

Kennesaw State University
Design and Construction Standards

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KENNESAW STATE
U N I V E R S I T Y

TABLE OF CONTENTS

DIVISION 01 – GENERAL REQUIREMENTS	7
SECTION 01 0000 – GENERAL REQUIREMENTS	7
SECTION 01 3546 – INDOOR AIR QUALITY PROCEDURES	10
SECTION 01 7419 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL	11
SECTION 01 7800 – CLOSEOUT SUBMITTAL REQUIREMENTS	12
SECTION 01 8113 – SUSTAINABLE DESIGN REQUIREMENTS	14
SECTION 01 9100 – GENERAL COMMISSIONING REQUIREMENTS	15
DIVISION 02 – EXISTING CONDITIONS.....	16
SECTION 02 0000 – EXISTING CONDITIONS	16
SECTION 02 2100 – SURVEYS.....	17
DIVISION 03 – CONCRETE	20
SECTION 03 0000 – CONCRETE.....	20
DIVISION 04 – MASONRY	21
SECTION 04 0000 – MASONRY	21
DIVISION 05 – METALS	22
DIVISION 06 – WOOD, PLASTICS & COMPOSITES	23
SECTION 06 0000 – GENERAL WOOD REQUIREMENTS	23
SECTION 06 4000 – ARCHITECTURAL WOODWORK.....	24
DIVISION 07 – THERMAL & MOISTURE PROTECTION	25
SECTION 07 1000 – DAMPPROOFING & WATERPROOFING.....	25
SECTION 07 2400 – EXTERIOR INSULATION & FINISH SYSTEMS.....	26
SECTION 07 5000 – MEMBRANE ROOFING, ACCESSORIES & FLASHING	27
DIVISION 08 – OPENINGS.....	29
SECTION 08 1000 – DOORS, FRAMES, & HARDWARE	29
SECTION 08 3100 – ACCESS DOORS & PANELS	32
SECTION 08 4113 – ENTRANCES	33
DIVISION 09 – FINISHES	34
SECTION 09 2000 – GYPSUM BOARD ASSEMBLIES	34
SECTION 09 3000 – TILING	35
SECTION 09 5100 – ACOUSTICAL CEILINGS.....	36
SECTION 09 6000 – FLOORING	38
SECTION 09 7200 – WALLCOVERINGS	40

SECTION 09 9000 – PAINTING	41
DIVISION 10 – SPECIALTIES.....	43
SECTION 10 1116 – MARKERBOARDS.....	43
SECTION 10 1400 – SIGNAGE.....	44
PART 1 - GENERAL	44
PART 2 - PRODUCTS	46
SECTION 10 2100 – TOILET & SHOWER / DRESSING COMPARTMENTS.....	48
SECTION 10 2200 – PORTABLE / MOVABLE PARTITIONS.....	49
SECTION 10 2600 – WALL PROTECTION	50
SECTION 10 2800 – TOILET ACCESSORIES.....	51
SECTION 10 4100 – EMERGENCY ACCESS	53
SECTION 10 4313 – DEFIBRILLATOR CABINETS	54
SECTION 10 4400 – FIRE EXTINGUISHER CABINETS.....	55
SECTION 10 8000 – INTERIOR WASTE RECEPTACLES	56
DIVISION 11 – EQUIPMENT	57
SECTION 11 1300 – LOADING DOCK EQUIPMENT.....	57
SECTION 11 3000 – BREAKROOM EQUIPMENT	58
SECTION 11 5313– FUME HOODS.....	59
SECTION 11 5200 – AUDIO-VISUAL EQUIPMENT.....	61
SECTION 11 8200 – FACILITY SOLID WASTE HANDLING EQUIPMENT	62
DIVISION 12 – FURNISHINGS	63
SECTION 12 2000 – WINDOW TREATMENTS	63
SECTION 12 4813 – ENTRANCE FLOOR MATS	64
SECTION 12 5000 – FURNITURE	65
DIVISION 14 – CONVEYING SYSTEMS	66
SECTION 14 2000 – ELEVATORS	66
DIVISION 21 – FIRE SUPPRESSION SYSTEMS.....	69
SECTION 21 0510 – GENERAL FIRE-SUPPRESSION REQUIREMENTS.....	69
SECTION 21 1100 – FIRE-SUPPRESSION PIPING	73
SECTION 21 1200 – FIRE-SUPPRESSION STANDPIPES.....	74
SECTION 21 1300 – FIRE-SUPPRESSION SPRINKLERS.....	75
SECTION 21 2200 – CLEAN-AGENT FIRE EXTINGUISHING SYSTEM	76
SECTION 21 3000 – FIRE PUMPS	77
DIVISION 22 – PLUMBING.....	78
SECTION 22 0510 – GENERAL PLUMBING REQUIREMENTS	80

SECTION 22 0519 – METERS AND GAUGES FOR PLUMBING PIPING.....	85
SECTION 22 0553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT	86
SECTION 22 0719 – PLUMBING PIPING INSULATION	87
SECTION 22 1005 – PLUMBING PIPING	88
SECTION 22 1006 – PLUMBING PIPING SPECIALTIES.....	90
SECTION 22 3000 – PLUMBING EQUIPMENT	92
SECTION 22 4010 – PLUMBING FIXTURES.....	93
DIVISION 23 – HEATING, VENTILATING AND AIR-CONDITIONING (HVAC).....	107
SECTION 23 0510 – GENERAL MECHANICAL REQUIREMENTS	108
SECTION 23 0513 – MOTORS FOR HVAC EQUIPMENT	120
SECTION 23 0514 – VARIABLE FREQUENCY CONTROLLERS.....	122
SECTION 23 0515 – ENCLOSED MOTOR CONTROLLERS.....	124
SECTION 23 0519 - METERS AND GAGES FOR HVAC PIPING.....	125
SECTION 23 0548 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT	126
SECTION 23 0553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT	130
SECTION 23 0593 – TESTING, ADJUSTING AND BALANCING FOR HVAC	134
SECTION 23 0713 – DUCT INSULATION.....	147
SECTION 23 0719 – HVAC PIPING INSULATION.....	149
SECTION 23 0913 – INSTRUMENTATION AND CONTROL DEVICES FOR HVAC	151
SECTION 23 0923 – DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.....	156
SECTION 23 09 43 – Laboratory Air Flow Control System.....	156
SECTION 23 2113 – HYDRONIC PIPING	157
SECTION 23 2114 – HYDRONIC SPECIALTIES	168
SECTION 23 2123 – HYDRONIC PUMPS	169
SECTION 23 2500 – HVAC WATER TREATMENT.....	195
SECTION 23 3100 – HVAC DUCTS AND CASINGS	197
SECTION 23 3600 – AIR TERMINAL UNITS	199
SECTION 23 4000 – HVAC AIR CLEANING DEVICES	201
SECTION 23 5216 – CONDENSING BOILERS	202
SECTION 23 5239 - FIRE-TUBE BOILERS.....	204
SECTION 23 6416 – CENTRIFUGAL WATER CHILLERS.....	206
SECTION 23 6417 – MAGNETIC BEARING CENTRIFUGAL WATER CHILLERS	209
SECTION 23 6516 – INDUCED DRAFT COOLING TOWERS	212
SECTION 23 7313 – CENTRAL STATION AIR-HANDLING UNITS - FAN ARRAY.....	214

SECTION 23 8130 – DUCTLESS SPLIT SYSTEM AIR CONDITIONERS (DAC-* & DCU-*).....	220
DIVISION 26 – ELECTRICAL	221
SECTION 26 0500 – GENERAL ELECTRICAL REQUIREMENTS.....	222
SECTION 26 0505 – SELECTIVE DEMOLITION FOR ELECTRICAL	223
SECTION 26 0513 – MEDIUM-VOLTAGE CABLES.....	224
SECTION 26 0519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES	227
SECTION 26 0526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.....	229
SECTION 26 0534 – CONDUIT.....	230
SECTION 26 0537 – BOXES	231
SECTION 26 0553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS.....	232
SECTION 26 1201 – PAD-MOUNTED TRANSFORMERS.....	233
SECTION 26 2413 – SWITCHBOARDS.....	241
SECTION 26 2416 – PANELBOARDS	242
SECTION 26 2417 – SURGE PROTECTIVE DEVICES (SPDS)	243
SECTION 26 2726 – WIRING DEVICES	244
SECTION 26 3213 – ENGINE GENERATORS	245
SECTION 26 4110 – FACILITY LIGHTNING PROTECTION.....	246
SECTION 26 5100 – INTERIOR & EXTERIOR LIGHTING.....	247
SECTION 26 5200 – SENSOR LIGHTING CONTROLS AND LIGHTING DESIGN.....	248
DIVISION 27 – COMMUNICATIONS	250
SECTION 27 0001 – AUDIO VISUAL SYSTEMS	251
SECTION 27 1006 – TELCOM/DATA INFRASTRUCTURE REQUIREMENTS.....	251
SECTION 27 1300 – OUTSIDE PLANT (OSP) CABLING, PATHWAYS, AND COMPONENTS.....	252
DIVISION 28 – ELECTRONIC SAFETY AND SECURITY.....	253
SECTION 28 1000 – ELECTRONIC ACCESS CONTROL SYSTEMS	254
SECTION 28 2000 – VIDEO SURVEILLANCE.....	255
SECTION 28 3100 – FIRE ALARM SYSTEM.....	257
SECTION 28 5001 – DISTRIBUTED ANTENNA SYSTEMS	258
DIVISION 32 – EXTERIOR IMPROVEMENTS.....	263
SECTION 32 1313 – CONCRETE PAVING	263
SECTION 32 1416 – BRICK UNIT PAVING	264
SECTION 32 1700 – PAVING SPECIALTIES.....	265
SECTION 32 3100 – FENCES & GATES	266
SECTION 32 3300 – SITE FURNISHINGS	267
SECTION 32 8000 – IRRIGATION.....	268

SECTION 32 9000 – PLANTING	270
DIVISION 33 – UTILITIES.....	271
SECTION 33 0010 – GENERAL UTILITY REQUIREMENTS	271

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 0000 – GENERAL REQUIREMENTS

A. GENERAL

1. Refer to [Georgia's Department of Community Affairs for Applicable Codes](#).
2. The intent of these standards is not to specify proprietary products or systems. The Design Professional shall specify basis of design with acceptable alternates.
3. All work shall comply with current published criteria of [ADAAG \(Americans with Disabilities Act Accessibility Guidelines\)](#) and all applicable codes.

B. ARCHITECTURAL DESIGN

1. Aesthetic opinions and evaluations by a Design Professional are advisory only – and not binding on KSU. KSU PDC reserves the right for final aesthetic judgment.
2. Interior and Exterior finishes proposed by a Design Professional are advisory only - and subject to review and approval by KSU PDC.
3. General overall layout of rooms, corridors and facilities shall be functional and logical, and meet current codes. Board of Regents Guidelines and Procedures must be satisfied.
4. All drawings shall use KSU Project Number and Project Name.
5. Provide north arrows on all floor plans. Provide key plans where needed for orientation. Confirm exact name and number of projects with Kennesaw State University. Include special conditions and requirement after discussing with the Owner.
6. Specifications shall be provided in book format.
7. In new construction, provide a dedicated service entrance, one service elevator, one service office and one storage room by the service office and the service elevator.
8. In new construction, provide a dedicated mechanical room, electrical room and communications closet on each floor.
9. Room numbering on all design/construction documents shall be coordinated with and approved by Planning, Design, and Construction. Initial space numbering to be established in Schematic Design..
10. For new and renovated buildings, after approval of construction documents, the Architect is to submit an Excel spreadsheet with the final room names, all room numbers per floor, room type, and square footage for our use. All interior spaces should be accounted for, and the total net and gross areas should be documented along with this information. A diagram showing the exterior dimensions and area of each floor should also be included. This information will be used by KSU for the campus Facilities Inventory Report.

11. Provide access to building for maintenance vehicles and loading dock access.
12. Provide adequate storage areas for custodial materials as well as maintenance equipment, preferably one or more per floor. Custodial materials and maintenance equipment not to be in same areas.
13. Mechanical rooms should not be located next to sound-sensitive spaces. Locate high voltage transformers as far as practical from office/classroom space and equipment. Mechanical noise should not be noticeable in classrooms and meeting rooms.
14. Systems requiring routine operation and maintenance, such as HVAC components and electrical panels shall be designed to provide adequate access and clearances for all operation and maintenance tasks.
15. Design space layouts so that all major equipment may be removed and replaced without removal of building elements. Where possible, provide an outside door to mechanical rooms and boiler rooms.
16. Provide safe rooftop access for maintenance and replacement of mechanical or utility equipment. Elevator rooftop access is preferred. Stair access is acceptable. This should be coordinated with Maintenance and Operations.
17. Avoid inaccessible ceiling systems where maintenance is required for above ceiling equipment. Where hard ceilings are required, access panels should be provided at appropriate locations.

C. BIDDING, CONTRACT DOCUMENTS AND CONSTRUCTION

1. Refer to [BOR Building Projects Procedures Manual](#) for general construction and design guidelines.
2. Refer also to Appendix for Section F – Supplementary General Conditions
3. Contractors and vendors are responsible for arranging their own network connections to the internet, etc. KSU can possibly accommodate them with a network connection if the job trailer is within 200-300 ft. of a building and there is sufficient capacity at that location.
4. Contractor to provide a safety plan that identifies temporary barriers, egress, site/building access & staging plan, construction entrance, etc.

D. PROJECT CLOSEOUT

1. Provide electronic copies of Operation and Maintenance Manuals(bookmarked) containing trade, company/vendor contact information, selection and submittal data, warranties,

guarantees and affidavits, etc. to the KSU Project Manager at the Acceptance/Turn-over of the project.

2. All PDF copies of drawing sets issued to the owner should be bookmarked. Individual PDF files shall also be provided for individual sheets. The file shall be numbered per sheet number and drawing title.
3. Design Professional to provide CAD drawings to Owner. BIM models are also required for projects with a Stated Cost Limitation over \$750,000. electronically, saved down to the most recent version of AutoCAD.

SECTION 01 3546 – INDOOR AIR QUALITY PROCEDURES

See Appendix.

SECTION 01 7419 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

See Appendix

SECTION 01 7800 – CLOSEOUT SUBMITTAL REQUIREMENTS**A. DELIVERABLES – DESIGN PROFESSIONAL**

1. Naming Structure - use correct terminology. Name files per sheet numbers (i.e. A101 First Floor Plan).
2. Delivery Type - Autocad file of floor plans, 2D format, with xrefs embedded into the file. Provide complete set of PDF including all disciplines. Also provide individual sheets, named per sheet number and title. Specs to be provided as a single compiled file in PDF format.

A/E DELIVERABLES			
Note: BOR or GSFIC projects shall follow respective Guidelines for deliverables.			
<u>PHASE</u>	<u>DRAWINGS</u>	<u>SPECS</u>	<u>OTHER</u>
SD	2 half size sets; electronic pdf set	N/A	3d Rendering (if within Contract)
	<i>Site Plan; Floor Plans; Building Elevations; Building Sections</i>	<i>Narrative</i>	
DD	1 full size sets; 2 half size sets; electronic pdf set	1 set; electronic pdf	- Cutsheets (lighting and plumbing fixtures [labeled to match schedule], HVAC equipment & door hardware) - Updated 3d Rendering
	<i>Site Plan; Life Safety Plan; Floor Plans; Roof Plan; Building Elevations; Building Sections; Typical Wall Sections; RCPs; Structural Diagrammatic Framing Plan</i>	<i>MEP Narratives; Outline Specifications</i>	
50% CD	1 full size sets; 2 half size sets; electronic pdf set	1 set; electronic pdf	
	<i>Civil Site Plans & Details; Life Safety Plans; Floor Plans; Roof Plan; building Elevations; building Sections; Wall Sections; RCPs; Interior elevations; Details; Schedules; Structural Plans and Details; MEP plans, schedules and details</i>	<i>Specifications</i>	
80% CD	1 full size sets; 2 half size sets; electronic pdf set	1 set; electronic pdf	
	<i>Civil Site Plans & Details; Life Safety Plans; Floor Plans; Roof Plan; building Elevations; building Sections; Wall Sections; RCPs; Interior elevations; Details; Schedules; Structural Plans and</i>	<i>Project Manual</i>	

	<i>Details; MEP plans, schedules and details</i>		
100% CD	2 full size sets; electronic pdf set	2 sets; electronic pdf	Physical Finish samples sent to Planning, Design and Construction.
	<i>Civil Site Plans & Details; Life Safety Plans; Floor Plans; Roof Plan; building Elevations; building Sections; Wall Sections; RCPs; Interior elevations; Details; Schedules; Structural Plans and Details; MEP plans, schedules and details</i>	<i>Project Manual</i>	
CLOSEOUT	Record pdf set Updated Master Campus Plan GIS file	Record pdf set	Updates shall be made to: building footprint; utilities, roads, parking, and other hardscape.

B. DELIVERABLES - CONTRACTOR

1. As-Builts - Contractor to provide a digital copy of the As-Builts.
2. O&M Manuals – Provide electronic copies of each manual for each system as required in the project specifications.
3. Naming Structure for digital files– name files by product type, sheet number and name, at a minimum. Include Project Name/Number on the cover.

SECTION 01 8113 – SUSTAINABLE DESIGN REQUIREMENTS**A. GENERAL**

1. The Design Professional shall incorporate the requirements of the Energy Efficiency & Sustainable Construction Act (SB 130) (O.C.G.A. 50-8-18). The project should also adhere to ASHRAW Standard 189.1 2014, Standard for Design and High Performance Green Buildings. Design Professional will work with Kennesaw State University and any third party to achieve sustainable design within a reasonable scope.

SECTION 01 9100 – GENERAL COMMISSIONING REQUIREMENTS**A. GENERAL**

1. The University, as a part of the State of Georgia, expects all projects to incorporate the requirements of the Energy Efficiency and Sustainability Construction Act of 2008 (“PEACH”) Commissioning activities must be pursued.
2. As a minimum- Commissioning of the following systems must be performed: mechanical, electrical, access controls, and building envelope.
3. PEACH Basic Commissioning requirements must be met.
4. University staff must witness and participate in the commissioning activities.
5. Test & Balance (T&B) is required on all projects. In the case of renovations, before and after.

DIVISION 02 – EXISTING CONDITIONS

SECTION 02 0000 – EXISTING CONDITIONS

A. GENERAL

1. All existing exterior and interior conditions not noted for demolition, improvement, or part of the scope of work in any way, shall be protected during the work to prevent damage and if damaged during the course of the work shall be restored to its original condition.
2. All damaged work shall be repaired by the Contractor at his own expense. If KSU elects to make the necessary repairs with the KSU work forces, the Contractor shall reimburse costs of such repairs.
3. The Contractor shall document with photos and videos all existing conditions of the project site and submit a copy to the KSU Project Manager.
4. The Contractor shall document the condition and operation of all existing equipment to remain.
5. All materials, equipment, and services that were active at the beginning of the project and that will no longer be in service at the end shall be removed from the site. Abandoned infrastructure must be removed.
6. Contractor shall restore existing trees, shrubs, grass, sprinklers, sidewalks, etc. to their original condition if disturbed.
7. Owner will be responsible for removing any items/systems (Salto, AV equipment, and low voltage) that they want to be salvaged or reused. Contractor to coordinate removal of all existing equipment with the Owner.

B. DEMOLITION

1. Contractor should not use KSU's waste management equipment. Contractor shall provide a waste management plan that identifies construction dumpster locations, staging and access routes.
2. Please refer to the Construction and Demolition Waste Diversion Appendix document for additional guidance.

SECTION 02 2100 – SURVEYS

A. GENERAL

1. Prior to excavation the Contractor shall verify that adequate existing conditions investigations have taken place, including utility locates, borings, etc. in coordination with the Owner.
2. Soil conditions should be tested by a licensed professional geotechnical engineer. Copy of soils report shall be delivered to University for project file.

B. DRAWING GUIDELINES

1. General Standards

- a. All deliverables and CAD drawings will be provided in the most recent version of AutoCAD or DWG.
- b. All CAD drawings shall be whole and complete with no Xrefs to symbols or other drawings. The format of the CAD file shall be AutoCAD RVT or DWG. No other format will be accepted.
- c. All drawings will be drawn at true scale and true coordinated in model space.
- d. All plots will be made from paper space at 1:1 (full scale).
- e. All text will be in CAPITAL LETTERS. Standard text height is 1/8", Arial font. Minimum text size is 3/32" for full size drawings.
- f. The paper size for plotting is 22"x34" (full size) and 11"x17" (half-size).

2. File Naming

- a. File names will have a maximum of 36 characters, including hyphens or underscores.
- b. The file name should best describe the design content of each specific drawing. It is advised to precede with the discipline name.
 - i. L3-GRADING_PLAN.DWG
 - ii. A1-FIRST FLOOR_PLAN.DWG
 - iii. Typical Sub-Sheet Designations

<u>G</u>	<u>General</u>	
<u>D</u>	<u>Demolition</u>	
<u>C</u>	<u>Civil/Site</u>	
<u>L</u>	<u>Landscape Arch</u>	
<u>U</u>	<u>Utility</u>	
<u>A</u>	<u>Architecture</u>	
<u>S</u>	<u>Structural</u>	
<u>M</u>	<u>Mechanical</u>	<u>HVAC</u>
<u>E</u>	<u>Electrical</u>	<u>Electrical Plan, Details</u>

- c. Final deliverable PDFs shall use the CD page number as the file name (A101, M101,P101).
3. Deliverable drawings shall follow Industry Standards set by the National CAD Standard, v4.0. It is expected that all CAD files adhere to the recommendations outlined in this standard, to the fullest extent possible.

4. Consulting firms should present project specifications in book format and should be provided separate from the drawings for all projects.
5. CAD Drawing Conventions
 - a. CAD files submitted as part of close-out documents must follow the KSU layering system. This can be found in the Architectural Template. CAD files submitted must follow the requirements:
 - i. Line work-line widths shall be appropriate for identification purposes and use a consistent pattern.
 - ii. Must not contain any additional layers other than those already in the template file.
 - iii. All objects must be placed on the closest appropriate layer, and designated color "By Layer".
 - iv. All blocks used, other than those contained in the template file, must be exploded into elemental objects, and placed on one provided layer for each original block definition.
 - v. All block definitions must be purged from the file.
 - vi. These type of CAD files must be submitted with 100% CD, and again at completion of any major changes that have occurred during the construction process.
 - vii. List of Layers Required
 - b. Floor plans- All rooms and spaces to be numbered per the Kennesaw State University Space Numbering Convention.
 - c. Show all fixtures, equipment, and millwork on the plans.
 - d. On the Reflected Ceiling Plan, show all light fixtures, including exit signs and emergency lights, HVAC supply and return grilles, sprinkler heads, and AV equipment.
 - e. Provide separate furniture plans as needed.
6. Space Numbering Guide-Construction Project Managers are responsible for submitting numbering changes to the Environmental Graphic Designer and CAD Specialist for approval by 50% CD or earlier. The final space numbers should be reflected in the 100% CD set.
 - a. New construction (2023 and beyond) shall follow the 4-digit system.
 - b. Buildings completed before 2023 shall follow the 4-digit system, if renumbered.
 - c. All spaces must be identified and numbered with a unique identifier, even though all spaces may not be given physical signage.
 - d. New Construction Room Numbering Convention
 - i. Single Room 4-digit number (4000)
 - ii. Basement levels have the prefix B (B000)
 - iii. Buildings with Ground levels have the prefix G (G000)
 - iv. All other levels follow numerical order (1000, 2000, 3000, 4000, etc.).
 - v. For a subdivided room where it is not possible to assign a new number in the main series add a capital letter after the number with no spaces (4000A).
 - vi. For a closet door or ancillary door inside a room add a lower-case letter after the number (4000a).
 - e. New Construction Door Numbering Convention
 - i. Single door in room- follow room number assignment (4000)
 - ii. Single room with multiple doors. Each door will be assigned a different letter. Add a dash and capital letter after the number with no spaces (4000-A, 4000-B).

