow wall installations where box- eliminators are used, the excess wire can be stored in the wall.
 - viii. No more than 12" of UTP and 36" of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls.
 - ix. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
 - r. Tenant Improvement Project
 - i. Abandoned cables, not identified or labeled for future use, increase the fire fuel local and shall be removed following the current approved National Electrical Code.
 - ii. Contact the RIT cable plant owner to survey the existing cable plant. There is a possibility that all or a portion of the existing installed cable may be reused.

27 15 13 - Data Communications Wireless Access Points

1. General

- a. For new construction and renovation projects, the ITS Network Communications Team will provide heat maps.
- b. Wireless access points consist of one data jack. The wireless device is to be terminated with an 8-position, 8 conductor module and placed into a surface mount box.

- c. Wireless network equipment shall be provided by the University.

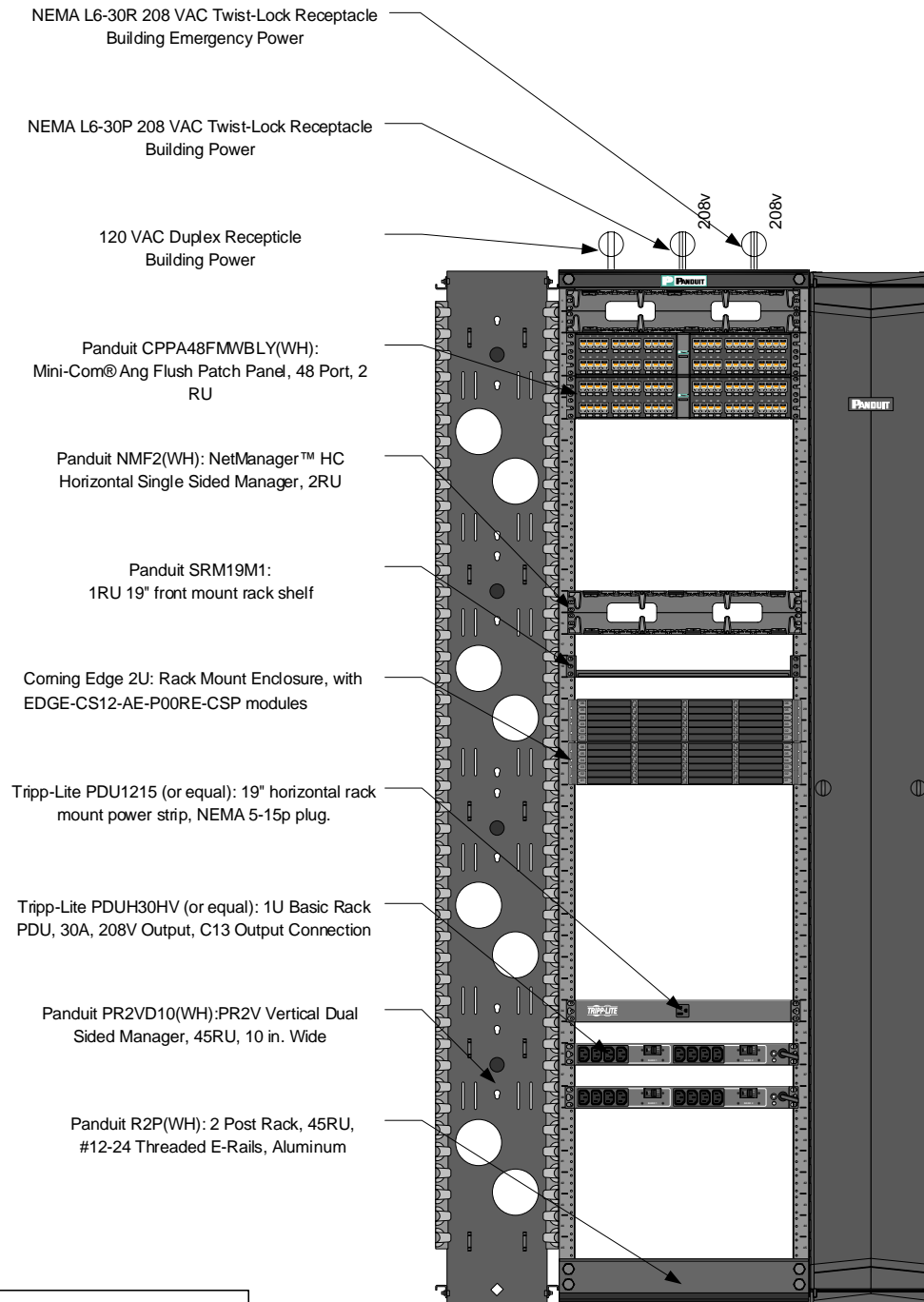
27 41 16 – Integrated Audio-Visual Systems and Equipment

- 1. Scheduling Tablet
 - a. Crestron TSS-1070 (10" screen) screen; white tablet with light bar; no alternates will be accepted.
 - b. 10" unit vs. 7" unit locations
 - c. Provided by contractor.
 - d. Installation
 - i. Cat 6a cabling with 12" service loop
 - ii. Security bracket