- f. Stairwells and Service Room Numbering- Numbering starts with the level number followed by the hallway or corridor number and then by a letter to identify the space as a stairwell or a service room. The letter is followed by the number assigned to the room/stairwell. The letter assignments per room function are:
 - i. "S" for Stairs (11S1)
 - ii. "E" for Electrical (12E1)
 - iii. "M" for Mechanical (12M1)
 - iv. "T" for Technology such as MDF/IDF, server rooms, etc. (10T1)
 - v. "C" for Custodial (12C1)
 - vi. "L" for Elevator (Lift) Control Rooms (13L1)
 - vii. "F" for Fire related rooms such as fire sprinkler, fire riser, etc. (11F1)
- g. Elevator Numbering Convention- Numbering starts with the letters "EL" to identify the space as an elevator, followed by the number assigned to the elevator. Level number is not assigned (EL01).
- h. Suite Numbering Convention- If needed due to the building layout, develop a grid to create the base pattern for numbering suites. Assign the suite number based on which area of the building most of the interior spaces are located. You may skip numbers in the middle of the series to leave room for subdividing large spaces in the future. All corridors within the suite receive the same number unless there is a door that divides them.
- i. Wayfinding- Room Assignment Logic
 - i. All space numbers shall be four (4) digits. There are exceptions. See Numbering Convention Notes.
 - ii. All spaces shall be numbered corresponding to the level (floor) they are located on.
 - iii. When assigning a number series to each main circulation path, consider the overall circulation of the building (not just the level).
 - iv. Numbering starts with the level number, followed by a distinct circulation (corridor) number- example: 1100, 1200, 1300, etc.
 - v. These number series inform the room number assignments per corridor- example: add rooms in corridor 1400 should start with the digits 14.
 - vi. Use wayfinding decision points as "dividers" to circulation number series.
 - vii. When assigning the circulation number series, be consistent from floor to floor- example: corridor 2100 should be above corridor 1100 (as much as possible).
 - viii. The circulation (corridors) number series should be consecutive so that the user can easily follow a recognizable flow/pattern.
 - ix. Reserve the first ten (10) digits on a corridor series for other non-room spaces- example: nooks, vestibules, collaboration spaces (non-defined).
 - x. Assign room numbers based on which corridor the space's door opens to.
 - xi. When assigning numbers to large rooms that could be subdivided later, you may skip numbers in the middle of the number series.
 - xii. Keep odd numbers on one side and even numbers on the other side of corridors.

DIVISION 03 – CONCRETE**SECTION 03 0000 – CONCRETE****A. GENERAL**

1. Concrete design shall meet or exceed American Concrete Institute (ACI) Standards. Structural drawings shall be sealed by a registered structural engineer in the State of Georgia.
2. Concrete Formwork
 - a. Formwork shall be designed by a professional engineer registered in the State of Georgia.
 - b. Materials shall have sufficient strength to resist deflection in excess of allowable tolerances.
3. Materials
 - a. Generally, all Portland Cement shall be Type I, unless otherwise specifically approved by the Architect or Structural Engineer.
 - b. To the extent feasible and practicable, the construction bid documents are to give preference to concrete materials harvested, extracted, or manufactured in the State of Georgia.
4. Concrete Testing
 - a. All concrete material testing shall be performed by an independent testing laboratory selected and engaged by the Owner.
5. Architectural Concrete
 - a. Exposed concrete as a finished material is acceptable to the University where determined to be appropriate during the design process.
6. Finishes
 - a. Concrete floors shall not vary more than 1/8" in ten (10) feet when measured in any direction.
 - b. Concrete floors shall slope uniformly to floor drains to provide adequate drainage without puddling. Level floors with "dished" areas around drains are unacceptable.
 - c. Concrete floors not receiving an applied finish flooring material shall be cured and protected in a manner that will give a finished surface uniform in color and texture.
 - d. Concrete floors scheduled to receive applied finishes shall not have an application of concrete curing compound or sealer.
 - e. Provide all exterior concrete ramps, walks, loading docks, aprons and similar applications subject to weather with a non-slip broom finish.

DIVISION 04 – MASONRY

SECTION 04 0000 – MASONRY

1. GENERAL

1. Brick Masonry is to be designed and constructed per the standards set by the Southern Brick Institute and the Brick Institute of America.
2. It is recommended for any new brick masonry to match adjacent buildings. Complementary colors are subject to approval by KSU.
 - a. For reference purposes, the typical brick on the Kennesaw, Kennesaw Campus is:
 - i. Cherokee Brick – Velour Cherokee Rose #53-05-206.
 - b. Brick selection on the Marietta Campus will be determined by the location of the construction and the proximity to surrounding buildings. The design should reflect the material of the adjacent buildings, and all designs should be reviewed by KSU PDC prior to finalization.
3. All stone for site or building shall match existing and be approved by KSU.

DIVISION 05 – METALS

A. GENERAL

1. Galvanic Reaction
 - a. Wherever dissimilar metals may come in contact with each other, they must be separated with an appropriate layer of bituminous coating.
 - b. Galvanized metal or zinc plated fasteners shall not be used to anchor aluminum or copper. Use compatible materials or compatible fasteners.
 - c. All exposed structural steel in exterior locations must be hot dipped galvanized or stainless steel.
2. Fireproofing
 - a. In order to achieve the Fire Rating required by the Building Code, it is the University's preference that structural steel and steel decking be protected with sprayed-on fireproofing systems.
3. Miscellaneous Metals
 - a. Handrails and guardrails shall be stainless steel with brushed satin finish. Painted steel railings should be avoided unless located in the interior and integral to the design intent or required by project budget.
 - b. Exterior ladders, stairs, landings and platforms shall be hot dipped galvanized. Ladders shall utilize refabricated (not round) non-slip rungs.
 - c. Pipe bollards shall be hot dipped galvanized and covered with a plastic bollard sleeve.
4. Testing
 - a. All testing, inspections and evaluations of connections shall be performed by an independent testing laboratory selected and engaged by the Owner.

DIVISION 06 – WOOD, PLASTICS & COMPOSITES**SECTION 06 0000 – GENERAL WOOD REQUIREMENTS****A. GENERAL**

Give preference to the use of sustainably grown Georgia lumber certified by the Sustainable Forestry Initiative, the American tree Farm System or the Forest Stewardship Council as stated in the Executive Order of the State of Georgia issued August 10, 2012.

B. BLOCKING

1. Blocking is to be provided at all wall hung and wall attached equipment, including but not limited to the following locations:
 - a. Casework / Millwork
 - b. Grab bars
 - c. Wall mounted toilet accessories
 - d. Toilet Partitions
 - e. Railings
 - f. Sectional Door tracks
 - g. Visual Displays
 - h. Wall door bumpers
 - i. Owner-Provided Digital Screens
2. Specify fire-retardant wood as required by Code.

SECTION 06 4000 – ARCHITECTURAL WOODWORK

A. GENERAL

Give preference to the use of sustainably grown Georgia lumber certified by the Sustainable Forestry Initiative, the American tree Farm System or the Forest Stewardship Council as stated in the Executive Order of the State of Georgia issued August 10, 2012.

B. COUNTERTOPS

1. Breakroom/Work Room/Lactation Room counters – Provide solid surface countertop with 4" high backsplash. Plastic laminate (with standard edge banding) may be considered if budget dictates.
2. Restroom/Unisex Toilet counters – Provide solid surface countertop with 4" high backsplash. **No Plastic Laminate Counters.**
3. Food Services/Dining Hall/Commercial Kitchen counters – Provide either solid surface or quartz countertops with 4" high backsplash. **No Plastic Laminate Counters.**

DIVISION 07 – THERMAL & MOISTURE PROTECTION**SECTION 07 1000 – DAMPPROOFING & WATERPROOFING****A. MOISTURE CONTROL**

1. General
 - a. Exterior envelope systems shall be selected with low maintenance longevity as the primary consideration. Also of primary consideration is the prevention of moisture penetration. EIFS and uncoated concrete masonry systems are not acceptable for permanent buildings.
2. Moisture Control
 - a. Prevent moisture problems (underground). Provide sheet membrane waterproofing and positive slope foundation perimeter drains to grade. Use protection board over all membranes. Vertical drainage sheets shall be specified for waterproof walls. The filter fabric shall wrap a perforated foundation drainage pipe at the base of the wall footing. The drainage pipe shall discharge into the nearest storm water collection system, if available.
 - b. Prevent moisture problems (above ground). Provide metal window and door head flashing, through-wall flashing, and counter flashing with 50-year minimum expected life. Slope all ledges and horizontal surfaces ¼ inch per foot minimum. Damp proofing shall be required on all concrete block surfaces in cavity wall type construction.
3. Vapor Barriers
 - a. Polyethylene is not an acceptable vapor barrier for use under concrete slabs on grade.
4. Roofing
 - a. Low Pitched Roofs
 - i. For concrete roof deck applications provide a peel and stick or torched down temporary roof
 - ii. For most applications 80 mil Gray PVC roofing membrane or a modified bitumen roofing membrane. Consult with the KSU Project Manager for selection.
 - iii. Use polyisocyanurate roof insulation and tapered insulation. Provide with a 20-year warranty.
 - iv. For select applications hybrid roofing system consisting of a reinforced single ply 60 mil Gray PVC fleece backed roofing membrane over a modified bitumen roofing membrane over fiberglass-mat faced gypsum roof cover boards over polyisocyanurate roof insulation and tapered insulation. Provide with a 20-year warranty.
 - b. Architectural/ High Pitched Roofs
 - i. Standing seam metal panels with underlayment. Provide preformed 24 gauge hot-dipped zinc coated fluorocarbon polymer coated steel sheet standing seam metal roofing. Provide with a 20-year warranty.

SECTION 07 2400 – EXTERIOR INSULATION & FINISH SYSTEMS**A. GENERAL**

1. Levels of insulation shall comply with the latest ASHRAE 90.1 requirements.
2. EIFS and uncoated concrete masonry systems are not preferred.
3. EIFS can be approved as an exception based on budgetary concerns. It is not preferred at grade level. Specify hardcoat type, height of high impact system, and drainable system.

SECTION 07 5000 – MEMBRANE ROOFING, ACCESSORIES & FLASHING**A. GENERAL**

1. Exterior envelope systems shall be selected with low maintenance longevity as the primary consideration.
2. All exposed metal shall be factory finished.

B. FLASHING

1. Prevent moisture problems (underground). Provide sheet membrane waterproofing and positive slope foundation perimeter drains to grade. Use protection board over all membranes.
2. Prevent moisture problems (above ground). Provide metal window and door head flashing, through wall flashing, and counter flashing with 50-year min. expected life. Slope all ledges and horizontal surfaces 1/4"/ft. minimum.

C. INSULATION

1. Minimum insulation requirements shall comply with the latest ASHRAE requirements and in no case shall be less than:
 - a. Roof Decks: R25
 - b. Walls: R19
 - c. Attic Ceiling: R38
 - d. Exposed Floors: R30

D. ROOFING

For most applications: 80 mil Gray PVC roofing membrane or a modified bitumen roofing membrane. Consult with the KSU Project Manager for selection. Use polyisocyanurate roof insulation and tapered insulation. Provide with a 20-year warranty.

1. Roofing material specifications shall require the use of "non-asbestos containing material". Roofing repair or replacement on roofs suspected of containing asbestos shall comply with regulations and codes.
2. Insulation Board: Mechanically attached polyisocyanurate insulation minimum 3" thickness. Provide cover board fully-adhered.
3. Use roofing materials with a solar reflectance index (SRI) equal to or greater than 78 for roofs with a slope less than or equal to 2:12 and 29 for roofs with a slope greater than 2:12 for 75% of the roof.

4. Provide minimum 30" wide protected walkway path from roof access to rooftop equipment with walk pads compatible with roofing system. Rooftop equipment should have a walkway path on all four sides for maintenance.
5. Provide an additional membrane "sacrificial" sheet under all rooftop equipment.

E. WARRANTY

1. Specify that the Manufacturer must provide a twenty (20) year, no dollar limit guarantee for the installed roofing system.

F. ROOF SYSTEM COORDINATION

1. Specify manufactured equipment curbs (Pate or Thycurb) for all roof mounted equipment. Don't allow equipment to be mounted on pressure treated wood. Roof maintained equipment should comply with recommended details of the National Roofing Contractors Association *"Handbook of Accepted Roofing Knowledge"*.
2. Fume hood fans, motor starters and other roof mounted equipment should be installed on fully flashed raised curbs without the use of pitch pans. When roof mounted equipment cannot be set on curbs, allow 18 inches clearance minimum to facilitate repairs and reroofing.
3. Provide a roof hatch if there is equipment on the roof. Roof hatch should be a minimum 36" x 30" and should include extendable post and fall protection guardrail. The hatch shall be lockable if not within an enclosed space. Provide a light fixture at point of entry if the hatch is in an enclosed space.
4. Piped overflow drains are preferred in lieu of parapet scuppers.

DIVISION 08 – OPENINGS

SECTION 08 1000 – DOORS, FRAMES, & HARDWARE

A. DOORS

1. Standard door sizes: 3'-0" x 7'-0" x 1.75" wherever possible.
2. Standard interior doors:
 - a. Material – 5 ply solid core plain sliced select white birch wood, book matched. Core construction shall be particle core unless mineral core is required for fire resistance rating.
 - b. Finish: Wood doors shall be factory finished with clear seal coat. Tops and bottoms of wood doors must be finished. Wood doors shall not be painted unless approved by the KSU Project Manager.
 - i. Exception when matching adjacent door veneers in renovation projects.
 - c. Glass Lites in Doors: Install glass lites in office doors to increase visibility and support supervision
3. Standard Exterior Doors:
 - a. Material: 16-gauge Hollow Metal, galvanized steel construction
 - b. Finish: shop-primed painted finish
4. All locksets shall be Grade 1. All locksets where key-override is present, shall accommodate Medico 6 pin interchangeable cores or Key in knob cylinders. Keyway (change) shall be selected by the KSU's Door Access Department. Cores will be provided directly to the Kennesaw State University Door Access Department. Do not provide key cabinets. All hardware shall use US26D finish unless otherwise approved by KSU Door Access Hardware Project Manager.
5. Automatic Swing Doors:
 - a. Provide Record Automatics Series 8000 heavy duty electric swing door operators. No Substitutions unless explicitly approved by KSU Door Access Hardware Project Manager.
 - b. Power door operators shall have a two-year warranty.
 - c. Actuators shall have a stainless-steel touch plate with a blue filled handicap symbol. The actuator shall be weather resistant and provide normally open momentary contacts. Camden Kinetic Series Wireless Actuators will be approved as an alternate when wired actuator installation is deemed not practical for conditions.
6. Manufactured Door Units:
 - a. Type 8000: Surface Applied Operator with Connecting Arms: The operator header shall be mounted to the surface of the existing door frame or wall. Connecting hardware shall be a double arm arrangement that can either push the door or pull the door open to suit the job condition. When the operator mounting is on the pull side and adjacent wall is within 4" (102 mm) of the door frame, specify a parallel arm.
 - b. All Installations/installers shall be Aaadm Certified. All Installations and Set-up should meet current operational code requirements.
7. If possible, where doors swing out, use a full height metal astragal for security. Provide keyed removable mullions at pairs of doors.
8. If possible, where doors swing out, use a full height metal astragal for security. Provide keyed

removable mullions at pairs of doors.

B. FRAMES

1. Standard door frames: Door frames shall be hollow metal, 14-gauge for exterior doors and 16-gauge for interior doors. Knock-down frames shall be used where welded frames are not practical.
 - a. Shop Prime paint all steel material.
2. Sustainable (LEED Certified) finishes and material selections contrary to the campus design standards briefly described herein shall be submitted to the KSU FPDS offices for approval.

C. HARDWARE

1. Hinges
 - a. Butt Hinges: Fully mortised ball bearing hinges for all applications. Non-removable pins must be used on all exterior applications.
 - b. Continuous Hinges: Provide continuous gear hinges at all exterior doors and heavily used interior doors. Continuous gear hinges shall be manufactured of extruded 6063-T6 aluminum alloy with clear anodized finish.
2. Locksets
 - a. Fully mortised Salto locksets with "A" lever handles.
 - i. Salto Mini cylindrical/tubular locksets will be approved as alternate in specified locations (ie: Student Bedrooms)
 - ii. Mechanical alternates will be accepted in specific locations (ie: Single occupancy restrooms)
3. Key Cores: KSU will only accept removable interchangeable key cores (SFIC/LFIC/KIK) keyed into the existing Medeco keying system as follows:
 - a. Kennesaw Campus Academic- LFIC
 - b. Kennesaw Campus Housing- SFIC/KIK
 - c. Marietta Campus Academic- SFIC
 - d. Marietta Campus Housing- SFIC/KIK
4. Closers
 - a. All closers with heavy-duty cast-iron cylinders with all-weather hydraulic fluid and thru bolted.
 - b. Closers shall be provided with a ten-year warranty.
 - c. Concealed closers and floor closers are not acceptable.
 - d. Closers must be thru bolted on hollow metal and wood doors.
 - e. All closers will be required to have LCN 4040 installation footprint regardless of manufacturer.
5. Exit Devices
 - a. All exit devices mounted on labeled wood doors shall be thru-bolted mounted on the door per the door manufacturers' requirements.
 - b. All trim shall be thru-bolted to the lock stile case. The institution prefers rim devices with a keyed removable mullion. Vertical Rod panic devices will not be accepted.
 - c. Exit devices shall be provided with a three-year warranty.

- i. Acceptable manufacturer and series: Von Duprin, 98 Series, Von Duprin, 35 Series
- 6. Trim Plates
 - a. KSU prefers .050" thick stainless steel. Provide both mop plates and kick plates for doors to toilet rooms, custodial closets, kitchens, concessions and locker rooms.
- 7. Thresholds
 - a. The Institution prefers extruded aluminum, complying with ADA requirements.
 - i. Hardware finishes: The Institution prefers US28 or US26D for most applications.
- 8. Glass and Glazing
 - a. Installed glazing systems shall withstand normal thermal movement and wind and impact loads without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials, or other defects of construction.
 - b. Generally, exterior glass shall be comprised of insulated glass units with a 1" nominal thickness utilizing ¼" thick clear inboard pane, ½" air space, and ¼" thick outboard pane.

SECTION 08 3100 – ACCESS DOORS & PANELS**A. GENERAL**

1. Access Panels - Provide appropriately sized flush access panels in gypsum board assemblies in order to service clean-outs, valves and any other devices concealed by drywall.
 - a. Where possible, locate serviceable equipment above accessible ceilings.
2. Type:
 - a. Not key locked, only tool operated.
 - b. Minimum size 18"x18".

SECTION 08 4113 – ENTRANCES**A. ALUMINUM ENTRANCES, STOREFRONTS, AND CURTAINWALLS**

1. Stacked storefront in lieu of curtainwall is NOT acceptable unless explicitly approved by KSU project manager.
2. Framing System
 - a. high performance thermal storefront systems with a u-value of 0.61 or less.
3. Door Construction
 - a. Rails: 2" deep, 3/16" thick, 5" wide minimum top rail, 6 1/2" wide minimum bottom rail
 - b. Stiles: 2" deep, 3/16" thick, 5" wide minimum
4. Aluminum finishes must be as follows unless approved otherwise by the KSU Door Access Project Manager
 - a. Kennesaw Campus: Clear Anodized
 - b. Marietta Campus: Clear Anodized

DIVISION 09 – FINISHES

SECTION 09 2000 – GYPSUM BOARD ASSEMBLIES

A. GENERAL

1. The typical (non-fire rated) interior partition construction shall be of the following minimum standards:
 - a. Metal studs – 3-5/8" 24 gauge minimum
Gypsum Wall Board – 5/8" minimum thickness
2. Work with Planning, Design and Construction to determine partition heights and acoustical requirements.
3. Acoustics should meet the STC ratings per industry standards.
4. Finish
 - a. Match existing design conditions where possible on renovations, Level 4 finish standard.
 - b. Level 5 drywall finish is required in all areas where gloss, semi-gloss enamel or non-textured flat paints are specified, except in building service areas that receive semi-gloss paint but will not need the Level 5 drywall finish.
 - c. New walls that are scheduled to receive special wall treatments should be finished to Level 5.
 - d. Moisture resistant gypsum board should be used at wet walls.
 - e. High abuse gypsum board should be considered for corridors and service areas and high impact areas.

SECTION 09 3000 – TILING**A. GENERAL**

1. Porcelain Tile – Large format tiles preferred. Design Professional to select tile that is readily available in USA and does not have a long lead time for delivery.
2. Natural Stone – Natural materials that have voids that may fracture under floor loads are not acceptable.
3. Grout – Stain resistant epoxy grout.
4. Restrooms & Janitor Closets – Tile flooring to be installed over a waterproof coating that extends up partitions a min. of 6" high.
5. Restrooms Wet Walls – Tile to extend up partition min. 6'-0" AFF.

SECTION 09 5100 – ACOUSTICAL CEILINGS

A. GENERAL

1. Typical suspended ceiling grid to be 24" x 24" – 15/16" white tegular exposed tee grid. Alternate ceiling types or designs may be submitted for approval by the University.
2. Campus Standard Ceiling Tile –
 - a. Dry Area Ceiling Tile
 - i. Armstrong "Mesa" 681, 24" x 24" x 3/4" Angled Tegular, NRC 0.60, CAC 38
 - b. Wet Area Ceiling Tile
 - i. Armstrong Ceramaguard Fine Fissured Perforated, 24" x 24" x 5/8", Square, Lay-In, NRC 0.55, CAC 38
3. Campus Ceiling Tile Acceptable Upgrades –
 - a. Armstrong "Cirrus" High NRC 556, 24" x 24" 5/16", NRC 0.75, CAC 35, AC 170
 - b. Armstrong "Cirrus" 584, 24" x 24" x 3/4", 5/16", Angled Tegular, , NRC – 0.70, CAC – 35.
 - c. Armstrong "Mesa" 680, 24" x 24" x 3/4", square edge, NRC – 0.60, CAC – 35. To be used exclusively when reusing a grid without regular edges.
 - d. Armstrong "Cortega" 770, 24" x 24" x 5/8", 5/16" square lay-in, , NRC – 0.55, CAC – 33. Only to be used when matching an existing ceiling tile in the same area.
4. Acoustical Performance to be determined by the following standards:
 - i. Ceiling Attenuation Class (CAC) – a measure of reduction in sound transmission via plenum path between two adjacent rooms, determined in accordance with ASTM e 1414, and plotting decibel reduction (transmission loss) obtained at 16 frequencies against a standard reference curve, in accordance with ASTM e 413. **A ceiling with a high rating of 35 is preferred.**
 - ii. Noise Reduction Coefficient (NRC) – a measure of sound absorbed by a material. The single number designation represents the average of the sound absorption coefficients of a material at 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz rounded to the nearest 0.05 when tested in accordance with ASTM C 423. **A minimum NRC is considered to be 0.65.**
 - iii. Articulation Class (AC) – rates a ceiling's suitability for achieving normal speech privacy in open office spaces as a function of noise absorption and reflection into adjacent cubicles. AC is the primary measure of acoustic performance in open plan offices and is covered in ASTM E1110 and E1111. **A ceiling with an AC above 170 is preferred.**
 - iv. Sound Transmission Class (STC) – a single-number rating of a material's or assembly's sound barrier effect. Higher STC values are more efficient for reducing sound transmission. For example, loud speech can be understood fairly well through an STC

30 wall or ceiling, but should not be audible through an STC 60 wall. The rating assesses the airborne sound transmission performance at a range of frequencies from 125 Hertz to 4000 Hertz. This range is consistent with the frequency range of speech. The STC rating does not assess low frequency sound transfer. Special consideration must be given to spaces where the noise transfer concern is other than from speech, such as mechanical equipment or music. Even with a high STC rating, any penetration, air-gap, or “flanking” path can seriously degrade the isolation quality of a wall. Flanking paths are the means for sound to transfer from one space to another other than through the wall. Sound can flank over, under, or around a wall. Sound can also travel through common ductwork, plumbing or corridors.