27 51 26 – Assistive Listening Devices

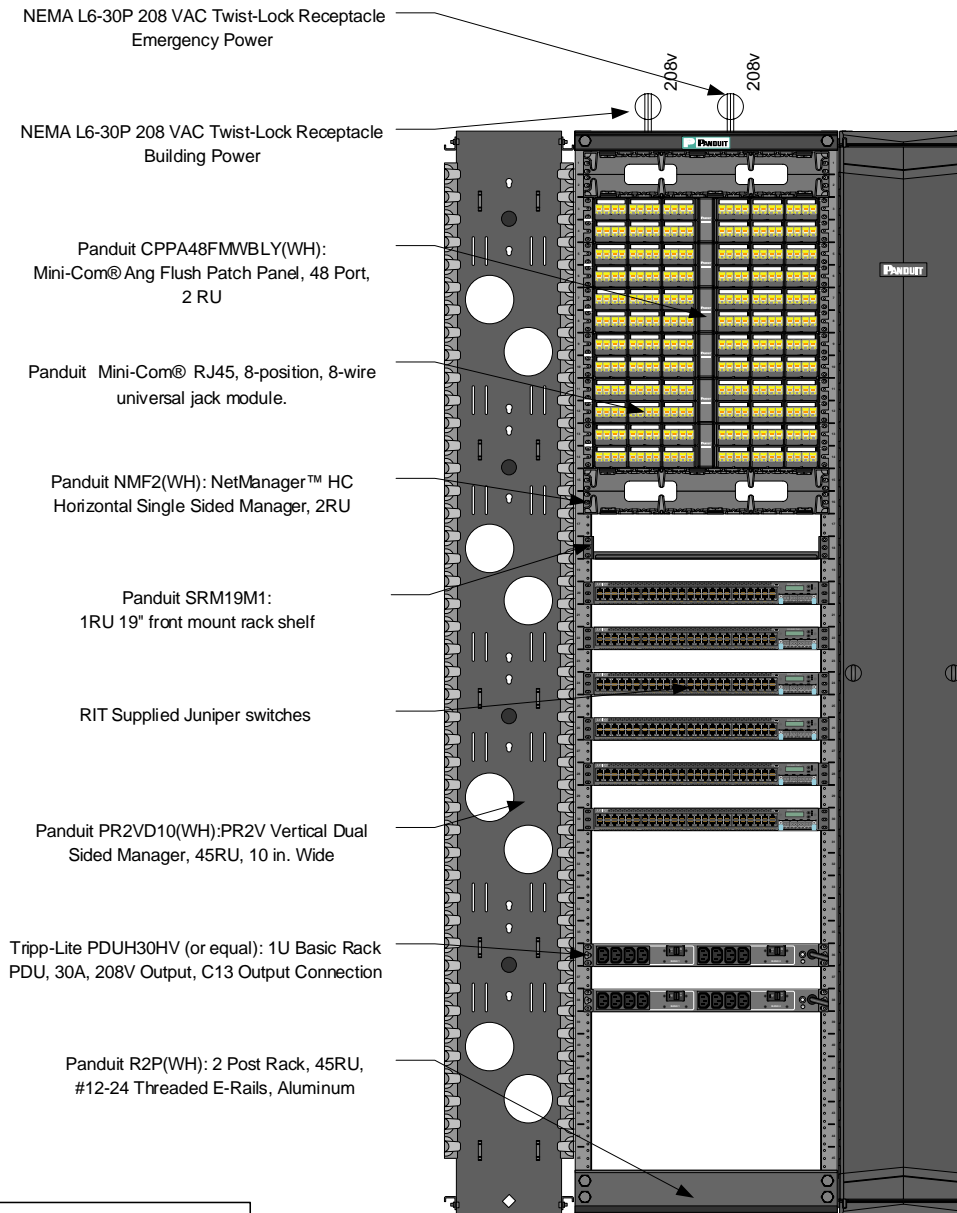
- 1. General
 - a. Product specification will vary based on location.
 - b. Provide in locations as identified by RIT.
- 2. Products
 - a. Contacta V34a PRO
 - i. Quantity: 1
 - ii. Description: Hearing Loop Driver
 - iii. Provide all required mounting and connection components
 - b. Induction Loop Receivers Kits
 - i. Model: Contacta RX-20
 - ii. Quantity: as directed by RIT
 - iii. Description: Induction Loop Listener
 - iv. Accessories:
 - 1. Provide batteries in each unit plus one set of spare batteries
 - 2. Provide headphones with each unit
 - c. Induction Loop Tester
 - i. Model: Contacta FSM
 - ii. Quantity: as directed by RIT
 - iii. Description: Field Strength Meter / Tester
 - iv. Accessories:
 - 1. Provide batteries in each unit plus one set of spare batteries
 - 2. Provide headphones with each unit
 - d. ListenTech LW-200P-04
 - i. Quantity: 1
 - ii. Description: 4 Channel WIFI ALS Server
 - iii. Provide all required mounting and connection components
 - 1. Provide Dante Input converter

Appendix 1 - Typical Backbone Rack Layout



Typical Backbone Rack		SIZE	FSCM NO	DWG NO	REV
DRAWN	JE Shanks			ITS Rack Layout	2
ISSUED	1/12/22	SCALE	1" = 1'-0"	SHEET	1 OF 2

Appendix 2 - Typical Station Rack Layout



Typical Station Cable Rack		SIZE	FSCM NO	DWG NO	REV
DRAWN	JE Shanks			ITS Rack Layout	2
ISSUED	1/12/22	SCALE	1" = 1'-0"	SHEET	1 OF 2

Appendix 3 – Bidders List

Billitier Electric (PCI) (NPI)

Dan Brown
737 Atlantic Avenue
Rochester, NY 14609
585-224-1111
dbrown@billitierelectric.com

O'Connell Electric (PCI) (NPI)

Sean Callaghan
830 Phillips Rd.
Victor, NY 14564
585-924-2176
sean.callaghan@oconnellelectric.com

Tele Data Com (NPI)

Jeremy Moony
90 Air Park Drive
Suite 102
Rochester, NY 14624
585-527-0800 office
JMoody@teledatacom.net

Lantek Communications (PCI) (NPI)

Mark Elliott
3870 Rush Mendon Rd.
Mendon, NY 14506
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END OF DIVISION 27

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**28 05 37 – Distributed Antenna System / Bi-directional Amplifier**

1. Per building; located pending signal

28 15 00 – Access Control Hardware Devices

1. Install card access device (Lenel compatible) in the following locations,
 - a. Main exterior doors of new residential and academic facilities and near 1st floor elevators to restrict access to upper residential floors. Limits key issuance to employees and students.
 - b. Main entrances into computer labs; employee entrances at cash handling units, and 24-hour facilities (such as Library; Campus Center, Fitness Center).
 - c. High risk areas where mechanical keys are not issued to employees or students.
2. See 10 41 16 for Knox Box requirements.

28 20 00 – Video Surveillance

1. Install closed circuit television cameras (CCTV) (Lenel compatible) in the following locations,
 - a. Interior and exterior perimeter security application such as main residential building entrances; outdoor art works; parking lots; main pedestrian thoroughfares (video threading during active and post incident investigations).
 - b. Subtle presence inside business units (all Dining Services; Student Financial Services; Library entrances; residence hall tower entrances; and campus galleries) to protect assets, monitor cash-handling operations, and target hardening relative to robbery prevention and employee safety.

28 30 00 – Security Detection, Alarm, Monitoring

1. Included devices
 - a. Key pad
 - b. Door contacts
 - c. Motion devices
 - d. Panic buttons
 - e. Sonic sensors
 - f. Fiber loops
 - g. Glass break devices
2. Install security alarm system inside business units (Dining Services; stores; Student Financial Services; Library entrances; Campus Galleries) to protect assets, employees, and cash-handling operations.
 - a. Keypad, motion sensors, and door contacts are basic layered protection in all applications noted above.
3. Install panic buttons where potential robbery may occur as well as customer trouble and domestic situations (all University Commons Suite bedrooms and living rooms have them to date).
4. Install fiber optic cable on valuables such as video monitors, computers, and related equipment in smart classrooms; conference rooms; labs, building lobbies, etc.
5. Install sonic sensors where money safes are planned in business operations (Dining Services; HUB; food stores; etc).
6. Install glass break devices in art gallery applications.

28 46 00 – Fire Detection and Alarm

1. Submittal and Construction Process
 - a. MEP consultant to Owner will perform preliminary design to applicable codes, standards, RIT Design and Construction Guidelines, RIT insurance carrier requirements, and Town of Henrietta Fire Alarm Submittal Checklist (<http://www.henrietta.org/index.php/doccenter/building-a-fire-prevention-permit-applications/commercial-permit-applications/2740-fp104-fire-alarm-submittal-checklist-1/file>).
 - b. All selected hardware and software will carry a minimum service and replacement life of at least 10 years maintaining full product compatibility and manufacturers support for the 10 year period.
 - c. Contractor to provide Owner with a submittal of a full set of shop drawings, specifications, materials list, product cut sheets, and any other items required as per Town of Henrietta Fire Alarm Submittal Checklist for Owner review before applying to the town for the Fire Alarm Permit.
 - d. Submittal shall comply with these guidelines and Town of Henrietta Fire Alarm Submittal Checklist in addition to all applicable codes, standards, and RIT insurance carrier requirements.
 - e. Submittal shall include a completed copy of the Town of Henrietta Fire Alarm Submittal Checklist.
 - f. Owner shall review submittal and meet with contractor to resolve any issues.

- g. Contractor shall apply for Fire Alarm Permit after Owner approves submittal.
 - h. Contractor and Owner shall meet and review materials and installation locations before ordering and rough in. This is to ensure correct materials and mounting height compliance with these guidelines.
 - i. Acceptance testing to be performed in full uninhibited normal operation mode.
 - j. Confirm all auxiliary functions perform correctly including walk test feature as specified by Owner.
 - k. Warranty period shall be 1 year full parts and labor.
 - l. After Acceptance testing, perform a 2nd full test of the system, at no charge to the owner, before the end of the warranty period at a time and date to be set by the Owner.
2. FMS will assign ADDRESS LABELS for all reporting points on fire alarm system. Contractor will supply FMS with Excel spreadsheet with device addresses, description, and floor plans showing device locations. FMS will assign labels and return spreadsheet for loading into FACP.
 3. The university's room numbering must be used to program the labels for the points in the control panel. The numbering typically will not be finalized until the later part of the project.
 4. Minimum conduit size shall be 3/4" EMT, and all conduit shall be RED in color.
 5. No conduits shall be mounted tight to the roof deck.
 6. Fire Alarm system batteries shall be mounted in separate enclosure from the FACP. Battery enclosures to be mounted on vertically mounted Kindorff stand offs in close proximity of FACP.
 7. An Alternate for unit pricing of detectors, pull stations, addressable strobes and horns shall be included with the bid package.
 8. COMPLETE as-built drawings and riser diagrams with device addresses and installation documentation (including complete manual sets) of each device, shall be provided to Owner.
 9. A digital copy of the as-built drawings in AutoCAD and PDF format shall be provided to Owner, and become property of the Owner. Drawings to be black and white only with all lines and devices labeled, no color on hardcopy, PDF, and AutoCAD sets.
 10. Warranty shall be for One Year and include a 4 hour response time by the Fire Alarm Contractor 24 Hours Per day including weekends and Holidays and shall commence after Acceptance Test.
 11. All Devices will be visibly labeled with device address.
 12. See appendices for wire information at end of this Guideline.

28 46 10 – Detection and Initiation

1. All sensors and detectors shall be UL listed and FM approved.
2. **ALL** field devices shall be programmed with individual addresses.
3. **ALL** monitoring/supervisory devices shall be programmed with an individual address.
4. Every fire sprinkler system tamper and flow switch shall be individually addressed, regardless of their proximity to other devices.
5. Where a Fire Pump is present, a "Pump Running" condition shall be treated as a supervisory condition, not an alarm.
6. **ALL** photoelectric smoke sensors shall be intelligent analog type detectors.
7. **ALL** thermal sensors shall be intelligent analog type detectors.
8. **ALL** duct detectors shall be the sample tube type and have key operated testing stations accessibly mounted (test switch to be mounted no higher than 72").
9. **ALL** projected beam smoke detectors will have local key operated testing stations accessibly mounted (test switch to be mounted no higher than 72"). When a key station is not available, a means for remote testing shall be provided.
10. Addressable module for projected beam smoke detector shall be mounted behind key in remote test station or in a box not more than 72" AFF.
11. **ALL** (pull) manual stations shall be intelligent individual address dual-action type with B Key operated reset, requiring operator to make two (2) distinct and separate actions to initiate alarm.
12. Line isolators shall be installed every 30 devices, allowing no more than 30 devices to be affected in the event of a wiring fault. Use only Line Isolator Modules. NO Isolator Bases shall be used. All Line Isolators Modules shall be located and labeled in the FACP.
13. **ALL** devices located above ceilings shall have a remote LED indicator mounted on the wall at eye level as near as possible below the device and labeled accordingly.
14. **ALL DEVICES MUST BE INSTALLED WITH GOOD ACCESS FOR SERVICING AND BE ABLE TO BE SERVICED FROM AN 8 FOOT LADDER.**
15. Smoke detector zones shall incorporate and utilize a smoke alarm verification feature, whereby a delay is allowed in alarm sequence to allow verification of alarm received.
16. Initiating device circuits shall be wired Class A to line isolators.
17. Smoke detection shall never be installed in:

- a. Laboratory fume hood exhaust,
 - b. Maintenance or mechanical areas (with the exception of a smoke detector as required near the FACP).
 - c. Attics, Exterior of buildings, or any location where temperature may be below 40°F or above 100°F, or where high humidity, dust, insects or airborne particulates might be present.
18. Smoke detectors shall be a minimum of 3 feet from HVAC diffusers.
19. Batteries shall not be used in any devices. Devices shall be hardwired back to FACP or appropriate power source as approved by Owner.
20. Where or custom ceilings (i.e. clouds) are incorporated in the building, ensure fire alarm system design is appropriate and code compliant (heads above and below ceiling as required).

28 46 21 – Addressable Fire Alarm Systems

1. Fire Alarm Control Panels (FACP) models
 - a. SIMPLEX FACP, minimally 4100U/ES model
2. FACP Features
 - a. Shall be totally solid state microprocessor based, use digital transmission and shall be field programmable.
 - b. Full detector sensitivity and device service status reporting.
 - c. **A minimum** of four (4) Programmable function switches located at main FACP and annunciators.
 - d. Dedicated network communications meeting 100% COMPATIBILITY with existing network fire systems.
 - e. Capacity to disable horns & strobes from the panel.
 - f. Capacity to disable fans, door holders, elevators, water flows, suppression systems, etc. from the panel.
 - g. Capacity to silence Audible Circuits (from FACP).
 - h. LCD Annunciators, with Bypasses programmed at annunciators as well as FACP.
 - i. Remote System annunciator shall be located at the Fire Department response location and shall be readily visible in the entrance lobby or vestibule. Display shall be at eyelevel between 60" and 68".
 - j. All system conditions shall be annunciated through LCD annunciator and network monitors.
 - k. FACP shall not be installed in any area where ambient temp could exceed 86°F or fall below 40°F or where excessive humidity or dust might be present. Control unit shall incorporate an "Event Memory" and the ability to access and view each event in memory from the keypad.
 - l. FACP shall provide **AT LEAST** two free internal expansion card bays for future expansion.
 - m. The FACP shall be used to control pre-action fire sprinkler systems. The FACP panel must be UL listed and approved for this function.
 - n. **ALL** Fan Shutdown Relays shall be addressable monitored devices that may be bypassed at the main FACP, and locally indicate the operational state (status LED on control relay shall be at or near eye level) of the relay. All shutdown controls shall be wired to the normally open, held closed, contacts during normal status (no Alarm) of the FACP. The status LED shall be lit for normal operation (see wiring diagram).
 - o. **ALL** Smoke Vent Releases shall have associated service bypass control switched from the main FACP front panel.
 - p. **ALL** Smoke Vent Releases will utilize 24 volt reset-able latching devices only, and shall be battery backed by main FACP or auxiliary supply. Fusible links shall not be a primary releasing mechanism and no ETL links will be used.
 - q. **ALL** Door Holder Circuits shall be 24 Volts DC and be on separate dedicated power supplies and have associated service bypass control switched from the main FACP front panel. By having separate power supplies for Door Holders, it prevents loss of main power supply due to a shorted Door Holder circuit.
 - r. Provide fire alarm circuits to elevator controller. Provide four supervised relays near the elevator controller. Program FACP, relays and elevator related smoke and heat detectors as per FMS Design and Construction Guidelines Division 14.
3. FACP Network Communications
 - a. Provide modules for connection to existing RIT campus fire alarm network.
 - b. All FACP's shall be NETWORKED to FMS Fire Alarms Systems Shop (located in Building 49, Room A063/065) & Public Safety Dispatch Center (located in Building 025 Grace Watson).
 - c. All networked FACP's will provide a BI-DIRECTIONAL communication interface to both Campus Safety monitoring station and FMS Bldg. 49 Fire Alarm Systems Shop.
 - d. All networked systems shall allow for both "Local Reset" and "Reset From Networked Head End".
4. FACP Wiring
 - a. FACP shall be wired to building LIFE SAFETY EMERGENCY POWER (110 VAC) with circuit labeling placed on FACP faceplate upper right hand corner including FACP indicated on panel circuit schedule.