1. **STC-45** if the adjacent space is a corridor, staircase, office or conference room,
 2. **STC-50** if the adjacent space is another core learning space, speech clinic, health care room or outdoors,
 3. **STC-53** if the adjacent space is a restroom,
 4. **STC-60** if the adjacent space is a music room, mechanical equipment room, cafeteria, gymnasium or indoor swimming pool.
 5. Classroom doors should be rated as **STC-30** or more, and music room doors as **STC-40** or more. Entry doors across a corridor should be staggered to minimize noise transmission.
- v. Impact Insulation Class (IIC) – tests the ability to block impact sound by measuring the resistance to transmission of impact noise or structure-borne noise (simulating footfalls, objects dropped on the floor, etc.).
1. IIC ratings for floor-ceiling assemblies above core learning spaces should be at least **IIC-45** and preferably **IIC-50** (measured without carpeting on the floor).
 2. In new construction, gymnasiums, dance studios or other high floor impact activities shall not be located above core learning spaces.
 - i. In existing facilities, **IIC-65-70** (depending on the volume of the space below) is recommended if gymnasiums, dance studios or other high floor impact activities are located above core learning spaces.

SECTION 09 6000 – FLOORING

A. GENERAL

1. Design Professional to verify with KSU Project Manager existing building finishes when renovating existing buildings.

B. CARPET

1. Carpet Tile/Plank – Modular carpet only. Carpet tiles shall be modular, high-performance, and suitable for commercial applications. Tiles must meet or exceed industry standards for durability, indoor air quality, and sustainability. All materials shall be free of hazardous substances and comply with local and national environmental regulations. Backing to be PVC-free backing with high dimensional stability, moisture resistance, and resistance to delamination. Pile constructions to be level loop, textured loop, or multi-level loop for enhanced durability.
2. The following manufacturers are acceptable, but not limited to:
 - a. Interface
 - b. Shaw Contract
 - c. Mohawk Group
 - d. Tarkett
 - e. Bentley Mills
 - f. Patcraft
 - g. J+J Flooring
3. Walk-off Mat – Modular carpet tile. Installation to be pressure-sensitive adhesive. Campus Standards are as follows:
 - a. Shaw Contract, Path Tile in color Lave

C. RESILIENT FLOORING

1. Luxury Vinyl Tile (LVT) shall be constructed from homogeneous or multi-layered vinyl with a reinforced wear layer. It must have a minimum 20 mil wear layer for commercial use and a total thickness ranging from 2.5 mm to 5 mm. Standard dimensions shall comply with manufacturer specifications, such as 6" x 48" or 12" x 24". The surface finish shall be UV-cured polyurethane with enhanced scratch resistance, and the edge profile may be either square or beveled
2. The following manufacturers are acceptable, but not limited to:
 - a. Interface
 - b. Shaw Contract
 - c. Armstrong Flooring
 - d. Mohawk Group
 - e. Tarkett
3. LVT flooring shall be installed in accordance with the manufacturer's guidelines, using only recommended adhesives and allowing for proper curing time. Tile and plank patterns must be consistently aligned throughout the installation. To ensure full adhesive contact, the flooring shall be thoroughly rolled after placement.
4. Vinyl Composite Tile (VCT) – NOT acceptable.

5. Rolled/sheet goods- (Marmoleum), NOT acceptable. Tiled products are acceptable. Cannot be used in heavily wheeled traffic areas (i.e. Dining Hall).
6. Rubber Base – Rolled goods only, sections not acceptable. Campus Standards are as follows, but not limited to:
 - a. Roppe, Pinnacle Rubber Base, 4” high, Standard Toe, Color: 193 Black Brown.
- 7.
8. .

D. OTHER

1. Poured/rolled flooring – mechanical rooms (epoxy rolled on with aggregate), kitchen facilities, dishrooms, (industrial grade), and Janitor closets.
 - a. Minimum slip resistance coefficient shall follow the requirements set forth by the IBC and ADA codes, for the intended use.
2. Polished/Stained Concrete – Refer to American Society of Concrete Contractors' Concrete Polishing Council (ASCC-CPC), Finishing: Class A or B, Gloss Level: 2 Satin (Honed) or 3 Polished.
3. Wood Base – NOT acceptable.

SECTION 09 7200 – WALLCOVERINGS

A. GENERAL

1. Vinyl and fabric wallcoverings shall only be used on a case-by-case basis with prior approval from KSU's Interiors Department.

SECTION 09 9000 – PAINTING

A. GENERAL

1. Interior paints and primers to be water-based complying with VOC requirements established by Green Seal Standard 11.
2. Paint Finishes:
 - a. Offices, Classrooms, Conf. Rooms, etc. – Latex eggshell finish.
 - b. Corridors, High Traffic Areas, etc. – Latex satin finish.
 - c. Restrooms, Janitor Closets, Wet Areas, etc. – Epoxy semi-gloss finish.
 - d. Metal Doors, Door Frames – Latex semi-gloss finish.
 - e. Wood Doors – Match existing finish in existing buildings, new construction either stained or clear coated with a urethane varnish satin.
 - f. Interior Railings (Public areas) – Factory or shop applied powder coat semi-gloss finish.
 - g. Interior Railings (Back of house or egress stairs) – Latex semi-gloss finish.
3. Paint Colors Campus Standards, but not limited to:
 - a. Sherwin Williams SW 7008 “Alabaster” (General Wall Color)
 - b. Sherwin Williams SW 7020 “Black Fox” (Door Frames and Railings)
 - c. Sherwin Williams SW 6904 “Gusto Gold” (KSU Gold)
 - d. Sherwin Williams SW 6991 “Black Magic” (KSU Black)
 - e. Sherwin Williams SW 7016 “Mindful Gray” (KSU Slap Rock Gray)
4. Design Professional to verify with KSU Project Manager existing building finishes when renovating existing buildings.

B. INTERIOR DESIGN

1. All proposed finish and furniture selections will be submitted to and approved by the KSU Project Manager and Interior Designer.
4. Color standards for existing campus building are on file in the Kennesaw State University Planning, Design and Construction office.

5. Finishes - All finishes shall be selected for easy maintainability and durability. In high abuse areas, these are the essential characteristics to consider in material selections.

DIVISION 10 – SPECIALTIES

SECTION 10 1116 – MARKERBOARDS

A. GENERAL

1. Markerboards shall be provided in all auditoriums, classrooms, conference rooms, and student group study rooms. Size and location to be determined based on room size, function, and audio-visual requirements. Sizes to be manufacturer standards, custom sizes not acceptable.
2. Frameless Whiteboards – Provide porcelain enamel steel magnetic boards without bottom tray and magnetic accessory pack with holder for markers, eraser, and cleaner.
3. Glass Wall Boards – Provide frameless, magnetic, glass boards with magnetic accessory pack with holders for markers, eraser, and cleaner.

SECTION 10 1400 – SIGNAGE

PART 1 - GENERAL

A. SUMMARY

This section outlines the signage design expectations for new construction and renovation projects. It is intended to guide Design Professionals in delivering signage systems that are fully coordinated, code-compliant, and aligned with the Kennesaw State University's visual identity signage and user experience standards.

1. The Design Professional shall plan, document, and coordinate a comprehensive signage package that includes, but is not limited to:
 - a. Permanent room identification signage.
 - b. Directional and wayfinding signage.
 - c. Regulatory and life safety signage (including stairwell identification and code-required elements).
 - d. Exterior campus wayfinding sign updates (as needed, if included in the project scope).
 - e. Branded environmental graphics/wall graphics (if included in the project scope).
 - f. Temporary or instructional signage for phased occupancy or transition periods.
2. All signs shall comply with the current **Kennesaw State University (KSU) Signage Standards**. Where signs are to match existing conditions (in phased renovations), design must align with the established visual and architectural context.
3. Signage shall meet all applicable codes and regulations, including:
 - a. Americans with Disabilities Act (ADA)
 - b. ICC/ANSI A117.1
 - c. Local fire and building codes

B. DESIGN REQUIREMENTS

1. **Comprehensive Signage Design:** Signage must be designed and fully documented, regardless of whether final fabrication is procured through the construction contract or separately by the University. The system must be logical, legible, and user-centered, supporting wayfinding and identification throughout the building or renovated area.
2. All signage shall follow the KSU Signage Standards and Guidelines.
 - a. Any proposed deviations from the signage standards must be reviewed and approved by KSU's Planning, Design, and Construction team.
3. **Room Identification:** The Design Professional shall provide code-compliant room number/identification signs for all project spaces that do not have existing signage meeting KSU standards or reflect updated room numbering. New signs shall match the University's approved standards in design, format, and placement.
4. **Egress Plan Integration:** The Design Professional shall identify and coordinate dedicated locations for code-required emergency egress plans.
 - a. Egress plans must be based on final construction floor plans and reflect all applicable fire and life safety codes.

- b. The Design Professional shall provide electronic floor plan files to the contractor for the fabrication of permanent egress signage.
 - c. These plans must be installed as part of the construction scope, with final locations clearly documented on plans.
- 5. **Design Consistency:** Typography, materials, layout, and color usage must align with KSU's established signage and environmental graphic standards. Deviations must be pre-approved by KSU's Planning, Design, and Construction department.
- 6. **User Coordination:** The Design Professional shall consult with designated University representatives and end users to confirm room names, sign text, department names, and special messaging requirements. All final copy and locations must be verified prior to completion of construction documents.

C. DOCUMENTATION AND DELIVERABLES

1. The design professional shall include the following in the Construction Document set:
 - A. **Signage Plan Drawings** identifying sign locations and types.
 - B. **Signage Schedule** with tag numbers, quantities, copy, and room numbers.
 - C. **Signage Design Sheets** illustrating typical sign types, mounting details, and dimensions.
 - D. Coordination notes indicating interfaces with other trades (e.g., wall finishes, lighting, access control).
 - E. Identification of any **signage requiring power or illumination**.
 - F. Notes on ADA and code compliance throughout.
2. The design professional shall prepare a signage package that can be priced and implemented independently of general construction.
3. The design team is responsible for ensuring **mounting conditions and backing requirements** are clearly documented for all sign types.

E. COORDINATION REQUIREMENTS

1. Signage documentation must be developed in coordination with architectural, interior, life safety, and MEP disciplines including but not limited to:
 - a. Interior finishes and wall protection.
 - b. Door and hardware schedules.
 - c. Fire alarm and life safety systems.
 - d. Lighting and ceiling conditions.
 - e. Technology and AV placements.
2. The Design Professional shall field-verify conditions and include mounting details and wall blocking requirements in coordination with General Contractor trades, as needed.
2. Signage design must be reviewed with the KSU's Planning, Design, and Construction team at each major design phase.
3. Signage scope shall be coordinated with the university's KSU's Planning, Design, and Construction team to determine procurement path (e.g., via Task Order Vendor or GC
4. Coordination meetings regarding **signage message schedules, graphics, and installation logistics** may be required during Design Development and Construction Document phases.

PART 2 - PRODUCTS

A. GENERAL

1. All signage shall be fabricated using durable, tamper-resistant materials appropriate for interior or exterior installation, and designed for long-term performance in high-traffic public and institutional environments.
2. Materials, finishes, and layout must match the standards outlined in the **Kennesaw State University Signage Guidelines**, unless otherwise directed by the University's Planning, Design and Construction team.

B. SIGN TYPE REQUIREMENTS

1. Building Directories – Provide a directory located on each floor at the elevator lobby and/or main building entry lobby listing the main spaces in the building, i.e. – auditorium, departments, colleges, dean's office, etc.
- 2.
2. Wayfinding Directional Signage – Provide directional signage as needed to support intuitive circulation and wayfinding within the building. Directional signage must reference **room numbers only; department names or program titles shall not appear** on these signs to maintain consistency and flexibility over time.

The appropriate sign type—**wall-mounted, flag-mounted, or ceiling-suspended**—shall be determined based on **field conditions and visibility at each decision point**. Sign placement must consider line of sight, ceiling height, corridor width, and potential obstructions to ensure optimal readability and user guidance.

3. Building Maps – Provide an 11" x 17" print format color graphic map mounted in an acrylic frame as detailed in the KSU Signage Standards located at the elevator lobby and/or main building entry lobby showing the main spaces in the building, i.e. – auditorium, departments, colleges, dean's office, etc. Graphic plan to also show egress routes, severe weather refuge areas, fire extinguishers, emergency exits, fire alarm pull stations, and automated external defibrillators.

Standardized graphic templates for these maps will be provided to the Design Team and must be used in the development and production of final graphics to ensure consistency with campus-wide signage and branding.

4. Interior Signage – All interior spaces are to be identified with an code compliant room identification sign mounted on the latch side of the door complying with ADA requirements.

The room type shall determine which ADA-compliant sign type from the KSU Signage Standards is to be used—for example, an ADA room plaque with a paper insert window, an auxiliary room ID, or a large ADA sign with symbol.

5. Amenity identification signage—including restrooms, vending areas, elevators, and similar spaces—shall be provided using flag-mounted signs, in accordance with the KSU Signage Standards and Guidelines. Sign placement, size, and mounting height shall comply with university requirements and applicable accessibility codes.
6. Department-Specific Signage – Signage identifying departments, colleges, or Dean’s suites shall be evaluated on a case-by-case basis due to the long-term maintenance implications and costs associated with updates resulting from departmental name changes or relocations. The Design Professional shall coordinate with the University to determine whether department-specific signage is appropriate for inclusion in the project scope.
7. Building Monument Sign – provide one monument sign located along the primary street frontage or main pedestrian walkway adjacent to the building’s main entrance. If a monument sign already exists at the site, its condition and relevance shall be evaluated. If updates are required to reflect the current project or institutional standards, the monument sign shall be included within the project scope for modification or replacement, subject to the approval of KSU Planning, Design, and Construction.
8. Building Number Sign(s) – Provide building number sign(s) on the exterior of the building in prominent location(s) adjacent to the building entrance(s) visible from a distance.
9. See Appendix – **KSU Signage Standards and Guidelines for detailed drawings, specifications, and approved sign types.** The Design Professional shall use these standards as the basis for all signage design, ensuring consistency in materials, typography, layout, and installation details across the project.

SECTION 10 2100 – TOILET & SHOWER / DRESSING COMPARTMENTS**A. GENERAL**

1. Provide floor anchored overhead braced toilet compartments. Ceiling hung compartments are NOT acceptable.

B. MATERIAL

1. Preferred panel construction may be either black core solid phenolic or stainless steel with “Diamond” embossed texture. Solid plastic (HPDE) panels may be used due to project budget limitations. Painted metal panels are NOT acceptable.

C. HARDWARE

1. Provide either continuous heavy duty anodized extruded aluminum or continuous heavy-duty stainless-steel wall brackets.
2. Provide continuous stainless-steel hinge at compartment doors.

SECTION 10 2200 – PORTABLE / MOVABLE PARTITIONS**A. GENERAL**

1. Operable partitions, where required for subdividing multi-use spaces, may be either manual or motorized operation depending on the specific function or use. Operation shall be simple enough for one person to operate.
2. Provide either horizontal single panel, horizontal double panel or vertical folding panels depending on project budget. Accordion partitions are NOT acceptable.
3. Design Professional to specify operable partition enclosures that meet or exceed a STC-50 rating and design enclosures to eliminate flanking paths for sound transmission, which shall be field verified by an independent testing agent.

SECTION 10 2600 – WALL PROTECTION

A. GENERAL

1. Corridors, public spaces, and high traffic areas enclosed with drywall partitions shall have corner protection at each corner. Areas that have movable furniture against drywall partitions shall have wall protection to prevent damage from tables and/or chairs sliding along or leaning against partitions.
2. Basis of Design (or prior approved equal):
 - a. Corner guards – Construction Specialties, SM-20N Acrovyn 4000 corner guards, min. 48” high, color coordinated with wall color.
 - b. Rubstrips – Construction Specialties, RS-40N Acrovyn 4000 rubstrips, min. 6” high mounted to coordinate with table/chair heights, color coordinated with wall color.

SECTION 10 2800 – TOILET ACCESSORIES**A. GENERAL**

1. Refer to “Toilet Accessories Table” below and Appendix for Toilet Accessory cut sheets.
2. Restrooms to have exhaust fan with back flow damper.
3. Waste receptacles shall be located under the lavatory counters with a stainless-steel waste chute or opening in counter. Provide one waste receptacle per pair of lavatories located between lavatories so they are accessible from both.
4. Install one soap dispenser per pair of lavatories located between lavatories so they are accessible from both.
5. Provide both paper towel dispensers and hand dryers in each restroom, with the exception of unisex toilets and lactation rooms. Unisex toilets and lactation rooms shall only have a paper towel dispenser.
 - a. Paper towel dispensers and hand dryers installed on drywall partitions shall have a water-resistant finish, i.e. – tile, stainless steel, solid surface, etc.
 - b. Never install paper towel dispensers or hand dryers on a painted drywall surface.
 - c. Locate units together preferably on wall opposite lavatories so as not to impede access to lavatories while drying hands.

TOILET ACCESSORIES TABLE						
Description	Contractor Provided	Contractor Installed	Owner Provided	Owner Installed	Manuf.	Model Number
Hand Dryer	X	X			Excel Dyson (ALT.)	Xlerator XL-SB Airblade V HU02 Sprayed Nickel (ALT.)
Seat Cover Dispenser	X	X			Bobrick	B-221
Toilet Tissue Dispenser	X	X			Bobrick	B-2892
Soap Dispenser		X	X		GOJO	LTX-12
Paper Towel Dispenser		X	X		Wausau Paper	Optiserv Hybrid

Janitor's Closet Utility Shelf	X	X			Bobrick	B-239

SECTION 10 4100 – EMERGENCY ACCESS

A. GENERAL

1. Design Professional to coordinate emergency access required with the Authority Having Jurisdiction.
2. Provide a Fire Department Knox Box for new construction and major renovations per Cobb County Fire Department specifications.

SECTION 10 4313 – DEFIBRILLATOR CABINETS**A. GENERAL**

1. Automated External Defibrillator (AED) cabinets to be provided, located and installed by KSU Public Safety. Each floor to have a min. of one AED unit, two depending on the floor area and layout, located adjacent to the elevator lobby and main circulation paths.
2. Design Professional to provide location and/or recess to comply with ADA requirements for protruding objects in circulation path.
 - a. AED cabinet is 18" x 18" x 7" deep mounted at 42" AFF to the bottom.
 - b. Design professional to request current manufacturer's cut sheet from KSU.

SECTION 10 4400 – FIRE EXTINGUISHER CABINETS**A. GENERAL**

1. Fire extinguisher cabinets shall be semi-recessed and should fit in a 3 5/8" metal stud partition.
2. Locations required per state building codes to be reviewed by KSU Fire Safety Manager to determine if additional locations are required.
3. Provide fire extinguisher cabinet adjacent to the MDF/IDF rooms, not within the room.
4. Provide Type A-B-C fire extinguisher, typical.

SECTION 10 8000 – INTERIOR WASTE RECEPTACLES

A. GENERAL

1. The University contracts with a waste management vendor, who provides a single stream recycling service so only one general recycling waste receptacle needs to be provided in lieu of separate receptacles for paper, plastic, glass, etc.
2. Interior waste receptacles shall be included in the Contractor's scope of work for new construction and major renovations. See Appendix.

B. RECEPTACLES

1. Public Areas, Entry/Elevator Lobbies & Corridors
 - a. General Waste – Rubbermaid FGSC22ERBSM, 50 gal., color: "Stardust Silver Metallic".
 - b. Recycled Waste – Rubbermaid FGDCR24TSM, 29 gal., color: "Stardust Silver Metallic".
2. Auditoriums, Classrooms, Conference Rooms, Group Study Rooms & Breakrooms
 - a. General Waste – Rubbermaid "Slim Jim" FG354060BLA, 23 gal., color: "Black".
3. Offices & Workstations
 - a. General Waste – Rubbermaid FG295600BLA, 28 qt., color: "Black".
 - b. Recycled Waste – Rubbermaid FG295673BLUE, 28 qt., color: "Blue".
4. Restrooms
 - a. General Waste – Rubbermaid "Slim Jim" FG354060BLA, 23 gal., color: "Black".

DIVISION 11 – EQUIPMENT

SECTION 11 1300 – LOADING DOCK EQUIPMENT

A. GENERAL

1. Min. requirements for a service dock to be 48" high concrete dock with projected dock bumpers sized based on slope of the loading area to the dock to prevent the top of the truck from hitting the loading dock door and/or building wall.
2. Recessed pit style mechanical leveler preferred, if project budget allows.
 - a. Mechanical Edge-of-Dock leveler acceptable as alternate to recessed pit mechanical leveler.

SECTION 11 3000 – BREAKROOM EQUIPMENT**A. GENERAL****1. Refrigerators:**

To be specified by Design Professional and to be included in the Contractor's scope of work.

- a. Provided with an icemaker
- b. One per Breakroom
- c. Finish to be stainless steel

2. Microwaves:

- a. To be specified by Design Professional and to be included in the Contractor's scope of work.
- b. One per breakroom
- c. Locate unit either on countertop or on shelf below counter to provide ADA accessibility.

SECTION 11 5313– FUME HOODS

A. CHEMICAL FUME HOODS

1. Hood locations
 - a. Must be located out of path of laboratory egress.
 - b. Must include appropriate make-up air supply.
 - c. Supply air shall not interfere with the fume hood air barrier.
2. Lab exhaust fan systems
 - a. Must be sized to provide an occupied flow rate of 100 linear feet per minute (lfpm).
 - b. An unoccupied flow rate of 60 lfpm as determined by occupancy sensors shall be maintained at all sash positions.
3. Sash stops must be provided at the 18" level.
4. Face velocity monitor with an audible local alarm will be installed at each hood.
 - a. Sensors must be hot wire. Pressure differential sensors are not acceptable.
5. Fume hood exhaust must be labeled hazardous.
6. Variable air volume hoods and manifold fan systems are recommended in high hood density locations.
7. Non-ducted fume hoods are not acceptable. Fume hood exhaust must be integral to lab ventilation system design.

B. SPECIAL CONSIDERATIONS

1. Perchloric acid hoods - must include provisions for wash down and exhaust must be separate from general lab exhaust.
2. Hydrofluoric acid – hood must be polymer lined.
3. Iodination - hood must be stainless steel lined filtered inserts inside the fume hood.
4. Glove box for chemicals.
5. Under hood storage cabinets for storage of corrosive/flammable are preferred.
6. Chemical storage cabinet doors (flammable liquid and others) must not have automatic closers.

C. ENERGY CONSIDERATIONS

1. Designs shall attempt to realize increased levels of energy performance.

2. Proximity sensors may be installed on chemical fume hoods to provide a setback to 60lfpm at all such heights in an unoccupied mode. Overrides must be provided.
3. Fume hoods may be put on a night set back to 60 lfpm for unoccupied mode. Overrides must be provided. Default for the hood shall be 100 lfpm.
 - a. Occupancy sensors or light **switch** interlocks are acceptable.
4. Energy recovery systems are acceptable. Fume hood exhaust must not be routed through energy wheels.
5. Biosafety level 3 laboratory exhaust energy recovery shall be evaluated by EHS and must have a means of decontamination prior to service.

SECTION 11 5200 – AUDIO-VISUAL EQUIPMENT

A. GENERAL

1. Audio-visual systems for auditoriums, classrooms, student group study rooms, conference rooms, etc. shall be designed and specified by KSU IT. Audio-visual design and equipment specifications will be provided by KSU IT to Design Professional to coordinate power, data and structural support requirements.
2. Auditoriums or classrooms with exterior windows that require black-out shades for audio-visual system shall be integrated with audio-visual system for operational control.
3. See Appendix for KSU Audio-Visual Equipment Design-Build Requirements.

SECTION 11 8200 – FACILITY SOLID WASTE HANDLING EQUIPMENT**A. GENERAL**

1. The University contracts with a waste management vendor, who provides a self-contained compactor. Design Professional to verify the equipment specifications with the current waste management vendor. See Appendix.
2. Provide two self-contained compactors, min. 34 CY/each, per building typical: One for recycling and one for regular trash.
3. Provide reinforced concrete pad sized per the current waste management vendor equipment specifications.