- b. Identify Fire Alarm circuits with printable tape at all terminal and junction locations in a manner that will prevent unintentional interference with the fire alarm circuits during testing and servicing (760.10).
5. Addressable Loop Wiring
 - a. **ALL** Addressable Loops shall be wired using STRANDED #18/2 conductor, shielded, with a drain wire, with conductor insulation colored red and black, RED PVC jacket, FPLP rated cable UL approved for use in fire alarm system wiring and approved by FMS (see wire information at end of this Guideline).
 - b. Addressable loops will be wired as a riser/backbone and branch circuit configuration. The Riser/Backbone shall not serve detectors directly, but will supply data feed to all line isolators. Line Isolators will be the only interface points for all branch circuits. Branch Circuits will supply data feed to all addressable devices. **NO MORE THAN 30 DEVICES** will be supplied by a single branch circuit. A Line Isolator shall not supply data to any more than a SINGLE branch circuit serving no more than 30 devices.
6. Other Fire Alarm System Wiring
 - a. **ALL** Visual Notification Appliance circuits (Strobes) shall be wired using STRANDED #14/2 conductor cable, with a RED PVC jacket, with conductor insulation colored red and black, FPLP rated cable UL approved for use in fire alarm system wiring and approved by FMS (see wire information at end of this Guideline).
 - b. **ALL** Audible Horn Notification appliance circuits shall be wired using STRANDED #14/ 2 conductor cable, with a RED PVC jacket, with conductor insulation colored red and black, FPLP rated cable UL approved for use in fire alarm system wiring and approved by FMS.
 - c. **ALL** Audible Speaker Notification appliance circuits shall be wired using STRANDED #18/2 or #14/2 conductor, shielded, with a drain wire, with conductor insulation colored white and black, RED PVC jacket, FPLP rated cable UL approved for use in fire alarm system wiring and approved by FMS (see manufacturers wiring requirements).
 - d. **ALL** wiring associated with fire alarm systems must be in metal conduit, 3/4 inch EMT minimum size and colored RED.
 - e. **ALL** Audible and Visual Notification Appliance Circuits shall be wired CLASS "A" (unless otherwise approved by FMS).
 - f. ALL Fire Alarm system junction boxes and cover plates shall be painted RED.
 - g. 24 Volt DC AUX wiring shall be run along with all addressable loop data cables.
 - h. **All** Door Holder Circuits shall be 24 VOLT DC and powered by separate dedicated power supplies (separate from power supply for Fire Alarm system). Power Supplies shall be a minimum of four (4) Outputs. Each Output shall be individually fused.
 - i. **All** Door Holder power supplies will initiate from dry contacts.
 - j. No battery backup shall be used on door holder power supplies.
 - k. Any fire alarm system wiring serving devices that may be exposed to moisture shall be on an individual isolated loop.
 - l. All fire dampers shall be 24 volt and powered by the FACP. Larger dampers may 115 VAC if approved by the RIT Director of Engineering and interfaced to the FACP with an output ZAM and Air Products relay with indicator LED.
7. Installation of FACP (CPU) and Transponder (RPU) units
 - a. All system enclosures housing central and remote processing units, and surface mounted annunciators shall be mounted using standoff bolts or vertically mounted Kindorf to isolate the enclosure from water/moisture contamination.
 - b. All enclosures housing LCD DISPLAY CONSOLES shall be mounted so that the display is placed between 60" and 68" above the floor (eye level).
 - c. All equipment, devices, and installation shall conform to NFPA 72, NEC, and ADA requirements.
 - d. Strobes shall be mounted at 80"-96" AFF.
 - e. The operable part of Manual Pull Stations shall be mounted 42"-48" AFF.
8. NAC Power Supplies
 - a. **All** NAC power extenders shall be mounted alongside of FACP using standoff bolts or vertically mounted Kindorf.
 - b. **All** interfacing modules and visual synchronizing devices shall be mounted, on standoff bolts or vertically mounted Kindorf, in close proximity to their associated power supplies and labeled accordingly to reflect address, purpose and circuit.
 - c. **All** NAC Supplies shall be labeled by NAC number and circuit number including type of circuit for area served (i.e. NAC 1 Circuit 2 Horns).
 - d. **All** NAC CIRCUITS shall be calculated for all NAC devices to be operated at their maximum output level and tap. Included within this calculation shall be an adequate allowance for expansion of at least 25%.
9. Fan Control Interfaces

- a. **All FAN CONTROL** relays shall be mounted next to or in close proximity to associated motor control / speed drives that are being interrupted.
- b. **All control relays** shall be mounted with LED status indicators within 36"-72" of fan contactor or VSD and be labeled for both duct detector address and air handler associated with shutdown.

28 46 23 – Fire Alarm Notification Appliances

1. All notification appliances shall be of a manufacture approved by RIT Facilities Management Services (FMS).
2. **ALL** Visual Notification Appliances will be synchronized with all others in a given area.
3. **ALL** Visual Notification Appliances shall be Addressable 2 Wire Type.
4. **ALL** peripheral devices shall be powered from the building emergency power circuit and battery backed.
5. **ALL** Horns shall be Addressable 2 Wire Type.
6. If addressable notification appliances cannot be used, then horns and strobes shall be on separate class-A circuits.
7. **ALL** Notification Appliances placed outside shall be Weather Proof and be placed in a STI-1229-HAZ weather proof enclosure.
8. Notification device installed on exterior of building at FDC shall be a strobe unit only (enclosed in a STI-1229-HAZ) to indicate water flow only, not general alarm.
9. **ALL** Notification Appliance Circuits (NAC) POWER EXTENDERS shall be approved by FACP manufacturer, support full monitoring and meet all NFPA requirements.
10. **ALL** NAC Power Extenders shall be installed next to the main FACP, all other installation locations must be approved by FMS.
11. **All** NAC Power Extenders must be connected to E-Power Source.
12. **ALL** NAC Power Extenders shall be monitored by an assigned individual addressable monitoring point for each extender with descriptive annunciation programmed for that device on the main FACP and remote LCD annunciator displays, and networked command centers (NCC).
13. Installation, hardware, and programming shall support all functions associated with a walk test. During a walk test, horn and strobe functionality shall be supported while testing devices using the walk test with signal feature. Devices and wiring methods that do not support testing in walk test mode with a signal having full functionality of that feature are **NOT** acceptable.
14. **All** NAC Power Supplies shall be Addressable and Wired Class A.
15. Do not use Wheelock Snap Series Z Strobes (unless approved by RIT Fire Alarm Shop).
16. No T Tapping.
17. On systems with voice, avoid speaker placement in individual offices and restrooms.
18. No ceiling mounted strobes, unless approved by RIT Director of Engineering.
19. Strobes shall be wall mounted between 82 and 96 inches AFF. Generally strobes have the lens at 84 inches AFF.

28 47 00 – Mass Notification

1. Products
 - a. Alertus Alert Beacons; POE; yellow
 - i. One beacon can feed up to two marquees
 - ii. Battery backup provided by RIT Public Safety
 - b. Alertus LED Marquees
2. Installation
 - a. RIT Public Safety will provide location plans to the Design consultants during the design development phase.
 - b. Marquees shall not obstruct or interfere with clearances of other life-safety devices when installed.

Appendix 1 – SIMPLEX Fire Alarm Wire Specifications (reference RIT wire chart for compatible wire)

FIRE ALARM WIRE SPECIFICATIONS			
A	AUXILIARY POWER CIRCUIT - 2 CONDUCTOR 14 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454718RE AREA=0.0380 SQ. INCH	CONDUIT ONLY; THHN PAIGE 454314BR #14 AWG TP (BLACK/RED) AREA=0.0394 SQ. INCH	PLENUM RATED; FPLP PAIGE 454719ARE AREA=0.0333 SQ. INCH
B	RUI/N2 COMMUNICATION - 1 PAIR 18 AWG TWISTED OVERALL NON-PLENUM RATED; FPL PAIGE 454722AREM AREA=0.0224 SQ. INCH		SHIELD PLENUM RATED; FPLP PAIGE 454717ARE AREA=0.0219 SQ. INCH
D	DOOR HOLDER CIRCUIT - 2 CONDUCTOR 14 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454718RE AREA=0.0380 SQ. INCH	CONDUIT ONLY; THHN PAIGE 454314BR #14 AWG TP (BLACK/RED) AREA=0.0394 SQ. INCH	PLENUM RATED; FPLP PAIGE 454719ARE AREA=0.0333 SQ. INCH
E	RS-232 - 1 PAIR 18 AWG TWISTED OVERALL SHIELD NON-PLENUM RATED; FPL PAIGE 454722AREM AREA=0.0224 SQ. INCH		PLENUM RATED; FPLP PAIGE 454717ARE AREA=0.0219 SQ. INCH
H	AUDIBLE CIRCUIT - 2 CONDUCTOR 14 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454718ARE AREA=0.0380 SQ. INCH	CONDUIT ONLY; THHN (2) #14 AWG (RED/BLACK) AREA=0.0097 SQ. INCH	PLENUM RATED; FPLP PAIGE 454719ARE AREA=0.0333 SQ. INCH
			***** REFER TO SIGNAL CIRCUIT DISTANCE CHART *****
K	REMOTE TEST SWITCH/LED CIRCUIT - (2) 2 CONDUCTOR 18 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454703ARE AREA=0.0204 SQ. INCH	CONDUIT ONLY; TFFN (2) #18 AWG (PINK/BROWN) (2) #18 AWG (WHITE/ORANGE) AREA=0.0055 SQ. INCH (EACH)	PLENUM RATED; FPLP PAIGE 454709ARE AREA=0.0165 SQ. INCH
L	REMOTE LED CIRCUIT - 2 CONDUCTOR 19 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454703ARE AREA=0.0204 SQ. INCH	CONDUIT ONLY; TFFN (2) #18 AWG (WHITE/ORANGE) AREA=0.0055 SQ. INCH	PLENUM RATED; FPLP PAIGE 454719ARE AREA=0.0333 SQ. INCH
M	MAPNET/IDNET CIRCUIT - 1 PAIR 18 AWG TWISTED OVERALL NON-PLENUM RATED; FPLR PAIGE 454722AREM AREA=0.0224 SQ. INCH		SHIELD PLENUM RATED; FPLP PAIGE 454717ARE AREA=0.0219 SQ. INCH
N	RS-485 COMMUNICATION TRUNK - 1 PAIR 18 AWG TWISTED OVERALL NON-PLENUM RATED; FPL PAIGE 454722AREM AREA=0.0224 SQ. INCH		SHIELD PLENUM RATED; FPLP PAIGE 4454717ARE AREA=0.0219 SQ. INCH
P	MAPNET/IDNET POWER CIRCUIT - 2 CONDUCTOR 14 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454718RE AREA=0.0380 SQ. INCH	CONDUIT ONLY; THHN PAIGE 454314BR #14 AWG TP (BLACK/RED) AREA=0.0394 SQ. INCH	PLENUM RATED; FPLP PAIGE 454719ARE AREA=0.0333 SQ. INCH
R	RELAY CIRCUIT - 2 CONDUCTOR 14 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454718RE AREA=0.0380 SQ. INCH	CONDUIT ONLY; THHN PAIGE 454314BR #14 AWG TP (BLACK/RED) AREA=0.0394 SQ. INCH	PLENUM RATED; FPLP PAIGE 454719ARE AREA=0.0333 SQ. INCH
S	SPEAKER CIRCUIT - 1 PAIR 18 AWG TWISTED OVERALL SHIELD NON-PLENUM RATED; FPL PAIGE 454722AREM AREA=0.0224 SQ. INCH		PLENUM RATED; FPLP PAIGE 454717ARE AREA=0.0219 SQ. INCH
			***** REFER TO PANEL INSTALLATION MANUAL *****
T	TELEPHONE CIRCUITS - 1 PAIR 18 AWG TWISTED OVERALL SHIELD NON-PLENUM RATED; FPL PAIGE 454722AREM AREA=0.0224 SQ. INCH		PLENUM RATED; FPLP PAIGE 454717ARE AREA=0.0219 SQ. INCH
V	VISUAL/SIGNAL CIRCUIT - 2 CONDUCTOR 12 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454720ARE AREA=0.0547 SQ. INCH	CONDUIT ONLY; THHN (2) #12 AWG (RED/BLACK) AREA=0.0133 SQ. INCH (EACH)	PLENUM RATED; FPLP PAIGE 454725ARE AREA=0.0468 SQ. INCH
			***** REFER TO SIGNAL CIRCUIT DISTANCE CHART *****
V	ADDRESSABLE VISUAL/SIGNAL CIRCUIT - 2 CONDUCTOR 12 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454720ARE AREA=0.0547 SQ. INCH		PLENUM RATED; FPLP PAIGE 454725ARE AREA=0.0468 SQ. INCH
			***** REFER TO SIGNAL CIRCUIT DISTANCE CHART *****
Z	ZONE CIRCUIT - 2 CONDUCTOR 18 AWG SOLID NON-PLENUM RATED; FPLR PAIGE 454703ARE AREA=0.0204 SQ. INCH	CONDUIT ONLY; TFFN (2) #18 AWG (YELLOW/BLUE) AREA=0.0055 SQ. INCH (EACH)	PLENUM RATED; FPLP PAIGE 454709ARE AREA=0.0165 SQ. INCH