DIVISION 12 – FURNISHINGS

SECTION 12 2000 – WINDOW TREATMENTS

A. GENERAL

1. All exterior windows shall have window shades in each auditorium, classroom, office, conference room, etc., except for large public spaces, i.e. – entry lobbies. Public spaces and/or corridors with seating/lounge furniture with exterior windows may have window shades to be determined on a case-by-case basis.
2. Use of draperies, vertical blinds and/or 1” wide aluminum horizontal mini-blinds is not allowed.
3. Manual roller fabric shades are the preferred window treatment. Fabric shades shall be max. 1% open fabric. Provide manufacturer’s standard aluminum fascia to conceal mechanisms with finish to match window framing.
4. Auditoriums and large (80 seat) classrooms with exterior windows shall have a dual motor-operated roller fabric shade connected to audio-visual system. Exterior fabric to be max. 1% open and interior fabric to be black-out shade with side channels.
5. Acceptable manufacturers and specifications- match existing when possible.
 - a. Mecho Shade
 - i. Thermoveil 1700 Series, 1719 Silver birth 1% open
 - ii. Classic Blackout, 0700 Series, 0702 Light Gray
 - b. SW Contract
 - i. Crosshatch R100, C7912 Eggshell/Fog 1% open
 - ii. Conceal Blackout, C2616 Dove

SECTION 12 4813 – ENTRANCE FLOOR MATS

A. GENERAL

1. All entrance vestibules shall have a walk-off area to cover the entire vestibule. Provide walk-off carpet tiles per [Section 09 6000 – Flooring](#).
2. Recessed aluminum grate or grille type floor mats are NOT acceptable.

SECTION 12 5000 – FURNITURE

A. GENERAL

1. The University will contract with a furniture vendor to design, layout, specify, procure, and install furniture for new construction and major renovations. Design Professional will participate in the furniture selections and finishes to coordinate with the design of the building.
2. Typical office layouts have been developed to provide office standards. Refer to Appendix for typical office furniture layouts.
3. Fixed seating for tiered auditoriums and/or large tiered classrooms shall be specified by the Design Professional to be included in the Contractor's scope of work. Fixed seating shall be 20" wide minimum. Provide adequate spacing to allow for the physically challenged and provide space for ADA accessibility seating areas.
4. The University has final approval on all furniture selections with the input from the University Building Committee and the Design Professional.
5. For all lounge furniture do NOT provide tablet arms.

DIVISION 14 – CONVEYING SYSTEMS

SECTION 14 2000 – ELEVATORS

A. GENERAL

1. The service elevator or at least one (1) elevator needs to be on the emergency generator.
2. Provide three complete sets of final wiring diagrams, operating and maintenance manuals, parts manuals and troubleshooting guides. Provide all user and service codes for all diagnostic equipment with instructions.
3. Provide all special diagnostic equipment, meters or monitors manuals needed to trouble shoot or repair elevators. Proprietary equipment, components, computer hardware and software, shall not be used.
4. Parts or troubleshooting equipment needed to repair or maintain elevator equipment should be easily obtainable and generic.
5. Provide 2 copies of "design certificates" to University.
6. To keep University elevator equipment in peak running environment, all new and renovated elevators shall have air conditioning and humidity controls in the control cabinets or equipment rooms. Shaft ways exposed to exterior environment (i.e. parking garages) shall be provided with humidity control to prevent water condensation on rails and operating mechanisms.
7. The entire elevator installation shall be in accordance with ASME A17, the most current edition.

B. MANUFACTURERS

1. Approved manufacturers:
 - a. KONE Elevators
 - b. Thyssen Krupp
 - c. Otis Elevator Company

C. ELEVATOR DESIGN

1. For passenger elevators, the elevator speed shall be no less than 150 FPM. For freight elevators, the speed is to be determined according to project needs.
2. Provide one dedicated service/freight elevator, listed at 5000#'s, for all new construction for facilities 4 stories or greater. And, provide one storage room adjacent to the service elevator.
3. Provide one elevator to access the roof for equipment replacement and other repairs. If there are two elevators in the building, this elevator will be the freight, rated at 5000 lbs.
4. Owner pre-approval is required prior to designing around:
 - a single elevator manufacturer's design,

- A machine room-less (MRL) elevator
 - Hydraulic elevators
 - Belt drive elevators
5. For hydraulic elevators, provide safety sleeve for jack.
 6. Provide an Area of Refuge to allow persons needing assistance in evacuating to wait while having access to an emergency phone.
 7. Area of Refuge to include an ADA-hand free communication with direct dial telephone line to KSU Public safety monitoring facility; one button push. Coordinate with KSU.
 8. Consider a spacer hoist way for future elevator in a new building with single or minimal elevator provisions.

D. CAB DESIGN

1. Elevator cab lighting - provide LED lamps or as approved by the University.
2. Provide key locks for independent service, fire service inspection, emergency stop, and fan. (Four [4] keys for each lock.)
3. Provide ADA-hand free communication with direct dial telephone line to KSU Public safety monitoring facility; one button push. Coordinate with KSU.
4. Provide wall panels in all elevator cabs with hangers for safety pads.
5. Provide safety pads in all elevator cabs (contractor must protect cabs during construction).
6. Provide hard, smooth, non-slip surface flooring (no carpet).
7. Provide Braille and tactile numbers and labels and meet all ADA requirements.
8. Provide instructions for fire service etched into panel.
9. Provide directional indicator lantern lights in hoist way opening jamb at each floor and car position indicator at main entry levels.
10. All interior cab finishes & call button plates should be stainless steel.

E. MACHINE ROOM

1. Upon power failure, one elevator must continue to operate off the emergency generator.
2. Provide one laptop computer and elevator software with remote capability in the elevator machine room.
3. Provide one spill control kit for each elevator machine room in accordance with KSU Spill Prevention Control and Countermeasures (SPCC).

F. MAINTENANCE

1. Starting at the date of Material Completion, provide a complete systematic inspection and maintenance of each elevator for a period of 24 months after Material Completion.
 - a. Furnish trained experts and equipment to check, adjust, lubricate, and otherwise maintain the elevators in operation without defects of deterioration.
 - b. Replace and repair materials and parts which become defective or deteriorated for any reason except through abuse or misuse by the Owner or occupants of the building.
 - c. Return to the Project, within 18 hours of time the Owner reports defective operation and proceed with repair and maintenance work to restore operation promptly.
 - d. Provide inclusive maintenance, call-back service, and emergency repair on each elevator after it is completed and placed in operating order for a period indicated above with no overtime charges during warranty period.

DIVISION 21 – FIRE SUPPRESSION SYSTEMS

SECTION 21 0510 – GENERAL FIRE-SUPPRESSION REQUIREMENTS

A. OWNER’S DESIGN CRITERIA

1. International Fire Code, Current Adopted Edition with Georgia Amendments.
2. International Building Code, Current Adopted Edition with Georgia Amendments.
3. National Electric Code, Current Adopted Edition.
4. International Energy Conservation Code, Current Adopted Edition with Georgia Amendments.
5. NFPA 13 - Standard for the Installation of Sprinkler Systems, Current Adopted Edition.
6. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems, Current Adopted Edition.
7. NFPA 20 - Standard for the Installation of Stationary Pumps for Fire Protection, Current Adopted Edition.
8. Rules and Regulations of the Safety Fire Commissioner 120-3-3, Current Adoption.
9. Plastic sprinkler piping is discouraged. Use of plastic pipe must be preapproved by KSU Fire & Life Safety department prior to design.

B. GENERAL

1. Provide fire sprinkler system in accordance with NFPA 13 for all new buildings and renovation/repair projects unless directed otherwise by the State Fire Marshal's Office.
2. All fire sprinkler system design drawings must be sealed by a Georgia registered professional engineer and must be approved by the State Fire Marshal's Office.
3. Contract documents shall require the fire protection contractor to submit sprinkler shop drawings and hydraulic calculations directly to the State Fire Marshal for approval.
4. Perform a fire flow test at the beginning of the fire sprinkler system design to determine available water pressure and flowrate. The sprinkler contractor shall perform an additional fire flow test within 6 months of submitting shop drawings to the State Fire Marshal's Office.
5. Close Out Document Requirements:
 - a. As-Built Drawings, Warranties, and Guarantees.

- b. Operation and Maintenance Manuals.
- c. Equipment Log with Model and Serial Numbers.
- d. Extra Equipment and Materials for Owner Stock.
- e. MEP Orientation for Plant Service. Provide video copy.

6. Operating and Maintenance Manuals

- a. Digital delivery of Operating and Maintenance Manuals:
 - i. Take steps to reduce submittal file size.
 - ii. Ensure any reproductions are legible.
 - iii. Identify the manuals in the email subject line using the official project title, specification section and submitted item.
 - iv. Table of Contents shall be included in the order listed with identifications typed in capital letters.
 - v. The O&M Pdf should contain bookmarks to each section of the manual, and bookmarks to each product.

7. Physical delivery of Operating and Maintenance Manuals:

- a. One bound and indexed Operating and Maintenance Manuals shall be provided.
- b. Data shall be bound in smooth surface hard back commercial quality three-ring notebooks with project identification shown on the front cover and binding back. Identification labels shall be typed and adhered with waterproof glue.
- c. Notebooks shall have 9-1/2-inch by 11-1/2-inch covers with back width to permit the covers to lie parallel or to converge, and have not less than 1-1/2-inch back width.
- d. Index divider sheets of heavy Manila paper shall be inserted between each section of the Manual with a 2-inch x 1/3-inch ready-cut shield tab attached to each sheet for identification of sections.
- e. Data sheets and diagrams shall be 8-1/2-inch x 11-inch or be mounted on 8-1/2-inch x 11-inch sheets of 16-pound paper if smaller, with reinforced 11-inch mechanically perforated edges. Drawings and diagrams larger than 8-1/2-inch by 11-inch shall be folded up from the bottom to form a height of 11-inches and folded to the left to form a width of 8-1/2-inches.
- f. Table of Contents (Index) sheets shall be provided in the order listed with identifications typed in capital letters.

8. Provide Pipe Sleeves in Slabs and Partitions:

- a. Elevated Slabs: Schedule 40 black steel pipe: Sleeves shall be sized to include the insulation with minimum gap around insulation. Install, without developing a break in the pipe insulation, according to the fire sealant manufacturer's installation instructions for a U.L. Listed assembly for a rated pipe penetration through a slab.
 - b. Rated Drywall Partitions: Schedule 40 black steel pipe: Sleeves shall be sized to include the insulation with minimum gap around the insulation. Install, without developing a break in the pipe insulation, according to the fire sealant manufacturer's installation instructions for a U.L. Listed assembly for a rated pipe penetration through a rated drywall wall/partition.
9. Seal sleeves and openings in mechanical room walls, fire rated partitions, and floors above grade vapor tight, watertight, or for smoke/fire protection as applicable.
10. Seal sleeves and openings in exterior walls vapor tight or watertight as applicable.
11. Piping Pressure Testing
 - a. General:
 1. Complete tests prior to installing ceiling. Leaks shall be repaired, defective materials replaced, and the system shall be retested. Strike all joints in copper and steel piping under a pressure test. Conduct tests prior to connecting to equipment or isolate equipment from system.
 2. No water pressure test shall be conducted in freezing weather where subject to freezing.
 3. Test shall be maintained at conditions specified until approved but, in no event, for less than two (2) hours minimum duration, unless otherwise noted.
 4. Hydrostatic pressure tests shall maintain pressure without change, except that due to temperature change.
 5. Test pressures shall be read from a gauge located at the low elevation point of the system being tested.
 - b. Existing Sprinkler System Piping:
 1. Test as specified where isolation is possible.
 2. Where fewer than 20 sprinklers are modified pressure testing is not required.
 3. Where isolation is not possible, pressure testing is not required.
 - c. Wet Sprinkler System:
 1. Hydrostatic Test; 200 PSIG

2. Portions of the system normally subjected to working pressures in excess of 150 PSIG shall be tested at 50 PSIG higher than the normal working pressure of the system.

d. Dry Pipe Sprinkler Systems:

1. Hydrostatic Test; 200 PSIG
2. In addition to Hydrostatic Test, an Air Pressure Leakage Test at 40 PSIG shall be conducted for 24 hours. Any leakage that results in a drop of 1.5 PSIG for 24 hours shall be corrected.
3. Where systems are installed in spaces subject to temperatures below 32 degrees F, the Air Pressure Leakage Test shall be conducted at the lowest nominal temperature of the space.

e. Water Service to Fire Protection System: Hydrostatic test, 200 PSIG.

C. DEMONSTRATION, TRAINING AND INSTRUCTIONS

1. A minimum of 40 total hours of training shall be provided for plumbing systems. Training shall occur in 3 hour sessions in the afternoon.
2. A manufacturer's service representative shall provide the instructions for each piece of equipment on system when specified in other Sections of this Division. A manufacturer's sales representative is not acceptable. (The instructor shall not be a sales person, but shall have service experience on a continuing basis and be knowledgeable about the subject equipment). The contractor shall have training sessions recorded (audio and video) by a third party.
3. The Contractor shall request the instruction date not less than 15 days of the desired date for coordination with the Using Agency. Operating manuals for the equipment/systems on which instructions are being given shall be in the possession of the operating personnel not less than 30 days prior to the date of instruction.
4. An Owner Training Video shall be made separate from training sessions and professionally recorded. The video shall cover all equipment and systems addressed in the owner training sessions.
5. The Contractor shall develop not less than three (3) copies of the instructions with an index for easy retrieval of information.

SECTION 21 1100 – FIRE-SUPPRESSION PIPING**A. GENERAL**

1. Wet System Piping: Black Steel Pipe: ASTM A 795 Schedule 10 or ASTM A 795 Schedule 40.
2. Dry System Piping: Black Steel Pipe: ASTM A 795 Schedule 10 or ASTM A 795 Schedule 40.
3. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
4. Install standpipe piping, hangers, and supports in accordance with NFPA 14.
5. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
6. Gate Valves:
 - a. Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, 200 PSIG working pressure.
7. Butterfly Valves:
 - a. Gear operated, cast iron body, wafer design type body, U.L. Listed - F.M. approved, with resilient seat, 175 pound W.O.G.
8. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
9. Provide drain valves at main shut-off valves, low points of piping and apparatus. Route drains to interior mop basins or exterior of building.
10. Backflow Preventer: (If installed inside building)
 - a. Double Check Detector Valve Assemblies:
 1. ASSE 1048, FM approved; two independently operating check valves within a single housing, sleeve access port, 4 test cocks and two OS&Y valves. Bypass assembly shall consist of a meter, a double check backflow device and test cocks.

SECTION 21 1200 – FIRE-SUPPRESSION STANDPIPES**A. GENERAL**

1. Install Wet and Dry Standpipe Systems in accordance with NFPA 14.
2. Locate standpipe valves on floor level of every egress stair.
3. Locate standpipe valves no more than 60 inches above finished floor.
4. Where static pressure exceeds 175 psi but is less than 350 psi at any fire valve cabinet, provide pressure reducing valve on hose connection valve to prevent pressure from exceeding 175 psi.

SECTION 21 1300 – FIRE-SUPPRESSION SPRINKLERS**A. GENERAL****1. Sprinkler Heads**

- a. All sprinklers installed shall be by the same manufacturer.
- b. Contractor shall select temperature ratings in accordance with NFPA 13. Provide Intermediate Rated (175°F-225°F) Sprinkler Heads in MDF and IDF Rooms.
- c. Provide quick response sprinkler heads throughout buildings.
- d. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- e. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

2. Dry Sprinkler Systems shall utilize Nitrogen Generators to pressure system, in lieu of Air Compressor.

- a. Nitrogen Generator: Provide 98% purity nitrogen to the dry fire sprinkler system. System shall include filtration to remove water and hydrocarbons. Control Panel to monitor air compressor runtimes, nitrogen generator pressure, and operational mode locally and over the internet. Leak detection system capable of determining sprinkler system leak rates and give alerts if leaks develop within the piping system, nitrogen system, or compressed air system. The shall automatically switch between air bypass mode and nitrogen generating mode based on demands from the dry sprinkler system. System shall be FM Approved.

SECTION 21 2200 – CLEAN-AGENT FIRE EXTINGUISHING SYSTEM**A. GENERAL**

1. Clean Agent Fire Suppression Systems should be considered for use to protect main server rooms and large data centers. Consult with the University project manager for each space that may utilize a clean agent system.
2. Install Clean Agent Fire Suppression Systems in accordance with NFPA 2001.
3. Interlock clean agent system with HVAC motorized dampers and building fire alarm system.

SECTION 21 3000 – FIRE PUMPS**A. GENERAL**

1. Fire Pumps and Jockey Pumps shall be installed in accordance with NFPA 20. Fire pumps should only be provided where required to meet NFPA 13 or NFPA 14 pressure requirements.
2. Provide access space around pumps for service; no less than minimum as recommended by manufacturer. Provide clearance in accordance with NEC for Controllers.
3. Fire Pump Rooms shall be conditioned to maintain maximum 75°F and minimum 50°F temperatures.
4. Fire Pumps:
 - b. Horizontal base-mounted type; UL 448 and FM approved; horizontal shaft, single stage, double suction, direct connected, horizontally split casing, for 250 psi minimum working pressure.
 - c. Vertical in-line type; UL 448 and FM approved; single stage, close coupled, radially split casing, for in-line mounting, for a minimum 250 psi working pressure.
 - d. All pumps to have mechanical seals.
5. Fire Pump Controller:
 - e. Digital solid-state starter with soft start and soft stop, in NEMA 2 enclosure, and shall include an automatic transfer switch to allow connection to an emergency generator.
 - f. Circuit Breaker: Comply with NFPA 20; minimum 100,000 amperes interrupting capacity.
 2. The controller shall be capable of interrupting a short circuit current at least equal to the available short circuit current in the controller supply circuit.
 3. This fire pump controller installation requires an withstand rating of not less than 100,000 amps RMS symmetrical at an operating voltage of 480 Volts.

DIVISION 22 – PLUMBING

A. OWNER’S DESIGN CRITERIA:

1. International Fire Code, current Edition
 - i. Implement smart fire suppression and monitoring systems to minimize water and energy waste.
2. International Plumbing Code, current Edition with Georgia Amendments
 - i. Require WaterSense-labeled fixtures across all installations. Prioritize greywater and rainwater harvesting for non-potable applications.
3. International Fuel Gas Code, current Edition with Georgia Amendments
 - i. Require high-efficiency gas-fired boilers (95%+ AFUE) and tankless water heaters with smart recirculation controls.
4. National Electrical Code, current Edition
5. International Energy Conservation Code, current Edition
6. International Swimming Pool and Spa Code, current Edition with Georgia Amendments
 - i. Mandate variable-speed pumps and automated controls for all pool systems.
 - ii. Require solar, on-demand gas, or heat pump water heaters for pools where applicable.
7. Americans with Disabilities Act, current Edition
 - i. Ensure compliance while integrating universal design principles for long-term accessibility and sustainability.
8. Rules and Regulations of the Safety Fire Commissioner 120-3-3, Dated January 1, 2020
 - i. Require low-energy emergency lighting and backup power systems optimized for efficiency.
9. WaterSense-Labeled Products (Mandatory Standard)

- i. All plumbing fixtures, irrigation controllers, and appliances must meet WaterSense certification for maximum water efficiency.
- ii. Require submetering for all major water-consuming systems to track and optimize usage.

SECTION 22 0510 – GENERAL PLUMBING REQUIREMENTS

A. GENERAL

1. The design team is responsible for designing to ensure there is adequate service clearance for equipment and systems. The General Contractor, and its subcontractors, shall coordinate and schedule the installation of all work above the ceiling in accordance with the manufacturer's installation instructions for all equipment. Such coordination shall include, but is not limited to, the following work:
 - a. Ceiling grid and Ceiling Tile Installation.
 - b. Access Door Sizes, and Locations.
 - c. Plumbing Piping and Valves.
 - d. All Equipment.
2. All equipment and accessories requiring service or adjustment shall be easily accessible to within 3 feet of the finished ceiling. Equipment access may require the installation of service platforms.
3. The contractor shall be solely responsible for determining, verifying, and complying with inspection requirements relative to the scope of work and with the authority having jurisdiction. All in-floor, in-wall, above ceiling, and pressure tests shall be inspected by the architect/engineer/inspector, commissioning agent and owner prior to cover-up. All inspection reports shall be in writing and supported by digital pictures where deficiencies are found. Once the deficiency is corrected, a follow-up inspection shall be made to verify compliance with the contract documents.
4. Close Out Document Requirements:
 - a. As-Built Drawings, Warranties, and Guarantees.
 - b. Operation and Maintenance Manuals.
 - c. Equipment Log with Model and Serial Numbers.
 - d. Extra Equipment and Materials for Owner Stock.
 - e. MEP Orientation for Plant Service. Provide video copy.
 - f. Valve Tag lists and Diagrams.
 - g. Piping Integrity Testing Videos.
 - h. GIS files for underground utilities.
5. Operating and Maintenance Manuals
 - a. Digital delivery of Operating and Maintenance Manuals:

- i. Take steps to reduce submittal file size.
 - ii. Ensure any reproductions are legible.
 - iii. Identify the manuals in the file name using the official project title, specification section and submitted item.
 - iv. Table of Contents (Index) sheets shall be included in the order listed The O&M Pdf should contain bookmarks to each section of the manual, and bookmarks to each product.
- b. Physical delivery of Operating and Maintenance Manuals:
 - i. One bound and indexed Operating and Maintenance Manuals shall be provided.
 - ii. Data shall be bound in smooth surface hard back commercial quality three-ring notebooks with project identification shown on the front cover and binding back. Identification labels shall be typed.
 - iii. Notebooks shall have 9-1/2-inch by 11-1/2-inch covers with back width to permit the covers to lie parallel or to converge, and have not less than 1-1/2-inch back width.
 - iv. Index divider sheets of heavy Manila paper shall be inserted between each section of the Manual with a 2-inch x 1/3-inch ready-cut shield tab attached to each sheet for identification of sections.
 - v. Data sheets and diagrams shall be 8-1/2-inch x 11-inch or be mounted on 8-1/2-inch x 11-inch sheets of 16-pound paper if smaller, with reinforced 11-inch mechanically perforated edges. Drawings and diagrams larger than 8-1/2-inch by 11-inch shall be folded up from the bottom to form a height of 11-inches and folded to the left to form a width of 8-1/2-inches.
 - vi. Table of Contents (Index) sheets shall be provided in the order listed with identifications typed in capital letters.
- 6. Contractor(s) to record and photograph the data plate information along with the location in the building and the name of the equipment(as designated on the blueprints) into an excel spreadsheet and a digital copy to be submitted when the building is turned over to KSU, as part of the close-out documents.
- 7. All equipment, piping, conduit, etc. within a renovated space which is abandoned shall be removed. If it cannot be removed, it shall be properly capped using the same type and gauge material as the existing system. In the event of any equipment, piping or conduit, etc., being abandoned in place, all as-builts and equipment labels shall be outlined as abandoned in place.
- 8. Provide Pipe Sleeves in Slabs and Partitions:

- a. Elevated Slabs: Schedule 40 black steel pipe: Sleeves shall be sized to include the insulation with minimum gap around insulation. Install, without developing a break in the pipe insulation, according to the fire sealant manufacturer's installation instructions for a U.L. Listed assembly for a rated pipe penetration through a slab. Provide 4" high concrete curb around piping penetrating mechanical penthouse floor slabs.
 - b. Rated Drywall Partitions: Schedule 40 black steel pipe. Sleeves shall be sized to include the insulation with minimum gap around the insulation. Install, without developing a break in the pipe insulation, according to the fire sealant manufacturer's installation instructions for a U.L. Listed assembly for a rated pipe penetration through a rated drywall wall/partition.
9. Pipe sleeves in footings and foundation walls:
- a. Schedule 40 black steel pipe.
 - b. Water pipe, distribution piping, soil or waste pipe or building drain passing under a footing or through a foundation wall shall be installed in a pipe sleeve, two pipe sizes larger than the pipe passing through.
10. Seal sleeves and openings in mechanical room walls, fire rated partitions, and floors above grade vapor tight, watertight, or for smoke/fire protection as applicable.
- a. Hilti rubber based fire caulking as standard (no foam caulking)
11. Seal sleeves and openings in exterior walls vapor tight or watertight as applicable.
12. Piping Pressure Tests
- a. General:
 - i. Complete tests prior to insulating.
 - ii. Leaks shall be repaired, defective materials replaced, and system shall be retested.
 - iii. Strike all joints in copper and steel piping under a pressure test.
 - iv. Conduct tests prior to connecting to equipment or isolate equipment from system.
 - v. No water pressure test shall be conducted in freezing weather where subject to freezing.
 - vi. Test shall be maintained at conditions specified until approved but, in no event, for less than eight (8) hours minimum duration, unless otherwise noted.
 - vii. Hydrostatic pressure tests shall maintain pressure without change, except that due to temperature change.