Appendix 2 – RIT Fire Alarm Wire Specifications

REPLACE SIMPLEX RECOMMENDATION	NUMBER OF CONDUCTORS	INSULATOR COLOR	SHIELD and DRAIN	JACKET and COLOR	TYPE / RATING	SUPPLIERS CONTACT INFORMATION
(1) USE IN PLACE OF “B,E,N, and M” LISTED IN SIMPLEX WIRE SPECIFICATION MAPNET/IDNET WIRE	#18/2 STRANDED COPPER TWISTED	(1) RED (1) BLACK	FOIL SHIELD STRANDED DRAIN	POLYFIN OR EQUIV RED JACKET	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(2) USE IN PLACE OF (1) OPTIONAL LISTED IN SIMPLEX WIRE SPECIFICATION MAPNET/IDNET WIRE	#16/2 STRANDED COPPER TWISTED	(1) RED (1) BLACK	FOIL SHIELD STRANDED DRAIN	POLYFIN OR EQUIV RED JACKET	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(3) USE IN PLACE OF “V” LISTED IN SIMPLEX WIRE SPECIFICATION VISUAL APPLIANCE CIRCUIT WIRE	#14/2 STRANDED COPPER TWISTED	(1) RED (1) BLACK	UNSHIELDED	POLYFIN OR EQUIV RED JACKET/WITH YELLOW STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(4) USE IN PLACE OF (3) OPTIONAL LISTED IN SIMPLEX WIRE SPECIFICATION VISUAL APPLIANCE CIRCUIT WIRE	#12/2 STRANDED COPPER TWISTED	(1) RED (1) BLACK	UNSHIELDED	POLYFIN OR EQUIV RED JACKET/WITH YELLOW STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(5) USE IN PLACE OF “D” LISTED IN SIMPLEX WIRE SPECIFICATION DOOR HOLDER CIRCUIT WIRE	#14/2 STRANDED COPPER TWISTED	(1) ORANGE (1) BROWN	UNSHIELDED	POLYFIN OR EQUIV RED JACKET/ WITH BROWN STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(6) USE IN PLACE OF “A, and P” LISTED IN SIMPLEX WIRE SPECIFICATION AUXILIARY POWER CIRCUIT WIRE	#14/2 STRANDED COPPER TWISTED	(1) WHITE (1) BLACK	UNSHIELDED	POLYFIN OR EQUIV RED JACKET/ WITH WHITE STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza

(7) USE IN PLACE OF "S" LISTED IN SIMPLEX WIRE SPECIFICATION SPEAKER CIRCUIT WIRE	#18/2 STRANDED COPPER TWISTED	(1) YELLOW (1) BLUE	FOIL SHIELD STRANDED DRAIN	POLYFIN OR EQUIV RED JACKET / WITH BLUE STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(8) USE IN PLACE OF "H" LISTED IN SIMPLEX WIRE SPECIFICATION AUDIO (HORN) CIRCUIT WIRE	#14/2 STRANDED COPPER TWISTED	(1) YELLOW (1) BLUE	UNSHIELDED	POLYFIN OR EQUIV RED JACKET/ WITH BLACK STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(9) USE IN PLACE OF "V" LISTED IN SIMPLEX WIRE SPECIFICATION VISUAL / SIGNAL CIRCUIT WIRE	#14/2 STRANDED COPPER TWISTED	(1) RED (1) BLACK	UNSHIELDED	POLYFIN OR EQUIV RED JACKET/WITH YELLOW STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(10) USE IN PLACE OF "K" LISTED IN SIMPLEX WIRE SPECIFICATION REMOTE TEST STAT	18/4 STRANDED COPPER TWISTED	(1)PINK (1)BROWN (1)WHITE (1)ORANGE	UNSHIELDED	POLYFIN OR EQUIV RED JACKET/WITH GRAY STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(11) USE IN PLACE OF "L" LISTED IN SIMPLEX WIRE SPECIFICATION REMOTE LED	18/2 STRANDED COPPER TWISTED	(1)WHITE (1)ORANGE	UNSHIELDED	POLYFIN OR EQUIV RED JACKET/WITH GRAY STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(12) USE IN PLACE OF "R" LISTED IN SIMPLEX WIRE SPECIFICATION RELAY CIRCUIT	18/2 STRANDED COPPER TWISTED	(1) WHITE (1) BLACK	UNSHIELDED	POLYFIN OR EQUIV GRAY JACKET/WITH RED STRIPE	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191 Direct Fax# 603-633-4910 Salesman, Joe Pellizza
(13) USE IN PLACE OF "Z" LISTED IN SIMPLEX WIRE SPECIFICATION ZONE CIRCUIT	18/2 STRANDED COPPER TWISTED	(1)WHITE (1)BLUE	UNSHIELDED	POLYFIN OR EQUIV RED JACKET/WITH	FPLP	WINDY CITY WIRE COMPANY PHONE: 1-800-379-1191

				PURPLE STRIPE		Direct Fax# 603-633- 4910 Salesman, Joe Pellizza
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**All wire listed above is custom manufactured by Windy City Wire Company and will require 5000ft minimum order per item.*

In addition, a (2) week lead time for production is required for all custom manufactured orders.

*** Please specify maximum allowable capacitance per foot when ordering.*

****All wire must be fire rated stranded cable.*

END OF DIVISION 28

DIVISION 32 – EXTERIOR IMPROVEMENTS**32 05 13 – Soils for Exterior Improvements**

1. All lawn areas shall consist of a minimum of 8" of screened and amended (compost added 15-20% minimum) topsoil, raked and hydro-seeded using specified grass seed mix. Include an alternate price for 12" of topsoil.
2. Landscaped bedding areas shall be a minimum of 18 inches of screened and amended topsoil with an organic content of 40%.