- b. Domestic Water System: Hydrostatic test; 150 PSIG.
- c. Soil, Waste and Vent System: Static test; 10 feet minimum head. Test system in its entirety or in sections. Plug all openings except highest opening above the roof. Water shall be kept in the system, or in the portion under test, for a minimum of one (1) hour. Inspect the system, or the portion under test, after one (1) hour, the system shall be tight at all points.
- d. Storm Drain System: Static test; 10 feet minimum head. Test system in its entirety or in sections. Plug all openings except highest opening above the roof. Water shall be kept in the system, or in the portion under test, for a minimum of one (1) hour. Inspect the system, or the portion under test, after one (1) hour, the system shall be tight at all points.
- e. Multistory Buildings: Test tees shall be provided in soil, waste and storm drain piping to eliminate pressure testing of more than two floors at a time.
- f. Natural Gas System: Pressure test; 50 PSIG air or inert gas; 3 hours minimum duration. Oxygen shall not be used.
- g. Force Main Piping: Hydrostatic Test; 100 PSIG.
- h. Piping Integrity Testing:
 - i. At the completion of construction, the contractor shall have a full video inspection of the new under slab sanitary and storm piping systems to the cleanout located 5 feet outside the building to verify integrity of piping.
 - ii. Any damage to the piping system shall be repaired prior to material completion. Provide an additional video inspection of the repaired areas.
 - iii. Record inspection and provide a digital copy of the video with the O&M Manual.

13. Equipment Bases and Housekeeping Pads:

- a. Provide housekeeping and equipment bases for all equipment.
- b. Bases/Pads shall be 4" High with a 4" overhang on all sides of the equipment.
- c. Provide a concrete pad at all pipe penetrations of floors in mechanical rooms above grade.

14. Mechanical Rooms shall have epoxy floors extending to wall and 4-inches vertical on wall seamlessly. All floors shall slope at 2% to floor drains.

15. Penthouses shall have epoxy floors extending to wall and 4-inches vertical on wall seamlessly. All floors shall slope at 2% to floor drains.

B. DEMONSTRATION, TRAINING AND INSTRUCTIONS

1. Training for plumbing systems must be provided within a timeframe specified by the Facilities/Plant Operations team. Sessions should be scheduled to ensure comprehensive instruction without excessive operational disruption.
2. A qualified manufacturer's service representative—not a sales representative—must conduct training for each specified piece of equipment.
3. The Contractor must coordinate training dates with the Using Agency at least 15 days in advance. Operating manuals for the relevant systems must be provided to personnel at least 30 days prior to training.
4. Training sessions shall be recorded (audio and video) by a third party, and a separate professionally recorded Owner Training Video must be provided, covering all relevant equipment and systems.
5. The Contractor must provide training materials/documents, organized with an index for easy reference. Instructions to be provided in electronic format such as .pdf.

SECTION 22 0519 – METERS AND GAUGES FOR PLUMBING PIPING**A. GENERAL**

1. All metering shall adhere to the KSU Utility Metering Standard , Located in Appendix 12.
2. Provide pressure gauge on incoming side of backflow preventer and pressure regulating assemblies. Provide one pressure gauge downstream from each backflow preventer or pressure reducing valve.
3. Provide thermometers on water heating systems. Locate thermometer on leaving side of thermostatic mixing valves and water heater heaters.
4. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

SECTION 22 0553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**A. GENERAL**

1. Identify equipment such as pumps, water heaters, tanks, compressors and enclosed motor controllers with plastic nameplates.
2. Where equipment is located above ceilings; Apply an additional nameplate to ceiling grid for equipment located above accessible ceilings or to access panel for non-accessible ceilings.
3. Identify control panels and major control components on the outside panels with plastic nameplates.
4. Install Pipe Markers on all piping systems at the following Locations:
 - a. Mechanical Equipment Rooms:
 - i. Within 18 inches of each valve.
 - ii. Within 36 inches of each 90 elbow, tee, connection to equipment or vessel and point where pipe exits room.
 - iii. At not over 20 feet intervals along all exposed piping.
 - b. Above Suspended Ceilings:
 - i. Within 18 inches of each valve or valve assembly.
 - ii. At tees, identify both main and branch within 36 inches of tee.
 - iii. Within 36 inches of each 90 elbow.
 - iv. At not over 15 feet intervals along all concealed piping.
 - c. Piping Exposed in Rooms Other Than Mechanical Equipment Areas:
 - i. Omit identification on piping, 1 inch exterior diameter or smaller (insulated or uninsulated) or exposed at connections to equipment or plumbing fixtures.
 - ii. With the above exception, identify at not less than one point each piping run visible in each room, with identification on not over 20 feet intervals.

SECTION 22 0719 – PLUMBING PIPING INSULATION**A. GENERAL**

1. Domestic Water:
 - a. Domestic Hot, Tempered, and Circulating Piping: 1.5-inch thick rigid glass fiber with factory **All Service Jacket** (ASJ) jacket.
 - b. Domestic Cold Piping: 1-inch thick rigid glass fiber with factory ASJ jacket.
2. Roof Drain Bodies: Flexible glass fiber; 1-1/2 inch thick.
3. Roof Drainage Piping: Flexible fiberglass blanket type, 1/2-inch minimum thick.
4. Waste Piping Handling HVAC Condensate: 1 inch thick phenolic foam with Saran vapor jacket. Insulate fittings with pipe insulation mitered to fit.
5. Insulation exposed to the exterior or unconditioned spaces shall be wrapped in an Aluminum Jacket.

SECTION 22 1005 – PLUMBING PIPING

A. GENERAL

1. A. Sanitary Sewer and Storm Drainage:

- a. All piping shall be cast iron pipe above and below slab on grade.
- b. Cleanouts shall be provided at the end of all restroom batteries, and they shall be readily accessible and located in the Men's restrooms where possible.
- c. Cleanouts shall be provided within the system run at intervals not to exceed 75 feet maximum to the first manhole.
- d. In renovation projects, video scope all below slab sanitary and storm drainage piping using appropriate camera technology that will be used to determine condition of piping and suitability for the new plumbing design.

2. Water Piping:

- a. All above ground piping shall be type L copper pipe with copper fittings and solder. Joints.
- b. Provide ball valves at all branch taps for isolation.
- c. Isolation valves shall be provided for each floor of a multistory building, to isolate the floor from the main building water supplies.
- d. Ball valves for hot, cold, and return shall be provided for all banks of restrooms and equipment to isolate from the main water supplies for that floor. Isolation valves should be located outside of the restroom in an accessible location.

Pressure Reducing Valves: Should be Zurn 500XL or equivalent with a bypass. Sizes 2" and larger shall be flanged. If more flow is needed, run parallel Zurn 500XL or equivalent.

3. Include a full-size bypass around equipment such as pressure reducing valves. Bypass to include a normally closed ball valve.
4. Water pipes feeding through multiple storage tanks in parallel shall be balanced to ensure proper flow.
5. Provide ample access for maintenance, service, and adjustment to all equipment, plumbing piping, and isolation valves.
6. All exposed exterior gas piping shall be primed, painted(yellow), and labeled. All equipment supports shall be primed and painted.
7. Provide unions in piping to all equipment and specialties to permit removal for service; unions shall be metal seat type. Provide insulating unions where needed. Dissimilar metals, i.e. copper and steel, shall not be installed to allow direct contact between the metals. Provide brass nipple or fitting connections as needed.

8. Piping Integrity Testing:

- a. At the completion of construction, the contractor shall provide a full video inspection of the new under slab sanitary and storm piping systems to the cleanout located 5 feet outside the building to verify integrity of piping.
- b. Any damage to the piping system shall be repaired prior to material completion. Provide an additional video inspection of the repaired areas.
- c. Record inspection and provide a digital copy of the video with the O&M Manual.

SECTION 22 1006 – PLUMBING PIPING SPECIALTIES**A. GENERAL****1. Floor Drains:**

- a. Provide square floor drains in tile floors.
- b. Install floor drains at low points in floor.
- c. Install trap primer connections to all floor drains.
- d. Locate floor drains in all janitor's closets, mechanical rooms, and restrooms.

2. Trap Primer Valves:

- a. Install unions on both sides of trap primer and distribution unit for ease of maintenance and replacement.
- b. MIFAB or Watts are acceptable and preferred brands.

3. Cleanouts:

- a. Provide cleanouts at the end of each restroom battery. Try to locate clean out in Men's Restrooms.
- b. Cleanouts to be readily accessible in the floor if possible.

4. Hose Bibbs:

- a. Locate hose bibs under the lavatories for each gang restroom, and in strategic locations around the mechanical rooms, boiler rooms, chiller rooms, air handler rooms, and mechanical penthouses.
- b. A 1" domestic water line with hose bibb or non-freeze yard hydrant will be installed within 25 feet of air-cooled chillers. Any piping exposed to the exterior or unconditioned spaces shall have heat tracing installed to prevent freezing.
- c. A 2" Utility Hydrant should be installed at all Cooling Towers. Any piping exposed to the exterior or unconditioned spaces shall have heat tracing installed to prevent freezing.
- d. Non-Freeze Wall Hydrants should be installed around the perimeter of the building spaced approximately 80'-100' apart.
- e. An isolation valve shall be provided for all Utility and Non-Freeze Wall and Yard Hydrants. The isolation valve shall be located at the closest readily accessible location of the supply piping.

5. Grease Traps:

- a. All grease traps are to be installed outside the building as near as possible to the fixtures being served.
 - b. Per Cobb County Health Department, The minimum size requirement is 1500 gallons. per The Cobb County Health Department.
- 6. Install water hammer arrestors complete with accessible isolation valve on hot and cold-water supply piping to all fixtures and toilet batteries. Size and install in accordance with the (Plumbing and Drainage Institute Standard) PDI WH-201.

SECTION 22 3000 – PLUMBING EQUIPMENT

A. GENERAL

1. Domestic Water Heaters:

- a. Install water heater on concrete housekeeping base, sized minimum 4 inches larger than heater base. Refer to Section 22 0510.
- b. Pipe relief valves to exterior of the building, 90 degrees down withing six (6) inches of fixed ground. .
- c. Pipe drains to nearest floor drain.
- d. Water Heaters shall high efficiency water heaters (heat pump, on demand) COP1 or greater or tankless natural gas water heaters selected based on lowest life cycle cost.
- e. Point of use waterheaters to be used as needed.
- f. Provide thermostatic mixing valves to control water temperature delivery to building. Ensure individual shut off valves for cold and hot water.

2. Pumps:

- a. Domestic Water Circulation Pumps shall be by Bell and Gossett, Grundfos, or Taco.
- b. Sump Pumps shall have oil alarm systems or shall be connected to oil separators to prevent hydraulic oil from discharging to the sanitary system. If the building has Building Automated Systems, the sump pump shall be tied in for monitoring and remote control over BAS.
- c. For applications where it is relevant, domestic water, HVAC, swimming pool, or pressure booster pumps shall be equipped with Variable Frequency Drives (VFDs) or EC motors to optimize efficiency and reduce energy consumption.
- a. Expansion tanks: To be included with all hot water tanks or as needed to compensate for water thermal expansion.
 - i. Manufacturers:

1. Watts Series PLT

SECTION 22 4010 – PLUMBING FIXTURES**A. FLUSH VALVE WATER CLOSETS****1. FIXTURE 'WC1'; WATER CLOSET (WH, FV (1.1/1.6 gpf), STD)****a. Bowl:****i. Manufacturers:**

1. American Standard Inc.; Model 2856.128
2. Kohler Company; Model K-4325
3. Sloan; Model ST-2459
4. Toto; Model CT708U(G)
5. Zurn; Model Z5615 - BWL

- ii. ASME 112.19.2M; 1.1gpf to 1.6 gpf operation range (1.1gpf to 1.28 gpf range for new construction), wall hung vitreous china closet bowl, with elongated rim, 1-1/2 inch top spud, chromium plated nuts and washers, china bolt caps; standard accessible.

2. FIXTURE 'WC2'; WATER CLOSET (WH, FV (1.1/1.6 gpf), ADA)**a. Bowl:****i. Manufacturers:**

1. American Standard; Model 2856.128
2. Kohler; Model K-4325
3. Sloan; Model ST-2459
4. Toto; Model CT708U(G)
5. Zurn; Model Z-5615-BWL

- b. ASME A112.19.2M; 1.1gfp to 1.6 gpf operation range (1.1gpf to 1.28 gpf range for new construction), wall hung vitreous china closet bowl, with elongated rim, 1-1/2 inch top spud, chromium plated nuts and washers, china bolt caps; disabled access.

3. FIXTURE 'WC3'; WATER CLOSET (FM, FV (1.1/1.6 gpf), STD)**a. Bowl:****i. Manufacturers:**

1. American Standard; Model 2234.001
 2. Kohler; Model K-96053
 3. Sloan; Model ST-2009
 4. Toto; Model CT705UN (G)
 5. Zurn; Model Z-5655- BWL1
- ii. ASME A112.19.2M; 1.1 gpf to 1.6 gpf operation range (1.1gpf to 1.28 gpf range for new construction), floor mounted vitreous china closet bowl with elongated rim, 1-1/2 inch top spud, chromium plated nuts and washers, china bolt caps; standard accessible.
4. FIXTURE 'WC4'; WATER CLOSET (FM, FV (1.1/1.6 gpf), ADA)
- a. Bowl:
 - i. Manufacturers:
 1. American Standard; Model 3043.001
 2. Kohler; Model K-96057
 3. Sloan; Model ST-2029
 4. Toto; Model CT705ULN (G)
 5. Zurn; Model Z-5665-BWL1
 - ii. ASME A112.19.2M; 1.1 gpf to 1.6 gpf operation range (1.1gpf to 1.28 gpf range for new construction), floor mounted vitreous china closet bowl with elongated rim, 1-1/2 inch top spud, chromium plated nuts and washers, china bolt caps; disabled accessible.

B. URINALS

1. FIXTURE 'UR1'; URINAL (WH, FV (0.125 gpf), STD)
- a. Urinal:
 - i. Manufacturers:
 1. American Standard; Model 6590.001
 2. Kohler; Model K-4991-ET-0
 3. Sloan; Model SU-1009
 4. Toto; Model UT445U(V)

5. Zurn; Model Z5758-U
 - ii. ASME A112.19.2M; 0.125 gpf, vitreous china, wall hung wash-out urinal fixture with integral trap, battery powered touchless electronic flush valve, and floor mounted carrier.
2. FIXTURE 'UR2'; URINAL (WH, FV (0.125 gpf), ADA)
 - a. Urinal:
 - i. Manufacturers:
 1. American Standard; Model 6590.001
 2. Kohler; Model K-4991-ET-0
 3. Sloan; Model SU-1009
 4. Toto; Model UT445U(V)
 5. Zurn; Model Z5758-U
 - ii. ASME A112.19.2M; 0.125 gpf, vitreous china, wall hung wash-out urinal fixture with integral trap, battery powered touchless electronic flush valve, floor mounted carrier, disabled accessible.

C. WALL HUNG LAVATORIES

1. FIXTURE 'LV1'; LAVATORY (WH, VC, ADA)
 - a. Lavatory Basin:
 - i. Manufacturers:
 1. American Standard; Model 0356.421
 2. Kohler; Model K-2007
 3. Sloan; Model SS-3103
 4. Toto; Model LT307
 5. Zurn; Model Z5341
 - ii. ASME A112.19.2M; vitreous china, wall hung, 21" x 18" fixture with single hole drilling, front overflow, soap depression, drilled for floor mounted concealed arm carrier, disabled accessible.

D. COUNTER MOUNTED LAVATORIES

1. FIXTURE 'LV2'; LAVATORY (CT, VC, ADA)

a. Lavatory Basin:

i. Manufacturers:

1. American Standard; Model 0475.047
2. Kohler; Model K-2196-1
3. Sloan; Model SS-3102
4. Toto; Model LT501
5. Zurn; Model Z5111

- ii. ASME A112.19.2M; counter mounted, vitreous china, 20" x 17" oval with single hole drilling, front overflow, soap depression; disabled accessible.

2. FIXTURE 'LV3'; LAVATORY (CT, VC, ADA)

a. Lavatory Basin:

i. Manufacturers:

1. American Standard; Model 0497.221
2. Kohler; Model K-2211
3. Sloan; Model SS-3001
4. Toto; Model LT569
5. Zurn; Model Z5220

- ii. ASME A112.19.2M; undercounter mounted, vitreous china, 17"x14"x5.5", front overflow, disabled accessible.

E. COUNTER MOUNTED SINKS

1. FIXTURE 'SK1'; SINK (SS, CT, 22" x 19" SC, ADA)

a. Sink:

i. Manufacturers:

1. Elkay; Model LRAD-22196
2. Just; Model SL-ADA-2219-A-GR

- ii. ASME A112.19.3M; 18 gauge, type 304 stainless steel, single compartment 22 x 19 x 6 -inches overall with 3 -hole drilling for faucet, 3-inch drain opening; ADA accessible.

F. SPECIALTY SINKS

1. FIXTURE 'SK2'; SINK (SS, UC, 22" x 19" SC)
 - a. Sink: Undermount Stainless Steel Sink
 - i. Manufacturers:
 1. Elkay; Model ELUHAD211555
 2. Just; Model USF-ADA-1824-16
 - ii. ASME A112.19.3M; 18 gauge, type 304 stainless steel, single compartment 21 x 15.75 x 5.375 -inches overall, 3-inch drain opening.
2. FIXTURE 'SK3'; SINK (SS, SM, 19" x 17" SC)
 - a. Sink: Surface Mounted Stainless Steel Sink
 - i. Manufacturers:
 1. Elkay; Model PSLVR1917
 2. Just; Model SL-ADA-17519-16-GR
 - ii. ASME A112.19.3M; 18 gauge, type 304 stainless steel, single compartment 16 x 11.5 x 6.125 -inches overall, 3-inch drain opening, disabled accessible.

G. MOP BASINS

1. FIXTURE 'MB1'; MOP BASIN (TERRI, FM 24" x 24" x 12")
 - a. Mop Basin:
 - i. Manufacturers:
 1. Acorn; Model TNC-24
 2. Fiat; Model TSBC-1610
 3. Stern-Williams; Model SBC-1700
 - ii. ASME A112.19.1M terrazzo stone, one piece basin, neo-corner, 24 x 24 x 12-inches overall with integral stainless steel grate with quick connect drain. Wall hung faucet, with hose and bracket.

H. MISCELLANEOUS FIXTURES

1. FIXTURE 'WMB1'; WASHING MACHINE BOX
 - a. Washing Machine Box Assembly

- i. Manufacturers:

- 1. Guy-Gray; Model FB200

- 2. Acorn; Model 8185

- ii. 20-gauge white powder-coated metal box, pre-punched, sloped to drain, 2-inch connection, 1/2"-inch FIP hose angle valves; with 18-gauge white powder-coated metal face frame/flange.

- 2. FIXTURE 'IMB1'; ICEMAKER SUPPLY BOX

- a. Icemaker Box Assembly

- i. Manufacturers:

- 1. Guy-Gray; Model BIM 875

- 2. Oatey; Model 38687/38689

- ii. 20-gauge steel with powder-coated white finish; 1/2"-inch FIP inlet by 1/4"-inch outlet compression angle valve with 1/2"-inch MPT connection.

- I. EMERGENCY SHOWERS AND EYE WASHES**

- 1. FIXTURE 'ES/EW1'; EMERGENCY SHOWER AND EYE WASH (Free Standing)

- a. Manufacturers:

- i. Haws; 8309WC

- ii. Speakman; Model SE-1200

- iii. Guardian; Model GBF1994

- iv. Water Saver; Model SSBF994

- v. ANSI Z358.1 and ANSI 117.1; ADA shower and eye wash assembly with galvanized steel stanchion, ABS shower head with pull rod & stay-open shower valve; thermostatic mixing valve assembly for providing 'tepid water'.

- 2. FIXTURE 'ES/EW2'; EMERGENCY SHOWER/EYEWASH (Recessed)

- a. Manufacturers:

- i. Haws; Model 8356WCC

- ii. Water Saver; Model SSBF2150

- iii. Guardian; Model GBF2150

- iv. ANSI Z358.1 and ANSI 117.1; ADA Recessed wall mounted combination shower/eyewash assembly; below ceiling chrome plated shower head with pull down lever activation. Pull down eyewash mounted in recessed cabinet; thermostatic mixing valve assembly for providing 'tepid water'.

J. ELECTRIC WATER COOLERS

1. FIXTURE 'EWC1'; ELECTRIC WATER COOLER (HI-LO w/Bottle Filling Station)

a. Water Cooler

i. Manufacturers:

- 1. Elkay; Model LZSTL8WSLK
- 2. Oasis; Model PG8EBFSL
- 3. Halsey Taylor; Model HTHB-HACG8BLSS-WF

- ii. ARI-1010; Bi-level, with ADA unit on the right, wall mounted electric water cooler assembly with stainless steel water surfaces, heavy duty galvanized steel wall mounting frame, 'sandstone' paint or vinyl finish cabinet, elevated anti-squirt bubblers with stream guard, automatic stream regulators; front and side push button actuators; high efficiency cooling tank and air cooled coil delivering 8.0 gph 50-degree water at 90-degree ambient air temperature; with ADA compliant bottle filling station. Bottle filling station to have no touch sensor activation with 30 second shut-off timer, filter, and 1.1 gpm flow rate.

2. FIXTURE 'EWC2'; ELECTRIC WATER COOLER (HI-LO MODULAR with Bottle Filling Station)

a. Water Cooler

i. Manufacturers:

- 1. Elkay; Model LZWS-LRPBM28K
- 2. Oasis; Model M8WREBF
- 3. Halsey Taylor; Model HTHBWF-OVLSER-I

- b. ARI-1010; Bi-level, ADA unit on right, stainless steel modular type electric water cooler assembly with round or oval bowls, integral heavy duty galvanized steel mounting frame, elevated anti squirt bubblers with stream guard, automatic stream regulators; front actuator buttons; recessed cooling unit consisting of high efficiency cooling tank and air cooled coil delivering 8.0 gph 50-degree water at 90-degree ambient air temperature; with ADA compliant bottle filling station. Bottle filling station to have no touch sensor activation with 30 second shut-off timer, filter, and 1.1 gpm flow rate.

K. FIXTURE ACCESSORIES

2. FLUSH VALVES – Campus Standard

a. Water Closet Flush Valve (Dual Flush Electronic Water Closet Valve)

i. Manufacturers:

1. Sloan Model; ECOS 111
2. American Standard; Model 606B.761 w/PK00.HAC
3. Zurn; Model ZR6000AV-WS1-DF-HW

- ii. ASME A112.18.1; Exposed chrome plated diaphragm type with hardwired infrared sensor operated flush valve with heavy duty cast escutcheon with set screw, integral screwdriver stop, vacuum breaker; 1 1/2 inch top spud, 11 1/2-inches high; 1 solid-ring supports; 1.1/1.6 gpf dual flush.

b. Urinal Flush Valve (Electronic Urinal Valve)

i. Manufacturers:

1. Sloan; Model ECOS 186
2. Zurn; Model ZEMS6003PL-ULF
3. American Standard; Model 606B.013 w/PK00.HAC

- ii. ASME A112.18.1; Exposed chrome plated diaphragm type hardwired infrared sensor operated flush valve with heavy duty cast escutcheon with set screw, integral screwdriver stop, vacuum breaker; 3/4 inch top spud, 11 1/2-inches high; 1 solid-ring support; 0.125 gpf maximum flush.

3. FLUSH VALVES – Budget Reduction Option Only

a. Water Closet Flush Valve (Dual Flush Water Closet Valve)

i. Manufacturers:

1. Sloan “Upper Cut”; Model WES-111-YK
2. Zurn “Aqua Vantage”; Model Z6000AV-WS1-DF-YK

- ii. ASME A112.18.1; Exposed chrome plated diaphragm type with battery powered sensor operated flush valve, non-hold open, heavy duty escutcheon with set screw, integral screwdriver stop, vacuum breaker; 1 1/2 inch top spud, 11 1/2-inches high; 1 solid-ring supports; 1.1/1.6 gpf dual flush.

b. Urinal Flush Valve (Urinal Valve)

i. Manufacturers:

1. Sloan; Regal Optima 186-0.125-YK
 2. Zurn; Aqua-Vantage Z6003AV-ULF-YK
 3. American Standard; Model 6145013.002
- ii. ASME A112.18.1; Exposed chrome plated diaphragm type with side oscillating handle, non-hold open, heavy duty cast escutcheon with set screw, integral screwdriver stop, vacuum breaker; 3/4 inch top spud, 1 1/2-inches high; 1 solid-ring support; 0.125 gpf maximum flush.