32 12 16 – Asphalt Paving

1. Parking and Roadways
 - a. Well compacted sub-grade
 - b. Geotextile Fabric- Mirafi 500x or as directed by Engineer
 - c. 12 inch #2 Crusher Run stone sub-base, NYSDOT Item 304.12
 - d. 3 inch base asphalt
 - e. 2 inch asphalt concrete binder course NYSDOT item 403.13 Type 3
 - f. 1 1/2 inch asphalt concrete top course NYSDOT Item 403.19 Type 7
 - g. Under drain as determined by Engineer
 - h. Compaction testing to 95% proctor value
 - i. Existing pavement to be saw cut and tack coat cuts as required. NYSDOT item 407.01
 - j. Seams to be, at minimum, 45 degree angles.
 - k. Asphalt concrete truing and leveling course NYSDOT item 403.2.1
 - l. Check with RIT Project Manager to confirm if heavy duty pavement detail is required.
2. Walkways
 - a. Well compacted sub-grade
 - b. Geotextile fabric-Mirafi 500X or as directed by Engineer
 - c. 12 inch #2 crusher run stone sub-base, NYSDOT item 304.12
 - d. 3 inch asphalt concrete binder course NYSDOT item 403.13 type 3
 - e. 1 1/2 inch asphalt concrete top course NYSDOT item 403.19
 - f. Must have a clear, unobstructed width of at least 8-feet
 - g. Sawcuts to be diagonal

32 13 13 – Concrete Paving

1. Well compacted sub-grade.
2. Geotextile fabric-Mirafi 500X or as directed by Engineer
3. 6 inch #2 crusher run stone sub-base, NYSDOT item 304.12 type 2
4. 6 inch concrete, minimum 4000 psi (broom finish) including 6x6x6 WWM. Expansion joint every 50 feet
5. Concrete to receive 2 coats of a membrane finish sealer applied at rates specified by product manufacturer
6. Control joints to be 1/8 inch wide saw cut, 1/3 slab depth thickness
7. Must have a clear, unobstructed width of at least 8-feet minimum

32 14 13 – Precast Concrete Pavers

1. Shall be "prest brick" as manufactured by Hanover Architectural Products, 240 Bender road, Hanover, PA 17331, or approved equal.
2. Width: 4" Length: 8", Thickness: 3"
3. Four color scheme of custom blended colors: Tan, Brown, Red/Brown (B92453), and Charcoal
4. 1" leveling course
5. 6" concrete base course (reinforced with wire mesh)
6. 12" compacted subbase
7. Where pavement abuts lawn or a shrub bed, provide a paver edge. Extend gravel under slab 3-5" from edge of pavers to allow for installation.

32 16 40 – Curbing

1. Granite 5 inch wide x 16 inch deep with 6 inch reveal
2. Compacted sub-base
3. Underdrain
4. Set on dry concrete
5. Backed up with wet concrete

32 17 23 – Pavement Markings

1. Parking spaces to be 9 feet 0 inch wide center to center with 4 inch solid yellow painted lines.
2. Handicapped spaces, access aisles and signage to be per NYS Building Code
 - a. Access aisles to be 8'-0"

32 35 00 – Screening Devices

1. Dumpster enclosures shall be a 9-foot high steel wall panel system matching Centria #BR5-36 (20 ga.). The color shall be 9911 Pebble or approved equal. A second option, if approved by the Director of Planning and Design is to match #390 Surrey Beige from Flexospan standard colors; with a Flexshield Kynar 500/Hylar 5000 siliconized polyester finish.

32 93 43 – Plants

1. Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.
2. Design consultant shall review tree placement with the FMS Grounds Foreman prior to issuance of bid documents.
3. Trees
 - a. Ornamental trees shall be planted at least 12-15 feet outside of the footprint of the nearest building.
 - b. Shade trees shall be planted at least 20-25 feet outside of the footprint of the nearest building.
 - c. Callery pear trees (*pyrus calleryana*) shall not be accepted.

END OF DIVISION 32

DIVISION 33 – UTILITIES**33 05 00 – Restoration Standards for Underground Utilities**

1. All underground excavation operations performed on Campus to install, repair, upgrade or remove a utility structure (i.e. gas, water, storm sewer, sanitary sewer or drain pipe, tank, hydrant, heating conduit or telecommunication duct), shall not be deemed complete until restoration of the disturbed area is completed per this standard.
2. Restoration under this standard shall consist of the following items or steps as a minimum:
 - a. Backfill excavated area in a manner designed specifically to protect any underground utility structure in the area from possible damage incurred by the type of backfill material being used. (i.e. sand padding, blocking, pea gravel or cement encasement may be required to protect underground utility structures).
 - b. Tamp all backfill material in 12" lifts to minimize subsequent settling of excavated area.
 - c. Under roadways and sidewalks, final 24" of backfill material shall be tamped "crusher-run" stone, tamped in 12" lifts.
 - d. Roadway and sidewalk asphalt surfaces shall be paved with a hot-mix asphalt material of equal quality and density to that material removed during excavation, with the surface rolled and smoothed to minimize surface irregularities where new surface adjoins other paved surfaces. Installation shall achieve maximum bonding with the vertical edges of adjoining paved surfaces.
 - e. Concrete surfaces shall be formed and poured with material to match as nearly as possible the adjoining concrete surfaces in alignment, thickness, texture and color.
 - f. All curbing units shall be reinstalled in the same manner and alignment as the adjoining units. Replacement units shall match adjoining units in material, size, shape and color.
 - g. In lawn areas, final 8" of fill material shall be topsoil with added compost 15-20% minimum, raked and hydro-seeded using grass seed mix as specified and approved per submittal by Grounds Foreman. Include an alternate price for 12" of topsoil.
 - h. All spoil, rock, construction materials and unused backfill material shall be removed from the Campus and disposed of in an appropriate manner unless directed to be stored on campus by the Grounds Foreman.
 - i. Contractor shall be responsible for repair of any settlement occurring over excavation site for eighteen (18) months after restoration completed.
3. **NO** concrete truck washouts on campus, unless prior arrangements are made for each project with the Project Manager and approved by the Grounds Foreman.
4. Uni-base: pour crushed stone to fill large gaps in uni-base up to 4 inches below grade; use topsoil to fill to grade

33 05 13 – Manholes

1. Pre-cast structures to be used.
2. No bricks, use plastic or concrete rings to raise cover ring.
3. Use 30" traffic H20 rated manhole covers and rings.

33 10 00 – Water Utilities

1. Use left hand valves on water mains and Hydrant guard valves. (Red Top)
2. Use push-on joint PVC Pressure Class C900-DR-18 – 235 plastic for water mains up to a maximum of 12 inches diameter.
3. Back fill around water lines with 12 inches of ice control sand after laying line on 12 inches of ice control sand (NYSDOT # 703-06).
4. Provide Copperhead Solid #12 tracer wire with blue jacket, terminate in curb boxes.
5. Underground valve or metering vaults shall not be installed.
6. Water lines shall have a minimum of 5 feet of cover.
7. Use Kennedy Hydrant K-81 in Kennedy Yellow.

33 30 00 – Sanitary Sewer Utilities

1. Sanitary Cover shall be ADA compliant in walks and driveways, 30" Diameter and have "SANITARY SEWER" cast in it.
2. Sanitary lines must always be straight from manhole to manhole unless it has been approved by the RIT Facilities Management Services.
3. All pipe intersections shall be made within a manhole.
4. Design drawings shall include the profile of sanitary piping and crossing existing Utilities.
5. All piped materials shall be specified by the Engineer and approved per the RIT Facilities Management Services. Generally, sanitary sewer laterals to be SDR 21 in 20 foot lengths, and mains to be SDR 35.