4. SEATS

- a. Water Closet Seat (Elongated, open front, less lid, white)
 - i. Manufacturers:
 1. Bemis; Model 1655SSC
 2. Beneke; Model 527SS
 3. Kohler; Model K-4666-S-C
 4. Church; Model 9500SSC
 5. Centoco; Model 1500 series
 6. Zurn; Model Z-5955-SS-LL
 - ii. Extra heavy weight, injection molded solid plastic, open-front, less lid, molded bumpers, external check hinges and stainless steel posts.

5. FAUCETS

- a. Lavatory Faucet (Electronic with standard spout) – Campus Standard
 - i. Manufacturers:
 1. American Standard; Model 605B.105 w/PK00.PAC and 605TMV1070
 2. Chicago; Model 116.102 AB 1 w/240.630.00.1 and 131-ABNF
 3. Sloan; Model EAF-100-P w/MIX-135-A
 4. Zurn; Model Z6913-XL-TMV-1-ACA-FS
 - ii. ASME A112.18.1M; Chrome plated brass electronic supply fitting with below counter ASSE 1070 thermostatic mixing valve, Plug in transformer with 6' cord, infrared sensor, water proof electronics with 60 second wash cycle, a 2 second maximum run-on time, aerator, maximum of 0.5 gpm; less grid drain.

- b. Lavatory Faucet (Single lever) – Budget Reduction Option Only
 - i. Manufacturers
 - 1. American Standard; Model 6114.110.002
 - 2. Chicago; Model 420-E2805ABP
 - 3. Moen; Model 8422F05
 - 4. Zurn; Model Z81000-XL-3M
 - ii. ASME A112.18.1M; Chrome plated brass combination supply fitting with standard chrome plated brass handles, ADA, standard spout, aerator, 0.5 gpm; less drain.
- c. Counter Mounted Sink Faucets (8-inch spread w/ gooseneck spout - Lavatories or Sinks)
 - i. Manufacturers:
 - 1. Chicago; Model 201-A-3GN8A-E3VP
 - 2. T&S Brass; Model B-2688-78-79A
 - 3. Zurn; Model Z-831-C4-2F-ICT
 - ii. ASME A112.18.1M; Chrome plated brass double service, 8-inch widespread gooseneck lavatory combination supply fitting rigid hi-arc gooseneck spout, aerator; 4-inch wrist handles, 1.5gpm; less drain.
- d. Mop Basin Faucet (w/ integral check stops and vacuum breaker)
 - i. Manufacturers:
 - 1. Chicago; Model 897-RCF
 - 2. Speakman; Model SC-5811-RCP-CK
 - 3. T&S Brass; Model B-0667-RGH
 - ii. ASME A112.18.1M; Rough Chrome plated brass exposed yoke wall-mount utility faucet assembly with integral stops and vacuum breaker, bucket hook, and threaded hose end, rough chrome finish.
- e. Mop Basin Accessories:
 - i. Mop Basin Hose and Bracket
 - 1. Manufacturers:
 - a. Florestone MR-370

- b. Fiat 832-AA
 - c. Stern-Williams T-35
 - 2. .625" outside diameter x 36" long, heavy duty hose with .75" coupling and wall-mounted stainless steel bracket with spring loaded rubber grip.
 - 3. Mop Hanger
 - a. Manufacturers:
 - i. Florestone MR-377
 - ii. Fiat 889-CC
 - iii. Stern-Williams T-40
 - b. 24" long stainless steel with 3 spring loaded rubber mop handle grips.
 - 4. Mop Basin Wall Guards
 - a. Manufacturers:
 - i. Florestone
 - ii. Fiat MSG-2424
 - iii. Stern-Williams BP
 - b. Two 24" long polished 20 gauge, type 304 stainless steel panels.

6. DRAINS

- a. Lavatory Drains (Flat grid off-set drain)
 - i. Manufacturers:
 - 1. Dearborn; Model 760W
 - 2. EBC; Model SG7WC
 - 3. Kohler; Model K-13885
 - 4. McGuire; Model 155-WC
 - 5. Sanitary-Dash; Model R7308
 - 6. Zurn; Model Z-8746

- ii. ASME A112.18.1M; 1 1/4" inch diameter chrome plated brass flat grid type drain with offset 17-gauge tailpiece.
- b. Counter Mounted Sink Drains (Flat off-set 3 1/2-inch grid)
 - i. Manufacturers:
 - 1. EBC; Model SF8WC
 - 2. Elkay; Model LKAD18
 - 3. Just; Model J-ADA-35-FS
 - 4. McGuire; Model 1149WC
 - 5. Zurn; Model Z-8750
 - ii. ASME A112.18.1M; 1 1/2" inch diameter chrome plated brass grid type strainer/drain assembly with offset 20-gauge off-set tailpiece.

7. SUPPLY STOPS

- a. Lavatory, Counter Mounted Sink, and Electric Water Cooler Supply Stops (3/8"-inch, 1/4 turn; Loose Key)
 - i. Manufacturers:
 - 1. Brasscraft; Model SR1512AC-LK
 - 2. Dearborn; Model SR1512-LK
 - 3. EBC; Model LA10-K
 - 4. McGuire; Model 165LK
 - 5. Zurn; Model Z-8820-LR-LK
 - ii. ASME A112.18.1M; Chrome plated brass angle heavy duty stop with nonmetal-to-metal seat and removable actuator key; supply tubing and escutcheon plate.

8. TRAPS

- a. Lavatory Traps (1 1/4"-inch Adj. 'P')
 - i. Manufacturers:
 - 1. EBC; Model TA-125-CF
 - 2. Dearborn; Model 707 DFBN
 - 3. Kohler; Model K-9000

4. McGuire; Model 8872
5. Zurn; Model Z-8700
- ii. ASME A112.18.1M; Chrome plated cast brass, 17-gauge P-trap assembly with cast brass nuts, cleanout plug and heavy duty escutcheon.
- b. Counter Mounted Sink Traps (1 1/2"-inch Adj. 'P')
 - i. Manufacturers:
 1. EBC; Model TA-150-CF
 2. Dearborn; Model 710 GDFBN
 3. Kohler; Model K-9000
 4. McGuire; Model 8912
 5. Zurn; Model Z-8702
 - ii. ASME A112.18.1M; Chrome plated cast brass, 17-gauge P-trap assembly with cast brass nuts, cleanout plug and heavy duty escutcheon.

9. CARRIERS

- a. Water Closets: Commercial Type with a 500 pound support weight capacity, adjustable vertically and horizontally from the faceplate, with base support, adjustable coupling, gasket, and chromium plated through bolts, and acron nuts.
- b. Urinals: Commercial Type, floor mounted, with hanger plates.
- c. Lavatories: Commercial type, floor mounted, with concealed arm supports.
- d. Electric Water Coolers: Commercial Type, floor mounted, with hanger plates.
- e. Carrier Manufacturers: Josam, Wade, Watts, J.R.Smith, and Zurn

10. ADA FIXTURE INSULATION

- a. Manufacturers:
 - i. EBC; Model 1K Series
 - ii. McGuire; Model 'Pro-Wrap' Series
 - iii. Plumberex; Model Pro-2000 Series
 - iv. True-Bro; Model 'Lav Guard' Series
 - v. Zurn; Model 'Trap Wrap' Series

- b. Insulation assembly shall be for supply stops & tubing; drains (including off-sets) and P-traps under all ADA lavatories and counter sinks.
- c. ANSI A117.1, ADA4.19.4; Fully molded, anti-bacterial flexible vinyl insulation assembly, minimum 1/8"-inch wall thickness, white in color, self-extinguishing meeting ASTM D635, and have a K-value of 1.17.

DIVISION 23 – HEATING, VENTILATING AND AIR-CONDITIONING (HVAC)**A. OWNER'S DESIGN CRITERIA**

1. Refer to Kennesaw State University Metering Standard Appendix Document.
2. Where requirements of these specifications exceed specified codes and ordinances, conform to these specifications.
3. Materials and equipment included in Underwriters Label Service shall bear that label. Electrical equipment shall be U.L. approved as installed.
4. Permits and Codes: Refer to the General Conditions.
5. Fire Prevention Precautions in Cutting and Welding Areas: Conform to Article 2605 Fire Prevention Precautions, Georgia State Minimum Standard Fire Prevention Code (International Fire Code), current Edition, with all Georgia State Amendments, for all work involving cutting and welding.
6. HVAC: Conform to the Georgia State Minimum Standard Mechanical Code, International Mechanical Code, current Edition with all Georgia State Amendments. Additionally, comply with ASHRAE Standard 90.1-2022 and, where applicable, ASHRAE Standard 189.1-2020 for higher performance green buildings, as required by Georgia state and local codes.
7. Energy: Conform to the Georgia State Energy Code for Buildings, which adopts the current International Energy Conservation Code (IECC), with all Georgia State Amendments. Additionally, comply with ASHRAW Standard 90.1, and where applicable, ASHRAE Standard 189.1 for enhanced energy performance requirements in green buildings.
8. All Work: Conform to State of Georgia Chapter 120-3-3 "Rules of Safety Fire Commissioner, Rules and Regulations, January 1, 2020", and ADA.
9. Electrical: Refer to Division 26. Conform to the National Electrical Code, current Edition, NFPA 70.
10. Building Code: Conform to the Georgia State Minimum Standard Building Code, International Building Code, current Edition with all Georgia State Amendments.
11. Carbon Monoxide sensors should be installed per ASHRAE 62.1.

SECTION 23 0510 – GENERAL MECHANICAL REQUIREMENTS

A. DEFINITIONS

1. Manufacturer's Representatives: Wherever MANUFACTURER'S REPRESENTATIVE is referred to in this division, said representative shall be regularly employed by the manufacturer to perform similar activities to those called for herein, which indicates his competence in that field of work.
2. Concealed: Where the word concealed is used in this Division, it shall mean items above ceilings, in attics, in crawl spaces, in chases, in tunnels, in cabinet work, and under counters or equipment so as to be not visible from an elevation of 5 feet at a horizontal distance of 10 feet.
3. Finished Spaces or Areas: Where finished spaces or areas are referred to in this Division, it shall mean all spaces except concealed spaces, mechanical rooms, or boiler rooms unless otherwise noted.
4. Provide: Furnish and install.
5. Control and Interlock Wiring: All wiring, both line voltage and low voltage, other than power wiring from an electrical distribution panel, through the primary control device, to the item of equipment.
6. Primary Control Device: That ONE device for any item of equipment which interrupts power flow during normal operation. Where magnetic starters are provided, they are the primary control. For items not switched by starters, the primary control device will be that ONE thermostat, time clock, manual switch, aquastat, P.E. switch, or relay performing the primary switching.
7. Diagrammatic: A drawing that shows arrangement and relations (as of parts).i.e.: A diagrammatic drawing uses symbols rather than pictorial representation of pipes, ducts, conduit and other items shown and is not necessarily to scale. Arrangement, location, and sizes shown are firm.
8. Readily Accessible: Items requiring maintenance shall be available for close approach for maintenance or use in a space, through an access door from floor elevation, or above a lay-in ceiling through an access point by maintenance staff safely standing on a ladder no taller than the ceiling.
9. Noted, Indicated or Shown: Where the terms "Noted", "Indicated" or "Shown" are used in these specifications, the words "in the specifications or on the plans" shall be inferred.
10. Detail: Where reference is made to a Detail, the Detail shall be on the plans unless otherwise noted.
11. Specifications: Where reference is made to these specifications, it shall be inferred in this Division of specifications.
12. Notification by the Contractor, and Instructions to the Contractor: Where reference is made in these specifications to notification by or instructions given to the Contractor, it shall be

inferred that the Design Professional shall be the instructor or shall be notified, as the case exists.

13. Division or Section Reference: Where reference is made to another Division or Section within this Division, refer to specifications table of contents for Division, Section, or Page Number.
14. Flow Diagram: A single-line, two-dimension, non-scaled drawing depicting arrangement and sequence of equipment, valves, controls, thermometers, gauges, and other specialty devices in a pipe or duct system.

B. OPERATING AND MAINTENANCE MANUALS

1. Operating and Maintenance (O&M) Manuals shall be prepared by the Contractor for all equipment and be submitted for review for a minimum of two months prior to the request for Material Completion. Digital delivery of Operating and Maintenance Manuals:
 - a. Operating and Maintenance Manuals to be delivered digitally.
 - b. Prepare the Operating and Maintenance Manuals as described above. Take steps to reduce submittal file size.
 - c. Ensure any reproductions are legible.
 - d. Table of Contents (Index) sheets shall be included in the order listed with identifications typed in capital letters.
 - e. Identify the manuals in the email subject line using the official project title, specification section and submitted item. I.E. Project No. G-xxx, Addition to Administrative Building.
2. Each Manual shall contain the following information, data and drawings:
 - a. Copies of approved submittals (with Design Professional's review comments and stamp), equipment and materials.
 - b. Manufacturer's installation, operating and maintenance instructions for each item of equipment with moving parts including recommended frequency of inspections and maintenance for one year of facility operation.
 - c. Manufacturer's list of renewal parts for each item of equipment with recommended stock items and quantities indicated.
 - d. A system schematic drawing for each hydronic system.
 - e. A system narrative with typical system operating parameters (pressure, temperature, flow rate, etc.) for each system.

- f. Control diagrams, electrical interlock diagrams, and control valve lists.
- g. Copies of as-built shop drawings showing layouts and construction details.
- h. Copies of Test and Balance Reports including list of instruments and description of methods employed.

C. PRODUCT DELIVERY, STORAGE, AND PROTECTION

1. Accept all products on site in factory-fabricated protective containers. Inspect for damage.
2. Store products in a clean dry place and protect them from weather and construction traffic.
3. Handle products carefully to avoid damage to components, enclosures, and finishes.
4. After placement, protect products from damage during construction, by all trade contractors.
5. Protect equipment nameplates and labels from damage, being painted, scarring, etc.
6. Materials and tools are not to be stored in mechanical rooms.

D. WARRANTY

1. Refer to Section 01 7000 - Contract Closeout, for additional warranty requirements.
2. Submit manufacturers' warranties prior to final inspection. Refer to the General Conditions.
3. Correct any defective Work within a one-year period after Date of Material Completion. Provide HVAC Installer's warranty letter dated the date of the Material Completion
4. Where warranties beyond the Contractor's one (1) year warranty are specified, the additional warranty time shall start on the same date as the Contractor's warranty.
5. Extended manufacture warranty pricing should be provided for packaged units.

E. DESIGN CRITERIA

- Energy Efficiency
 - a. Projects must comply with the Georgia Energy Code and ASHRAE standards (ASHRAE 90.1).
- Design criteria for major renovations or new buildings to be based on results of energy modeling and life cycle cost analysis. Final system and equipment selection to be based on proven designs, and high efficiency. System Selection

- a. HVAC systems must be selected based on life-cycle cost analysis (LCCA).
 - b. Preference for central hydronic systems when feasible, especially on campuses with central utilities.
 - c. Hydronic systems to be designed as primary-secondary configuration. Variable primary will not be considered.
 - d. Cooling system preferences include:
 - i. Chilled water:
 - 1. Chiller heat pump
 - 2. Water cooled chiller
 - 3. Air cooled chiller
 - ii. Water Source heat pump
 - 1. Geothermal source
 - 2. Cooling tower
 - iii. Air cooled chiller
 - iv. Variable Refrigerant Flow (VRF)
 - 1. Not to be used in residential units.
 - 2. To be used on limited basis as necessary after approval from KSU- PDC Engineering.
- Sustainability Goals
 - a. Design must support high-performance building standards, including indoor air quality, thermal comfort, and ventilation rates consistent with ASHRAE 62.1.
 - b. Prioritize durability, maintainability, and operational efficiency in HVAC design.
 - c. Design documents shall include projects anticipated energy use intensity (EUI) estimates based on Energy Star median. www.energystar.gov/
 - Control Systems
 - a. Must be compatible with the institution's building automation system (BAS).
 - b. Approved controls manufacturers:
 - i. Niagara Framework (Distech or Honeywell controllers)
 - ii. Automated Logic Corporation (ALC)

- iii. Delta Controls
 - iv. Schneider Electric EcoStruxure
- c. Existing system additions or upgrades to coordinated with KSU PDC Engineering and KSU Plant Operations.
- d. All devices must use open BACnet protocols.
- e. Wireless controls may be acceptable if a building does not have a BAS system.
- Commissioning
 - a. HVAC systems must be fully commissioned under a process that meets University, University System of Georgia and industry standards (such as ASHRAE Guideline 0 and 1.1). Commissioning agent to be hired by and report directly to the owner. Engineer and contractor to assist commissioning agent.
- Indoor Air Quality
 - a. Proper filtration (e.g., MERV ratings) and ventilation are expected. Typically Merv 8 and Merv 13 to be used in air distribution equipment.
 - b. Humidity and CO₂ control may be required, particularly in labs, galleries or high-occupancy spaces.
- The design criteria should address load shedding and additions to keep equipment properly sized. It must also ensure load calculations are maintained to prevent oversizing or under sizing issues.
- Redundancy is desired in HVAC equipment:
 - a. Air handling systems (manifold AHU's).
 - b. Air handling unit fans (fan array). Minimum of 2 Fans with no less than 70% of CFM redundancy.
 - c. Secondary chilled and heating water pumps (100% redundancy).
 - d. Chillers (minimum 120% of connected load).
 - e. Boilers (minimum 120% of connected load).
 - f. Data Center air conditioners (100% redundancy).
- All buildings with hydronic systems shall include chilled and heating water stub-outs (U.G.) for future connection to district energy plants. Stub-outs shall include isolation valves and extend minimum 5 foot beyond building exterior wall.
- Carbon Monoxide sensors should be installed per ASHRAE Standard 62.2.
- Roof-mounted HVAC equipment including chillers, cooling towers, and boilers, is not permitted.

- Where possible, fans should be direct drive type.
- In general KSU prefers non-condensing firetube boiler hot water plants, optionally a hybrid (high-mass condensing & non-condensing boilers) hot water boiler plant would be acceptable; if either is not feasible, high mass condensing boilers versus a low-mass type condensing boiler.
- Chiller preferences:
 - a. Water-cooled systems (preferred chilled water system type): magnetic bearing centrifugal type chillers with VFD.
 - b. Manufacturers: Daikin, JCI, or Trane.
 - c. All chiller and cooling towers shall include sound attenuation packages. Specify noise criteria for equipment components. Noise criteria shall be provided for the full operating range of the chiller. Refer to ASHRAE standards for maximum allowable decibel level.
- In general A/V closets shall be ventilated by ventilation fan.
- IDF rooms should be ventilated. MDF room should be cooled. Room temperature should be maintain a temperature between 75-80 degrees with 75 degrees being the set point.
 - a. Primary Option: Utilize a heat recovery system to manage and repurpose waste heat, compliant with IECC standards
 - b. Secondary Option:
 - i. Employ exhaust ventilation to remove excess heat, ensuring compliance with IECC Section C403.3.0 for ventilation system controls and temperature maintenance.
 - ii. Use high-efficiency mini-split units that meet Energy Star guidelines. Unit must have a minimum SEER of 20.
- Design documents shall include projects anticipated energy use intensity (EUI) estimates based on Energy Star median. www.energystar.gov/
- In general the use of grooved hydronic pipe is acceptable where readily accessible.

F. MECHANICAL SLEEVE SEALS

1. Manufacturers: Link-Seal series 300M as manufactured by Thunderline Corporation, Metraseal by Metraflex or Advance Products and Systems Innerlynx.
2. Synthetic rubber elements linked together to form a watertight seal between pipe and opening for penetrations.

3. Openings in new construction shall be provided with schedule 40 pipe sleeves having 10 gauge leak plate, 4-inch larger than sleeve O.D., welded thereto and poured in place.

G. MANUFACTURED CURBS, EQUIPMENT RAILS AND OTHER ROOF ASSEMBLIES

1. Manufactured Curbs:

- a. The Pate CompanyPC-*: www.patecurbs.com
- b. ThyCurb TC-*: www.thybar.com

2. Manufactured Equipment Rails:

- a. The Pate CompanyES-*: www.patecurbs.com
- b. ThyCurb TEMS-*: www.thybar.com

3. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies: Factory-assembled hollow sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water.
4. Equipment Rails: Two-sided curbs in straight lengths, with top of rail horizontal for equipment mounting.
5. Pipe, Duct, and Conduit Mounting Pedestals: Vertical posts, minimum 8 inches square unless otherwise indicated.

H. PREFABRICATED PIPE CURB

1. Manufacturers: Pate, ThyCurb.

I. INSTALLATION

1. Clearance above and in front of electrical switchgear, electrical power panels or control panels shall be maintained by mechanical systems so that no mechanical ducts, pipes, vents or equipment is routed above or across the space directly above this equipment in conformance with the National Electrical Code.
2. All equipment shall be installed in accordance with manufacturers' published installation instructions shipped with the equipment. In the event there is a discrepancy between these specifications or Drawings and the manufacturers' instructions, no work shall be performed until additional instructions are received.
3. Install and connect all appliances, equipment, and appurtenances as specified, indicated or required in accordance with the manufacturer's instructions and recommendations. Furnish and install complete auxiliary piping, water seals, valves, electric connections, and similar items, recommended by the manufacturer or as required for proper operation.

4. Equipment, valves and other items installed under this division requiring service shall be installed to be readily accessible. Refer to definitions in this section. Additionally, isolation valves shall be provided for all equipment to facilitate maintenance and service.
5. Route piping and ductwork to avoid skylights, translucent, and transparent ceilings.
6. Pipe Sleeves in Slabs, Masonry Walls and Partitions:
 - a. Provide sleeves in all slabs and walls/partitions unless otherwise noted.
 - b. Omit sleeves on cast iron pipe through slabs on grade.
 - c. Provide sleeve seals where pipe passes thru building wall to a below grade location.
 - d. Elevated Slabs: Schedule 40 black steel pipe: Sleeves shall be sized to include the insulation with minimum gap around insulation. Install, without developing a break in the pipe insulation, according to the fire sealant manufacturer's installation instructions for a U.L. Listed assembly for a rated pipe penetration through a slab.
 - e. Masonry Partitions: Schedule 40 black steel pipe: Sleeves shall be sized to include the insulation with minimum gap around insulation. Install, without developing a break in the pipe insulation, according to the fire sealant manufacturer's installation instructions for a U.L. Listed assembly for a rated pipe penetration through a rated masonry wall/partition.
 - f. Omit sleeves in openings core drilled in masonry partitions.
 - g. Rated Drywall Partitions: Twenty gage galvanized steel. Sleeves shall be sized to include the insulation with minimum gap around the insulation. Install, without developing a break in the pipe insulation, according to the fire sealant manufacturer's installation instructions for a U.L. Listed assembly for a rated pipe penetration through a rated drywall wall/partition.
 - h. Non-Rated Drywall Partitions: Omit sleeves.
7. Pipe sleeves in footings and foundation walls:
 - a. Schedule 40 black steel pipe.
 - b. Chilled water, heating water, condenser water, refrigerant, or process piping passing under a footing or through a foundation wall shall be installed in a pipe sleeve, two pipe sizes larger than the pipe passing through.
 - c. Sleeves in walls to spaces below grade shall be provided with 10 gauge leak plates.
8. Seal sleeves and openings in mechanical room walls, fire rated partitions, and floors above grade vaportight, watertight, or for smoke/fire protection as applicable. Refer to Section 07 8400

9. Seal sleeves and openings in exterior walls vaportight or watertight as applicable. Refer to Section 07 9000.
10. Install roof equipment support rails spanning roof joists.

J. SPACE CONDITIONING DURING CONSTRUCTION

1. Coordinate with the Contractor regarding the limits of space conditions specified or requested by other trade sections.
2. Assist the Contractor in the preparation of the construction schedule and determine to what extent the project's HVAC system can be operated within the restrictions listed below to help maintain those conditions.
3. Ducted air handling systems shall not be placed into operation for testing or for temporary space conditioning until all walls in areas served by the system have been prepared for painting and the building is broom clean.
4. The building's HVAC system shall be kept clean during the entire construction process. Protect equipment, motor, ducts, pipes from dirt and debris.
5. Filters during construction:
 - a. Provide and maintain filters on all air handling equipment and terminal units used for space conditioning during construction.
 - b. Provide and maintain filters on all return air grilles once ceilings are installed when air handling equipment or terminal units are used for space conditioning during construction.
 - c. Provide filters with a minimum MERV rating of 8.
6. Heating Terminal units such as unit heaters, cabinet heaters and finned radiation may be used for temporary heat during construction. Clean to new condition.

K. PIPING PRESSURE TESTS

1. General:
 - a. Provide 48 hours notification to the Design Professional, owner and commissioning agent in advance of any test.
 - b. Complete tests prior to insulating.
 - c. Leaks shall be repaired, defective materials replaced, and system shall be retested.
 - d. Strike all joints in copper and steel piping under a pressure test.
 - e. Conduct tests prior to connecting to equipment or isolate equipment from system.

- f. No water pressure test shall be conducted in freezing weather where subject to freezing.
- g. Test shall be maintained at conditions specified until approved but, in no event, for less than eight (8) hours minimum duration, unless otherwise noted.
- h. Hydrostatic pressure tests shall maintain pressure without change, except that due to temperature change. A documented pressure test and evacuation shall be required with photographic evidence provided for recordkeeping.

L. EQUIPMENT BASES AND HOUSEKEEPING PADS

- 1. Provide housekeeping and equipment bases as shown or listed below. Rough up slab under bases before pouring concrete.
- 2. Materials: Refer to Section 03 3000 - Cast-in-Place Concrete. Omit test cylinders for concrete poured under this section.
- 3. Bases/Pads shall be rectangular with vertical sides 4-inches from centerline of anchor bolts or 2 inches from edges of equipment supports, whichever provides the larger dimension, side of equipment or base edge, unless otherwise noted.

M. EQUIPMENT BACKBOARDS

- 1. General: Provide wood backboards for installation of surface mounted control panels, enclosed motor controllers, variable frequency controllers, and where shown.
- 2. Type: 3/4-inch thick grade 1 fire retardant treated plywood supported by 3/4" x 3/4" x 1/8" aluminum angle frame attached to wall with 1/4-inch toggle bolts for hollow masonry, expansion shields for solid masonry.
- 3. Finish: Frame and board with two coats light gray enamel paint.

N. STARTING EQUIPMENT AND SYSTEMS

- 1. Adjust equipment for proper operation within manufacturers' published tolerances.
- 2. Demonstrate proper operation of systems and equipment to the Owner's designated representative.
- 3. Provide manufacturer startup sheets completed in their entirety with all necessary documentation.

O. DEMONSTRATION, TRAINING AND INSTRUCTIONS

1. A minimum of 40 total hours of training shall be provided for mechanical, electrical, plumbing, and fire protection systems. Training shall occur in 3 hour sessions in the afternoon.
2. Training shall include a minimum of 24 hours of training dedicated to building controls; of which at least 4 hours shall be field training and at least 20 hours for classroom instruction.
3. A manufacturer's service representative shall provide the instructions for each piece of equipment or system when specified in other Sections of this Division. A manufacturer's sales representative is not acceptable. (The instructor shall not be a sales person, but shall have service experience on a continuing basis and be knowledgeable about the subject equipment.)
4. The Contractor shall request the instruction date not less than 15 days before the desired date for coordination with the Using Agency. Operating manuals for the equipment/systems on which instructions are being given shall be in the possession of the operating personnel not less than 30 days prior to the date of instruction.
5. An Owner Training Video shall be made by the contractor(s) separate from training sessions and professionally recorded. The video shall cover all equipment and systems addressed in the owner training sessions.
6. The Contractor shall develop not less than three (3) copies of the instructions with an index for easy retrieval of information.

P. CLEANING AND PROTECTION

1. All materials, equipment and mechanical rooms shall be cleaned prior to Material Completion.
2. Wash down and scrub clean all mechanical room floors, walls, equipment bases and equipment on a daily basis to prevent workplace injury.
3. Paint equipment where finish has been damaged requiring retouching of finish to match factory finish.
4. All air handling equipment shall be cleaned internally prior to Material Completion. Clean unit casing externally and internally. Seal/replace all damaged duct liner. If drywall work is being performed, the coils are to be washed.
5. Chipped or scraped paint shall be retouched to match original finish.
6. Clean and polish all equipment nameplates. All nameplate information shall be legible.
7. All dents and sags in ductwork and equipment casings shall be straightened.
8. During Construction, as ductwork is being installed, all new openings should be protected with covering to prevent infiltration of dust or other debris.

9. All ductwork, insulation, equipment, pipe, pipe fittings and appurtenances shall be free of dust, rust and stains prior to Material Completion.
10. Additional cleaning due to contractor use of building systems during construction:
 - a. Contractor shall have all associated duct work, coils, heat exchangers, and piping professionally cleaned prior to turn over of the building to the owner.

Q. FINISHING EQUIPMENT AND MATERIAL

1. Use paint systems specified in Division 9 for the substrates to be finished. All surfaces to be painted shall be properly prepared to ensure adequate adhesion and durability.
2. Paint shop-primed equipment.
3. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
4. Finish equipment, piping, conduit, and exposed duct work in utility areas in colors according to the color coding scheme indicated.
5. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
6. All ferrous fasteners and hanger supports not having a corrosion resistant plated finish and exposed to outside conditions or in mechanical rooms shall be painted to prevent rust.
7. Paint all exposed un-insulated ferrous metals, flat black.
8. Paint miscellaneous ferrous metals such as nipples and fittings on chilled water piping at drains, vents and instrument tapping before insulation.
9. Paint all exterior un-insulated ferrous metals at cooling tower and tower piping with aluminum paint.
10. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
11. Concrete Equipment pads: Clean concrete and paint pad safety yellow for indoor mechanical rooms.

SECTION 23 0513 – MOTORS FOR HVAC EQUIPMENT**A. MANUFACTURERS**

1. Baldor
2. Century
3. GE
4. Lincoln
5. Marathon
6. Magnetec
7. Toshiba

B. GENERAL CONSTRUCTION AND REQUIREMENTS

1. Electrical Service:
 - a. Motors 1/2 HP and Smaller: 277 volts, single phase, 60 Hz. 120/208v Acceptable only if building not equipped with 277/480v system.
 - b. Motors over 1/2 HP: three phase 60 Hz.
 - i. 460 volt motors on 480 volt systems.
 - c. Refer to Electrical drawings for voltage and phase required.
2. Overload Protection: Single phase motors shall be furnished with built-in automatic reset overload protection.
3. Efficiency: Motors 1 HP and larger shall be premium efficiency motors and have minimum full load efficiencies not less than listed in the Energy Code. ECM motors shall be used for PIUs, which shall be arranged in a parallel configuration.
4. Brake Horsepower: All motors shall have rated horsepower at least 10 percent above the indicated brake horsepower of equipment including belt losses and inlet vane losses.
5. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
6. Motors serviced by Variable Frequency Controllers:
 - a. Motors shall be Definite Purpose Inverter-Fed Motors complying with NEMA MG1-Part 31. Stator laminations shall be vacuum-pressure impregnated with varnish for reduction of audible motor noise.

- b. Motors shall be equipped with factory installed grounding rings to electrically ground the motor shaft to prevent eddy current damage to bearings, AEGIS-SCR.

7. Wiring Terminations:

- a. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
- b. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

8. Location Motor

- a. Motors should all be located where a technician can easily access for servicing and replacing with appropriate access panels installed as needed if in a hard ceiling and no other utilities or ductwork in the way.

SECTION 23 0514 – VARIABLE FREQUENCY CONTROLLERS

A. MANUFACTURERS

ABB drives are standard for KSU installations.

B. DESCRIPTION

1. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
 - a. Employ microprocessor-based inverter logic isolated from power circuits.
 - b. Employ pulse-width-modulated inverter system providing a carrier frequency adjustable from 4,000Hz to 8,000Hz.
 - c. Design for ability to operate controller with motor disconnected from output.
 - d. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

C. COMPONENTS

1. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
2. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
3. Furnish HAND-OFF-AUTOMATIC selector switch and manual speed control. Omit on fans with automatic isolation dampers.
4. Include undervoltage release.
5. Control Power Source: Integral control transformer.
6. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.
7. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.
8. Control Interlocks:
 - a. Furnish terminals for remote contact to allow starting in automatic mode.

- b. Furnish factory installed BACNET communication device(s) to interface VFD with the BAS. Information communicated between the BAS and the unit controller shall allow unit monitoring, control, and alarm notification.
 - c. Provide auxiliary outputs to comply with the sequence of operation specified in Section 23 0994. Furnish programmable analog outputs(two minimum) and programmable digital outputs(three minimum).
- 9. Manual Bypass: Manual bypass is not required, optional. Bypass shall be integral to the variable speed drive and manufactured by same firm that manufactures drive. Furnish contactor, motor running overload protection, and short circuit protection for full voltage, non-reversing operation of the motor. By-pass shall be two contactor type (does not allow maintenance on inverter while motor is operating).
- 10. Emergency Stop: Use dynamic brakes for emergency stop function.
- 11. Jogging: On drives serving motors of supply, return, or exhaust fans ducted into one single header duct, provide capability to bring motor up to preset, adjustable, low speed, prior to fan isolation damper opening, signal fan isolation damper to open, then continue to ramp motor up to controlled speed.
- 12. Disconnecting Means: Include integral circuit breaker on the line side of each controller.
- 13. Wiring Terminations: Match conductor materials and sizes indicated.

SECTION 23 0515 – ENCLOSED MOTOR CONTROLLERS

- A. USE OF MOTOR CONTROLLERS:** Motor Controllers should not be used unless approved by KSU's Plant Operations department. VFDs should always be installed instead of motor controllers. If a motor controller is approved, the following is the standard.

B. MANUFACTURERS

1. Allen Bradley
2. Cutler Hammer
3. Furnas
4. General Electric
5. Square-D

C. AUTOMATIC CONTROLLERS

1. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
2. Starters shall be NEMA type starters. IEC type starters are not allowed.
3. Coil Operating Voltage: 120 volts, 60 Hertz.
4. Overload Relays: NEMA ICS 2; bimetal.
5. Enclosures:
 - a. Enclosures: NEMA ICS 6, Type 1 indoors.
 - b. Enclosures: NEMA ICS 6, Type 3R outdoors.

SECTION 23 0519 - METERS AND GAGES FOR HVAC PIPING**A. REFER TO KSU METERING STANDARDS APPENDIX FOR:**

1. Electrical Meters/Metering
2. Natural Gas Meters/Metering
3. Domestic Water Meters/Metering
4. Makeup Water Meters/Metering
5. Chilled Water Meters/Metering
6. Heating Water Meters/Metering

B. LIQUID FLOW METERS

1. Annular element flow stations (FM):
 - a. Manufacturers: Ellison Annubar, Barco, Mid-West, Preso.
 - b. Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
 - c. Pressure rating: 275 psi.
 - d. Maximum temperature: 400 degrees F.
 - e. Accuracy: Plus 0.55 percent to minus 2.30 percent.

SECTION 23 0548 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**A. PERFORMANCE REQUIREMENTS**

1. General:

- a. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
- b. Steel springs to function without undue stress or overloading.

B. EQUIPMENT SUPPORT BASES

1. Concrete Inertia Bases:

- a. Construction: Engineered, steel forms, with integrated isolator brackets and anchor bolts, welded or tied reinforcing bars running both ways in a single layer.
- b. Size: 6 inches minimum depth and sized to accommodate elbow supports.
- c. Mass: Minimum of 1.5 times weight of isolated equipment.
- d. Connecting Point: Reinforced to connect isolators and snubbers to base including template and fastening devices for equipment.
- e. Concrete: Filled on site with minimum 3000 psi concrete. See Section 03 3000 for additional requirements.

C. INSTALLATION - GENERAL

1. Install in accordance with manufacturer's instructions.

2. Bases:

- a. All bases shall be placed in position and supported temporarily by blocks or shims prior to the installation of the equipment, isolators and restraints.
- b. Isolators shall be installed after all equipment is installed without changing equipment elevations.
- c. Adjust equipment level.
- d. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolators or the isolation system.

3. Support piping connections to equipment mounted on isolators using isolators or resilient hangers as follows:

- a. Pipes within ground floor mechanical rooms shall be vibration isolated from the building's floor above. Minimum first three points of support from base mounted pumps.
 - b. Up to 4 Inches Pipe Size: First three points of support.
 - c. 5 to 8 Inches Pipe Size: First four points of support.
 - d. 10 inches Pipe Size and Over: First six points of support.
 - e. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.
4. Vibration isolation hangers shall be positioned as close as possible to the structure without coming in contact with any object (including the structure).
- a. Hanger rods shall not contact any object which would short circuit the isolator.

D. SCHEDULE

1. Equipment Isolation Schedule.

- a. Base Mounted HVAC Pumps on Grade.
 - i. Base: Concrete pad.
 - ii. Base Thickness: 8 inches.
 - iii. Isolator Type: None
- b. Base Mounted HVAC Pumps above Grade.
 - i. Housekeeping Pad: 4 inches thick.
 - ii. Base: Concrete inertia base.
 - iii. Base Thickness: 6 inches.
 - iv. Isolator Type: Open spring isolators.
 - v. Isolator Deflection: 2.0 inches.
- c. Base Mounted Fans.
 - i. Housekeeping Pad: 4 inches thick.
 - ii. Base: Structural steel base.
 - iii. Isolator Type: Open Spring Isolators

- iv. Isolator Deflection: 1.5 inches.
- d. Roof Mounted utility and fume Fans.
 - i. Base: Structural steel base.
 - ii. Isolator Type: Restrained Closed Spring Isolators
 - iii. Isolator Deflection: 0.75 inches.
- e. Suspended fans:
 - i. Isolator Type: Spring Isolator.
 - ii. Isolator Deflection: .75 inches.
- f. Air Handling Units mounted on floor slabs on grade: Fan is factory spring isolated.
 - i. Base: Housekeeping pad.
 - ii. Housekeeping Pad Thickness: 6 inches. minimum, unless noted otherwise on Drawings. Increase pad height for unit furnished to provide space for condensate drain trap, refer to trap detail on drawings.
 - iii. Isolator Type: Neoprene Pads, or better.
 - iv. Isolator Deflection: 0.25 inches.
- g. Air Handling Units mounted on floor slabs above grade: Fan is factory spring isolated. Isolate unit casing from housekeeping pad to reduce vibration from casing.
 - i. Base: Housekeeping pad.
 - ii. Housekeeping Pad Thickness: 4 inches. minimum, unless noted otherwise on Drawings. Increase pad height for unit furnished using galvanized steel base rails to provide space for condensate drain trap, refer to trap detail on drawings.
 - iii. Isolator Type: Neoprene Pad or better.
 - iv. Isolator Deflection: .25 inches.
- h. Air Cooled Condensing Units, 7-1/2 tons capacity and less. Refer to Detail on Drawings.
 - i. Base: Exterior concrete pad.
 - ii. Isolator Type: Rubber Mount.
- i. Air Cooled Water Chiller:

- i. Base: Exterior concrete base.
 - ii. Base Thickness: 6 inches.
 - iii. Isolator Type: Neoprene Pad Isolators, or better
 - iv. Isolator Deflection: 0.10 inches.
- j. Centrifugal Water Chillers.
 - i. Base: Concrete Pad.
 - ii. Base Thickness: 6 inches.
 - iii. Isolator Type: Neoprene pad isolators, or better.
 - iv. Isolator Deflection: 0.10 inches.
- k. Induced Draft Cooling Tower.
 - i. Base: Concrete Sump.

SECTION 23 0553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

A. IDENTIFICATION APPLICATIONS

1. Chillers: Nameplates.
2. Cooling Towers: Nameplates.
3. Boilers: Nameplates.
4. Air Handling Units: Nameplates.
5. Air Terminal Units: Nameplates.
6. Automatic Controls: Tags. Key to control schematic.
7. Control Panels: Nameplates.
8. Dampers: Ribbon tied to the damper where located above lay-in ceiling.
9. Heat Transfer Equipment: Nameplates.
10. Instrumentation: Tags.
11. Major Control Components: Nameplates.
12. Piping: Pipe markers.
13. Pumps: Nameplates.
14. Tanks: Nameplates.
15. Valves: Tags and ceiling tacks where located above lay-in ceiling.
16. Water Treatment Devices: Nameplates.

B. MANUFACTURERS

1. Brimar.
2. Kolbi.
3. Seton.

C. NAMEPLATES

1. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
2. Size: 1/2-inch-high letters unless otherwise noted.
3. Size when located on ceiling grid: 3/8 inch high letters unless otherwise noted. Background color to match ceiling grid.

D. TAGS

1. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.
2. Tag Chart: Typewritten letter size list in anodized aluminum frame.

E. PIPE MARKERS

1. Manufacturers: Brimar, Kolbi Industries Style A through E (5 inch and smaller) else Style F through H, Marking Services Inc., Seton Identification Products - Setmark.
2. Color: Conform to ASME A13.1.
3. Pipe Markers for Indoor Use: Media indicator with direction-of-flow arrows on calendared vinyl sheet; snap-around type for pipe sizes to 5-7/8 inches diameter, strap around type with nylon ties for pipe sizes 6 inches diameter and larger.
4. Pipe Markers for Outdoor Use: Media indicator and detachable direction-of-flow arrows on weather-resistant pressure-sensitive vinyl sheet; service temperature -40 to 175 degrees F.

F. VALVE TAGS

1. Brass; Media and identification number imprinted on tag.
2. Securing Devices: Number 6 brass bead chain; provide one securing device for each tag in accepted schedule.
3. Valve Chart Frame: Aluminum frame, plastic window; sized to accommodate included chart, minimum 8-1/2 by 11 inches.

G. INSTALLATION

1. Install tags with corrosion resistant chain.
2. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
3. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
4. Where equipment is located above ceilings; Apply nameplate to ceiling grid for equipment located above accessible ceilings or to access panel for non-accessible ceilings.
5. Where manual air vents are located above ceilings; Apply nameplate to ceiling grid for equipment located above accessible ceilings or to access panel for non-accessible ceilings.
6. Identify control panels and major control components outside panels with plastic nameplates.
7. Identify all equipment with plastic nameplates.
8. Tag automatic controls, instruments, and relays. Key to control schematic.
9. Install Pipe Markers on all piping systems at the following Locations:
 - a. Mechanical Equipment Rooms:
 - i. Within 18 inches of each valve.
 - ii. Within 36 inches of each 90° elbow, tee, connection to equipment or vessel and point where pipe exits room.
 - iii. At not over 20 feet intervals along all exposed piping.
 - b. Above Suspended Ceilings:
 - i. Within 18 inches of each valve or valve assembly.
 - ii. At tees, identify both main and branch within 36 inches of tee.
 - iii. Within 36 inches of each 90° elbow.
 - iv. At not over 30 feet intervals along all concealed piping.
 - c. Concealed Piping in Chases or Shafts: Identify each pipe visible through access door panel.
 - d. Piping Exposed in Rooms Other Than Mechanical Equipment Areas:
 - i. Omit identification on piping, 1 inch exterior diameter or smaller (insulated or uninsulated) or exposed at connections to equipment or plumbing fixtures.

- ii. With the above exception, identify at not less than one point each piping run visible in each room, with identification on not over 20 feet intervals.

10. Valve Tags:

1. Valve Chart: List all tagged valves indicating system, valve identification number, location and purpose or special information. Mount to wall in mechanical room.

SECTION 23 0593 – TESTING, ADJUSTING AND BALANCING FOR HVAC**A. SECTION INCLUDES**

1. Duct leakage testing of 4 inch WG pressure class or higher ducts.
2. Leakage testing of building return air chase.
3. Initial testing, adjustment, and balancing of air systems.
4. Winter and Summer Seasonal testing, adjustment, and balancing of air systems.
5. Initial testing, adjustment, and balancing of hydronic systems.
6. Winter and Summer Seasonal Testing, adjustment, and balancing of HVAC systems.
7. Measurement of final operating condition of HVAC systems.
8. Testing of control sensors, controllers and safeties.
9. Commissioning activities.

B. SUBMITTALS

1. Refer to Section 23 0510 - General HVAC Requirements for submittal procedures.
2. Field Logs: Submit at least once a week to the Commissioning Authority.
3. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
4. Initial Review: Submit results of testing and balancing agency's examination of documents and systems within 30 days after Notice to Proceed.
5. Initial Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - a. Submit two weeks prior to Contractor's Request for Material Completion.
 - b. Submit to the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
 - c. Submit copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - d. Submit an electronic copy of typewritten report in searchable format.

- e. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - f. Reports shall include the manufacturer's performance curves, graphs, and tables with the specified design and actual, measured/as-balanced duty points identified on each. The performance data shall show efficiencies, brake horsepower, speeds, etc. for design and actual operating conditions.
 - g. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - h. Units of Measure: Report data in I-P (inch-pound) units only.
 - i. Test Reports: Indicate data on NEBB forms.
 - j. Include the following on the title page of each report:
 - i. Name of Testing, Adjusting, and Balancing Agency.
 - ii. Address of Testing, Adjusting, and Balancing Agency.
 - iii. Telephone number of Testing, Adjusting, and Balancing Agency.
 - iv. Project name.
 - v. Project location.
 - vi. Project Architect.
 - vii. Project Engineer.
 - viii. Project Contractor.
 - ix. Report date.
6. Seasonal Reports: Submit seasonal reports within 14 days of completion of seasonal adjustments. Include test reports for any equipment that could not be tested at the initial report due to season, temperature, or other conditions.
- a. Submit an electronic copy of typewritten report in searchable format.
 - b. List of deficiencies noted, adjustments made, and corrective action taken.
 - c. Temperature of each conditioned space and dry bulb setting of controlling thermostat.
 - d. Temperature at all sensors in equipment, space duct or pipe and settings of controllers.
 - e. Date and outdoor DB and WB range during the time of the seasonal test.

C. GENERAL REQUIREMENTS

1. TAB shall be performed by an independent testing laboratory selected and engaged by the Owner.
2. Perform total system balance in accordance with one of the following:
 - a. AABC MN-1, AABC National Standards for Total System Balance.
 - b. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
3. TAB work shall not commence until building envelope is completed, doors and windows installed, ceilings installed, and HVAC systems and controls to be tested, adjusted, or balanced are operational.
4. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the State Fire Marshal.
5. TAB Agency Qualifications:
 - a. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - b. Having minimum of five years documented experience.
 - c. Certified by one of the following:
 - i. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - ii. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - d. Company shall an independent firm with no relationship with any Contractor on this Project.
6. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.
7. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor experienced in performance of this Work and licensed at the State in which the Project is located.
8. Reports shall be certified by a AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor experienced in performance of this Work.

D. EXAMINATION

1. Review the contract documents and existing conditions for appurtenances and arrangement for balancing prior to the installation of any equipment or material. the Contractor shall notify Architect of any omissions noted within 30 days of the Contractor's notice to proceed.
2. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - a. Systems are started and operating in a safe and normal condition.
 - b. Temperature control systems are installed complete and operable.
 - c. Proper thermal overload protection is in place for electrical equipment.
 - d. All filters are clean and in place. If required, install temporary media in addition to filters.
 - e. Duct systems are clean of debris.
 - f. Fans are rotating correctly.
 - g. Fire and volume dampers are in place, accessible, operable and open. Report observation on test report.
 - h. Smoke dampers are in place, damper and operator are accessible, damper is operable, and open. Report observation on test report.
 - i. All dampers and operators function smoothly from shut-off to full open.
 - j. Air coil fins are cleaned and combed.
 - k. Access doors are installed at specified components are accessible, are closed and duct end caps are in place.
 - l. Air outlets are installed and connected.
 - m. Duct system leakage is minimized.
 - n. Hydronic systems are flushed, filled, and vented.
 - o. Pumps are rotating correctly.
 - p. Proper strainer baskets are clean and in place.
 - q. Service and balance valves are open.