6. Sanitary Utility Pumping Stations: All packaged lift and pumping stations shall be submitted to the RIT Facilities Management Services for review and approval.
7. Sanitary Utility Piping: Submit TV video of all piping to Utilities for review prior to acceptance.
8. New Manhole: Provide manhole boot connector for cast-in-place pipe to manhole connectors. Manhole boot connector shall provide a positive watertight connection with up to 20 degree omni-directional deflection and 1.00" of vertical or horizontal movement without loss of seal. Manhole boot connector shall be made from an EPDM compound with stainless steel hardware and meet requirements of ASTM C-923 "Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals" and ASTM C-1644 "Standard Specification for Resilient Connectors Between Reinforced Concrete On-Site Wastewater Tanks and Pipes."
9. Existing (core bored hole): Provide pipe to manhole connectors for cored holes in existing manholes. Pipe to manhole connector shall provide a positive watertight connection. Pipe to manhole connector shall be made from an EPDM compound or poly-isoprene rubber with stainless steel pipe clamp and compression band to seal against cored hole in concrete structure.

33 40 00 – Storm Drainage Utilities

1. All storm lines to be HDPE plastic (6 inches diameter and above to be smooth bore with corrugated exterior).
2. Galvanized or steel pipe is not to be used.
3. All structure covers in walkway and driveway areas are to be ADA compliant, 30" Diameter and have "STORM SEWER" cast in it.

33 44 16 – Trench Drains

1. Avoid the use of trench drains if at all possible. Use of trench drains requires Utilities Director approval.

33 44 31 – Catch Basins

1. Pre-cast catch basins only.
2. No bricks to be used to level grate.
3. Cast a concrete apron around grate – 6" min.
4. Set catch basin 2" low in lawn areas.
5. All catch basin covers and grates in walkway and driveway areas are to be ADA compliant.

33 51 00 – Natural Gas Distribution

1. Use HDPE plastic for gas lines.
2. Provide a 12 inch ice control sand envelope around gas line.
3. Provide Copperhead Solid #12 tracer wire with blue jacket, terminate in curb boxes.
4. Underground valve or metering vaults shall not be installed.
5. Gas lines shall have 3-4 feet of cover.

33 70 00 – Electrical Utilities

1. Utility line depth (also see drawing details):
 - a. Conduit for roadway or walkway lighting – 18 inch cover.
 - b. Conduit for 12KV – 5 inch PVC Sch. 40, concrete encased 6 inch all sides, 4 feet cover over concrete.
 - c. Conduit for Telecom/Data – 3 feet cover.
2. All conduits (Telecom, low voltage (600V) or medium voltage (12KV)) entering a building shall be pitched away from the building and shall immediately enter a pullbox in the building. Conduits leaving the pull box shall be higher so that any water entering the pull box via the exterior conduits cannot flow to conduits or equipment inside the building.
3. 15KV cable shall be General Cable, Kerite, Perelli (Prysmian), or Okonite and shall be 500Kcmil between manholes.
4. 15KV cable shall be EPR 133% insulation level (220 mil), MV-105, with 5 mil copper tape with a minimum of 20% overlap, and with flame retardant, moisture and sunlight resistant PVC jacket.
5. Use only Elastimold Series 600 Deadbreak bolt-together tee type splices in 12 KV manholes.
6. For underground 12 KV conduits, use 5 inch Schedule 40 PVC conduit. Transition to RGS sweeping elbow when rising above grade or entering a building. Encase with 6 inch of concrete on all four sides. Provide 4 feet of cover by backfilling in 12 inch lifts with compaction between lifts. Provide 8 inch of top soil in lawn area.
7. Always install double the number of conduits needed for 12KV service (if 4 are required, install 8 conduits)
8. Use only fiberglass and stainless steel hardware on 12KV wire racking materials in manholes.

9. Pull in a tracer wire of single conductor #10AWG solid copper insulated (THHN) wire in all 12 KV and Telecom conduits, terminate at top of manholes so that entry is not required Use type THHN stranded copper wire for low voltage class 1 (600v) electric service in underground conduits, and no smaller than #10 AWG.
10. Use 30 inch diameter H2O rated manhole rings and covers for all manholes, ADA compliant and cover shall have "ELECTRIC" cast in.
11. Use pre-cast rings (concrete or plastic) for all manhole risers...do not use brick.
12. For Lighting Circuits, use Schedule 80 PVC conduit for underground use. Transition to RGS sweeping elbow when rising above grade.
13. Use only scotch 33+ tape on class 1 and 2 systems.
14. Use Ideal or 3M (but not 3M Scotch Lock) wire nuts
15. For site power, splices are only permitted in poles or existing hand holes.
16. For site power with wire sizes #10awg and #12awg use 480/277 volt colors or 208/120 colors as needed.
17. Use Kistner Uni-bases for outdoor light poles – expose only 4 inch with 8 inch of top soil as shown on RIT detail – do not use leveling nuts to true poles (use washers or shims).
18. All light poles shall be powder coated black finish unless stated and approved otherwise by Owner.
19. Decorative site poles use AAL SP1 with 55 watt LED lamps. Hand hole in pole shall be 18 inch above base so that decorative base cover may be installed. A GFCI duplex outlet shall be 24 inch above base on all poles. Contact RIT for cut sheets.
20. All light pole bases to be installed with 4 inch of base exposed, and a minimum of 8 inch of top soil. Shims are to be used to level poles. Leveling nuts shall NOT be used.
21. Photo cells (with by-pass switch) shall be used for exterior lighting control. Time clocks shall not be used.
22. A minimum of 1 fc shall be between lighting poles.
23. Hand holes are to be avoided. No small round hand holes are to be installed. Quartzite or equal (subject to Owner approval) are to be used.
24. For lawn repairs due to trenching, boring, or other digging, include 8 inch top soil, dressing, and seeding to restore lawn to original conditions with 18 month warranty against settling.
25. For walk or road repairs due to trenching, boring, or other digging, include any pavement repair to original conditions with 18 month warranty against settling.
26. Outdoor Blue Lights
 - a. Specifications
 - i. Blue cubes from Laird Plastics (585-254-8110).
 - ii. 12 inch square Blue cube
 - iii. ¼ inch (.250) thick Blue plastic - color #2051
 - iv. 9 inch diameter hole.
 - v. Light fixture for top of pole (4 inch square) is a Pemco CRY2-X-70MH-120/277 top cap assembly without cube.
 - vi. Light fixture on wall mount bracket is a Pemco S410-A/125 - Powder Coat Black finish used with a Pemco CRY2-X-70MH-120/277 top cap assembly without cube.
 - vii. Use Kistner Uni-base, and 10 feet tall 4 inch square pole (power coated Black) by Flagpoles Inc.
 - viii. Use Ramtel Model RR733 phone in Ramtel Model 926-D enclosure.
 - ix. Contact RIT for cut sheets.
 - b. Install in or near quads and parking lots. New units shall be visible from at least one existing or new call box.

33 82 00 – Communications Transmissions and Distribution

1. Use Schedule 40 PVC conduit for underground use. Transition to RGS sweeping elbow when rising above grade. Provide 3 feet of cover.
2. Pull in a tracer wire of single conductor #10 AWG solid copper insulated (THHN) wire in all conduits, terminate at top of manholes so that entry is not required
3. Use 30 inch diameter manhole rings and covers for all manholes, ADA compliant and cover shall have "TELCOM" cast in.
4. Use pre-cast rings (concrete or plastic) for all manhole risers... do not use brick.
5. Reference Division 27 for further details.

END OF DIVISION 33