E. ADJUSTMENT TOLERANCES

1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
2. Air Outlets and Inlets: Adjust total to within plus 5 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
3. Laboratory Spaces:
 - a. Air Inlets: Adjust total to within plus 0 percent and minus 5 percent of design to space. Adjust inlets in each space to within plus 5 percent or minus 5 percent of design.
 - b. Fume Hoods: Adjust for 100 FPM average face velocity with the sash at 18 inches above the work surface.
 - c. Air Outlets: Adjust total to within plus 5 percent and minus 0 percent of design to space. Adjust outlets in each space to within plus 5 percent or minus 5 percent of design.
 - d. Ensure tolerances result in airflow from the corridors or adjacent non-laboratory spaces into each laboratory.
4. Building Pressure: Ensure that installation tolerances result in each floor of the building being positively pressurized with respect to outside ambient pressure.
5. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

F. RECORDING AND ADJUSTING

1. Ensure recorded data represents actual measured or observed conditions.
2. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
3. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
4. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
5. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
6. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

7. Duct pressure tests shall be reviewed and accepted prior to installing insulation.

G. FUME HOOD TESTING (ON SITE)

1. General: Test fume hoods as installed to assess airflow velocity, airflow visualization, and level of containment. Perform tests with static mode (set sash position) conditions. Conduct testing as outlined below for 100% of the hoods provided in the Project.
2. Testing Requirements:
 - a. Perform the following tests, in order:
 - i. Airflow Velocity Test.
 - ii. Airflow Visualization Test.
 - iii. Tracer Gas Containment Test.
 - b. Airflow Velocity Test: Conform to Section 9 of NEBB (FHT) Fume Hood Testing Standard - current edition.
 - c. Airflow Visualization Test: Conform to Section 10 of NEBB (FHT) Fume Hood Testing Standard - current edition.
 - d. Tracer Gas Containment Test:
 - i. Conduct a static mode test of the hood and laboratory configuration. Conduct testing in accordance with ASHRAE Std 110, except as modified herein:
 1. Test hood with simulated scientific apparatus set-up within the hood. Apparatus to consist of: two (2) each 1 gal. round paint cans, one (1) 1' by 1' by 1' cardboard box, and three (3) each 6" by 6" by 12" high cardboard boxes. Position these items from 6 to 10 inches behind the sash, randomly distributed, and supported off of the work surface by 2 inch by 2 inch by 2 inch block of any material.
 2. 6 liters per minute release rate for tracer gas.
 3. Conduct only at the center position for the manikin.
 4. Each tracer gas test duration to be 5 minutes.
 5. Acceptable test results will be 0.05 PPM or better.
 6. At the conclusion of each 5-minute test there will be three rapid walk-by at 1' behind the manikin. Each walk-by to be spaced 30

seconds apart. If a rise in test gas concentration occurs, it cannot exceed 0.10 ppm and must return to 0.05 ppm within 15 seconds.

7. There must be a minimum of three and a maximum of five people in the space in which the fume hood is located during the test procedure.
8. Representatives of the Architect, Engineer, Owner, and Contractor must witness the tests.
9. Test of Alarm: Shut off the fume hood exhaust and verify that the individual fume hood alarm activates.
10. Test individual controls: Test any controls that are provided at the fume hood such as unoccupied cycle override, alarm override, etc.

H. AIR SYSTEM PROCEDURE

1. Pressure test ducts and building return air chase in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
 - a. Return Air Chase: Class 12.
 - b. 4 inch WG or higher: Class 6 for rectangular ducts and Class 3 for round and oval ducts.
2. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
3. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct. Close openings after measurement with permanent manufactured plugs.
4. Measure air quantities at air inlets and outlets.
5. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
6. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
7. Vary total system air quantities by adjustment of fan speeds by drive sheave adjustment. Provide drive changes required to place belt in mid-position at final RPM. Vary branch air quantities by damper regulation.
8. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

9. Measure static air pressure conditions on air supply units, including pressure drops at all components including filters and fans, and total pressure across the fan. Make allowances for 50 percent loading of filters.
10. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Adjust operators on outside air dampers to ensure tight seal when shut.
11. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
12. The differential at the time of balance between the outside and return air streams shall be 15 degrees F, minimum, when the outside air quantities are established by temperature differential.
13. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
14. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain positive building pressure near the building entries under all operational sequences.
15. On fan powered VAV boxes, adjust air flow switches for proper operation.
16. Air Handler Wide Open Airflow Test:
 - a. Test system and limit air flow to a 550 FPM chilled water coil air velocity OR loading of motor to 90% of nameplate, whichever occurs first.
 - b. The test shall be performed with all air terminals open to their 100% design airflow (artificially set thermostat setpoints 5 degrees, minimum, below coldest space temperature) and under control.
 - c. The purpose of this test is to determine fixed sheave size that shall be provided for the air handler. Contractor shall provide a new sheave prior upon completion of air flow test and balance work.
 - d. The VFD may be used to temporarily set maximum speed while balancing. Drive shall not be used to provide permanent adjustment.
 - e. The Wide Open maximum speed on the VFD shall be locked on drive to prevent air flow above maximum.
17. Test the apparatus casing(s) downstream of the cooling coils to measure the tightness of assembly by proving that infiltration into this section(s) is less than 3 1/2% of design maximum system air quantity. This infiltration shall be proved by measuring the following:
 - a. Cooling coil L.A.T. (average)
 - b. Fan EAT.
 - c. Duct supply air temperature at discharge of fan.

- d. Supply air fan motor amperage draw, all legs.
- e. Air delta temperature across apparatus casing shall not be less than 20 F during test with maximum air flow.

I. WATER SYSTEM PROCEDURE

1. Adjust water systems to provide required or design quantities.
2. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
3. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
4. Effect system balance with automatic control valves fully open to heat transfer elements.
5. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
6. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

J. COMMISSIONING

1. Perform prerequisites prior to starting commissioning activities.
2. Fill out Prefunctional Checklists for:
 - a. Air side systems.
 - b. Water side systems.
3. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
4. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 50 percent of the air handlers plus a random sample equivalent to 25 percent of the final TAB report data as directed by Commissioning Authority.
 - a. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.

- b. Use the same test instruments as used in the original TAB work.
 - c. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - d. For purposes of re-check, failure is defined as follows:
 - i. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - ii. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
 - iii. Temperatures: Deviation of more than one degree F.
 - iv. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - v. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
 - e. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
5. In the presence of the Commissioning Authority, verify that:
- a. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - b. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
 - c. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.
 - d. The building pressure control sequences operate as specified through a range of CFMs and maintain the building positive under all conditions.

- e. Adjust air system economizer operation for stable damper operation and ensure that operation does not open building doors.

K. CONTROL SYSTEM PROCEDURE

1. Low Limit Thermostats, Fire Thermostats, Smoke Detectors and other Safety devices: Test and verify operation. Record setpoint.
2. Sequence of Operation: Operate systems thru specified Sequence and confirm system function.
3. Thermostats, Input/Output sensors and Controls: Measure temperature or flow at device and record measurement and setting of controller.
4. Flow Rate Transducers: Calibrate flow meters. Confirm accuracy of flow meter by testing thru a four point operating range.
5. Humidistats, Humidity Input/Output sensors and Controls: Measure temperature and relative humidity at device and record measurement and setting of controller.

L. SMOKE MANAGEMENT SYSTEM TESTING

1. Upon completion of the project installation, check-out of equipment and systems under Divisions 15 and 16, and following satisfactory completion of the specified test and balance, smoke removal tests shall be performed to demonstrate system performance.
2. The testing shall be in accordance with the State of Georgia Fire Marshal's criteria.
3. Where said criteria is not available, the following shall be performed as a minimum to demonstrate specified performance to the Authority observing the demonstrator
4. Operate all building systems in their normal sequence.
5. Record exterior temperature, humidity, wind speed and direction. Record any change in conditions during testing period.
6. Demonstrate that correct sequences and outputs are obtained in normal mode, automatic smoke control mode, manual over-ride mode and return to normal mode.
7. Tests shall be repeated until each criteria is successfully proven.
8. Demonstration of system performance shall be in the presence of the Fire Marshal (if desired by Fire Marshal) or the Architect's representative. Schedule to conform to schedule desired by Fire Marshal or the Architect, as applicable.
9. Minimum knowledgeable representatives to be present include General Contractor, Mechanical Sub-contractor, Electrical Sub-contractor and representatives of Fire Alarm

System, HVAC Controls, and Test & Balance. Other trades necessary for the Contractor to satisfactorily complete the tests shall be scheduled by the Contractor.

10. Reports: Three copies of a certified report of the Smoke Removal system Performance Tests shall be submitted within ten (10) days of the event. Report shall be entitled "Smoke Management System Performance Test(s)" and shall include certification of compliance to criteria by the Contractor.
11. Large Volume space management systems:
 - a. Measure pressure differentials across door openings with systems operating in normal mode.
 - b. Activate the smoke management system and :
 - i. Confirm equipment operation.
 - ii. Measure the force required to open exit doors.
 - iii. Record the pressure differentials across all doors that separate the smoke management system area from adjacent spaces.
12. Test shall be performed using actual simulated smoke to test device activation and smoke removal and not just simulation of logic or device activation.
13. Plant Operations and Environmental Health and Safety for KSU should be present for any testing, demonstration, or training.

M. BALANCE UNDER SEASONAL OPERATING CONDITIONS

1. After the initial balance has been completed, reviewed and accepted; the contractor shall balance and adjust the system under seasonal operating conditions by performing operational tests over a minimum period of eight hours under both cooling and heating conditions.
2. These tests shall be performed only after each piece of equipment has been individually tested, and is verified to be in correct operating condition, and shall be made at times when outdoor dry bulb temperatures are above 85 F for cooling, or below 50 F for heating.
3. When test is run during the cooling cycle the building must be occupied, and all lights shall be turned on for a minimum of six (6) hours. Doors to all spaces shall be closed and all space thermostats set at its normal setpoint.
4. Purpose: Prove correctness of installation; prove functioning of capacity and safety controls; prove calibration of operating controls; and prove stability of operation under actual loading conditions.

N. SPECIALTY SPACE TESTING

1. All specialty spaces such as vivarium clean rooms, and any other non traditional space should have detailed testing, adjusting, and balancing specific for it to ensure all requirements of its operation are met.

SECTION 23 0713 – DUCT INSULATION

A. REGULATORY REQUIREMENTS

1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
2. All duct work shall be insulated in accordance with ASHRAE 90.1.
3. All duct liner shall be preformed flexible closed-cell elastomeric rubber type insulation.
4. All adhesives, sealants, and coating compounds shall be low VOC type.

B. INSTALLATION

1. Install in accordance with manufacturer's instructions.
2. Install in accordance with NAIMA National Insulation Standards.
3. Provide insulation with vapor barrier jackets.
4. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
5. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, duct lined with duct liner, heating coil return bends at terminal units, and expansion joints.
6. Fiber Glass, Flexible:
 - a. Do not pull insulation tight around ducts.
 - b. Lap transverse joints 2 inch, minimum and secure with staples 18 inches on center.
 - c. Install mechanical fasteners not more than 18 inches on center on ducts over 24 inches wide.
 - d. Provide 24 inch length, minimum, of rigid glass fiber insulation on bottom of ducts supported from trapeze hangers.
7. Glass Fiber, Rigid:
 - a. Cut to fit between standing seams and stiffeners to provide 1/2 inch, minimum cover.
 - b. Secure insulation to ducts with duct insulation adhesive applied to duct to provide 100% coverage and with mechanical fasteners 12 inch on centers, maximum.

- c. Butt transverse joints.
 - d. Secure metal corner beads to all exterior edges.
 - e. Tape all joints and fastener penetrations with 4 inches wide, minimum, foil scrim kraft tape after pointing clip penetrations with insulating cement.
8. Weld mechanical fasteners to duct. No glue or stick on allowed.
9. Fire Rated Duct Wrap: Install in accordance with manufacturer's installation guide using qualified applicators.
10. Flexible Elastomeric Cellular Insulation: Secure sheet insulation with adhesive. Seal Joints with adhesive. Paint exposed insulation with two coats of vinyl insulation paint after adhesive has dried for twelve hours, minimum. Allow two hours, minimum, between coats.
11. Exterior Applications:
- a. Under no circumstances shall insulation applied to exterior ductwork be allowed to get wet prior to final material covering.
12. Duct Accessories, Duct Mounted Meters and Gages Instruments and Duct Mounted Instrumentation and Other Control Devices:
- a. In conditioned spaces devices shall be left exposed and/or accessible above the insulation vapor barrier jacket for access. Seal to vapor barrier jacket.
 - b. In non-conditioned spaces devices shall be insulated within the insulation vapor barrier jacket with the insulation and jacket arranged to provide access.
 - c. Accessible devices to include:
 - i. Duct mounted Instrumentation,
 - ii. Airflow Measuring Station pressure ports,
 - iii. Input/Output Sensors,
 - iv. Duct access door handles,
 - v. Volume Control damper handles(MVD),
 - d. Damper operators shall be left exposed and/or accessible above the insulation vapor barrier jacket for access. Seal to vapor barrier jacket.

SECTION 23 0719 – HVAC PIPING INSULATION

A. REGULATORY REQUIREMENTS

1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
2. All hydronic piping shall be insulated in accordance with ASHRAE 90.1.
3. All adhesives, sealants, and coating compounds shall be low VOC type.

B. INSTALLATION

1. Exposed Piping: Locate insulation and cover seams in least visible locations. Exterior of insulation shall be uniform in appearance.
2. Insulation jacket shall fit snug to insulation.
3. Valves and fittings:
 - a. Insulate pipe and all valves and fittings including valve bonnets on A.C. condensate drain, chilled water, refrigerant suction, and steam and steam condensate (in return air plenum) piping. Leave only valve stems, open ends of wells and gauge cocks exposed.
 - b. Insulate pipe and all valves and fittings including valve bonnets on Heating Water piping within five feet of terminal unit heating coils. Leave only valve stems, open ends of wells and gauge cocks exposed.
 - c. All Other Piping: Insulate pipe and fittings, but omit insulation on unions and valves. Taper insulation ends and cover with jacket material.
4. Insulation at Hangers: Hangers for horizontal, A.C. condensate drain, chilled water, refrigerant suction, and trapeze supports shall be outside of insulation with saddles as specified herein.
5. Saddles:
 - a. Provide galvanized steel saddles at each point where pipe insulation passes through a hanger or rests on a support.
 - b. Saddles shall be 180 arc for horizontal piping, 360 arch for vertical piping.
 - c. Center saddle on pipe hanger.
6. Flexible elastomeric cellular rubber insulation: Install without splitting and under compression during pipe fabrication. Seal Joints with adhesive. Paint exposed insulation

with two coats of vinyl insulation paint after adhesive has dried for twelve hours, minimum. Allow two hours, minimum, between coats.

7. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 15010.
8. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.
9. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

C. SCHEDULES

1. Heating Hot Water Systems:

- a. Shall be insulated with glass fiber type insulation.
- b. Heating Water Runouts to Terminal units coils shall be insulated with preformed flexible elastomeric cellular rubber insulation.

2. Steam Systems:

- a. Steam piping shall be insulated with calcium silicate type insulation.
- b. Steam condensate piping shall be insulated with glass fiber type insulation.

3. DX Cooling Systems:

- a. Refrigerant Suction: 3/4 inch thick preformed flexible elastomeric cellular rubber insulation.

4. Chilled Water systems:

- a. Chilled water piping shall be insulated with cellular glass or phenolic foam type insulation.
- b. Pipe subject to condensation: 3/4 inch thick preformed flexible elastomeric cellular rubber insulation.

5. Condensate Drains from Cooling Coils: 3/4 inch thick preformed flexible elastomeric cellular rubber insulation.

6. Outside insulated piping should have metal, venture clad or PVC jacketing.

SECTION 23 0913 – INSTRUMENTATION AND CONTROL DEVICES FOR HVAC**A. EQUIPMENT - GENERAL**

1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

B. CONTROL VALVES

2. Globe Pattern:

- a. Up to 2 inches: Bronze body, bronze trim, stainless steel rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
- b. Over 2 inches: Iron body, bronze trim, stainless steel rising stem, plug-type disc, flanged ends, renewable seat and disc.
- c. Hydronic Systems:
 - i. Rate for service pressure of 125 psig at 250 degrees F.
 - ii. Replaceable plugs and seats of stainless steel.
 - iii. Packing: EDPM O-ring.
 - iv. Refer to Valve Coefficients indicated on drawings for size.
 - v. Two-way valves shall have equal percentage characteristics. Size two-way valve operators to close valves against pump shut off head.

3. Butterfly Pattern:

- a. Manufacturers: Bray 31, Centerline Model 200, Crane 12, Grinnell 8000, Hammond 5111, Milwaukee WA, Mueller 51, Nibco WD-2000-3, Stockham LG551.
- b. Iron body, aluminum bronze disc, resilient replaceable EDPM seat for service to 180 degrees F wafer or lug ends, stainless steel stem, extended neck.
- c. Hydronic Systems:
 - i. Rate for service pressure of 125 psig at 250 degrees F.
 - ii. Size for 1 psig maximum pressure drop at design flow rate.
- d. Electric operator:
 - i. Manufacturers: Bray 70, Grinnell, Johnson.

- ii. Single phase, permanently split-capacitor, reversible motor with Class F insulation or better with self-locking worm gear drive mechanism in enclosure.
- iii. Enclosure: Water-proof die-cast aluminum cover and base, NEMA-4, 4X, IP 65, polyester powder coated, coupling direct to valve. One power and one control conduit NPT entries.
- iv. Provide all corrosion resistant (non-ferrous) components, fasteners and mounting devices and connections.
- v. Valve status display: Color coded visual indicator to display valve position through full range of travel.
- vi. SPDT-DB travel limit switches.
- vii. Manual override with aluminum handwheel.
- viii. Stainless steel mechanical travel stops.
- ix. Provide servo control for modulating control sequences.
- x. Provide heater with thermostat prewired to terminal block for operators located in exterior locations.

4. Electric Operators:

- a. Manufacturers: Belimo Actuators and Energy Valves and the Standard. No substitution.
- b. Valves shall spring return(reversible) to normal position as indicated on freeze, fire, or temperature protection.
- c. Valves shall spring return to normal position as indicated on freeze, fire, or temperature protection.
- d. Select operator for full shut off at maximum pump differential pressure.
- e. 24 VAC reversible motor with Class F insulation or better with drive mechanism in enclosure, 10VA maximum.
- f. Enclosure: Water-proof aluminum cover and base, NEMA-2, IP 54, coupling direct to valve.
- g. Provide all corrosion resistant (non-ferrous) components, fasteners and mounting devices and connections.
- h. Unit shall be prewired. Provide a conduit fitting and a three foot long appliance cord.
- i. Valve status display: Color coded visual indicator to display valve position through full range of travel.

- j. External built-in travel limit switch to reverse direction.
 - k. Manual override with hex operator.
5. Terminal Unit Control Valves:
- a. Bronze body, bronze trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.
 - b. Rate for service pressure of 125 psig at 250 degrees F.
 - c. Size for 3 psig maximum pressure drop at design flow rate.
 - d. Two way valves shall have equal percentage characteristics, three way valves linear characteristics. Size two way valve operators to close valves against pump shut off head.
 - e. Operators (Modulating): Self-contained, linear motorized operator with approximately 3/4 inch stroke, 60 second full travel with transformer and SPDT contacts: 24 v DC, 6 watt maximum input.

C. CONTROL DAMPERS

- 1. Manufacturers: TAMCO-1000 Greenheck VCD-33 as standard.
- 2. Dampers must have manual operator for positioning dampers.

D. DAMPER OPERATORS

- 1. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
 - a. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - b. Provide one operator for maximum 36 sq. ft. damper section.
- 2. Electric Operators:
 - a. Manufacturers: Belimo AF24, TFB24, or NF24
 - b. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.

E. TOWER BASIN LEVEL CONTROL

1. Displacement Type:

- a. Manufacturers: Magnetrol Displacer Type B15, Robertshaw Levelac SL-400 SOR 736.
- b. Top mounting style with flanged connection; polymer coated aluminum NEMA 4X enclosure; stainless steel cable; porcelain displacers; stainless steel clamps; two SPST or SPDT switches. Upper switch for high alarm, middle switches for control, lower switch for low alarm.
- c. Upper switch breaks on high level; lower switch breaks on low level. 2 inch fixed differential on upper level.
- d. Enclose displacers in Schedule 40 PVC pipe column to prevent false reading from water turbulence.
- e. Provide heat tape to protect the basin level controls.

F. INSTALLATION

1. Install in accordance with manufacturer's instructions.
2. Locate all control devices except for sensors and devices integral to equipment within control panels, unless otherwise noted.
3. Install control devices in a readily accessible location.
4. Coordinate with Contractor and monitor the work so that other trades do not obstruct control devices or other items requiring access for service.
5. Mount outdoor thermostats and outdoor sensors indoors, with sensing elements outdoors on north side of building or in shaded location. Mount with sun shield.
6. Mount outdoor thermostats and outdoor sensors away from building discharge openings or doors where conditioned air from building will effect signal. Do not mount on positive pressurized HVAC devices where conditioned air can leak thru opening effecting signal.
7. Install control valves in a readily accessible location.
8. Install control valves with stems upright or horizontal, not inverted.
9. Provide mixing dampers of opposed blade construction arranged to mix streams.
10. Provide isolation (two position) dampers of parallel blade construction.
11. Install damper operators in accessible locations.

12. Install damper operators on outside of duct in warm areas. Do not install operators in locations at outdoor temperatures.

SECTION 23 0923 – DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

Please refer to the Direct-Digital Control System Appendix Document

1.

SECTION 23 09 43 – Laboratory Air Flow Control System

1. Laboratory fume hood exhaust system shall comply with the USG Fume Hood Design Criteria.
2. Exhaust system design shall comply with ANSI/AIHA Z9.5 and IBC codes.
3. Ventilations systems
 - a. Direct drive fans fans are preferred.
 - b. Fume hood exhaust fans:
 - i. Tall stack – greater than 10 feet
 - ii. Basis of design: Greenheck
 - iii. Exhaust duct to be type 316 stainless steel with welded joints.

SECTION 23 2113 – HYDRONIC PIPING

A. HYDRONIC SYSTEM REQUIREMENTS

1. Comply with ASME B31.9 and applicable federal, state, and local regulations.
2. Piping: Provide piping, fittings, hangers and supports as required as follows:
 - a. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - b. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 - c. Grooved mechanical joints may be used in accessible locations only.
 - i. Accessible locations include those exposed on interior of building, in mechanical rooms and aboveground outdoors.
 - ii. Grooved mechanical connections and joints comply with AWWA C606.
 1. Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
 - iii. Use rigid joints unless otherwise indicated.
 - d. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
3. Pipe-to-Equipment Connections: Use unions or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
4. Welding Materials and Procedures: Conform to ASME BPVC-IX.

B. HEATING WATER PIPING, ABOVE GRADE

1. Floor distribution piping 2 inch and smaller and all Runouts to terminal equipment shall be copper tube with soldered fittings.
2. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black, using one of the following joint types:
 - a. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - b. Threaded Joints: ASTM B 16.3, malleable iron fittings.
 - c. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings. Refer to "UNIONS, FLANGES, AND COUPLINGS" for acceptable manufacturers and housing type.

- d. Joints:
 - i. Pipe sizes 2 inch and smaller: Threaded.
 - ii. Pipe sizes 2-1/2 inch & larger and all concealed above non-accessible ceilings: Welded.
 - iii. Pipe sizes 2-1/2 inch & larger in mechanical rooms and other non-concealed locations may be grooved joints at Contractor's option.
- 3. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using the following joints and fittings:
 - a. Fittings: Solder type ASME B16.18 cast/bronze/brass or ASME B16.22 wrought copper fittings, unless otherwise noted.
 - b. Joints:
 - i. Coil connections, and within equipment cabinets:
 - 1. Soldered ASTM B32 lead and antimony free solder, 96 Sn/4 Ag (tin-silver) alloy with zinc fluoride flux.
 - 2. Typical product is Harris Product Group 'Stay -Brite' with 'Staya-Clean' flux.
 - ii. Couplings, Tees and elbows in piping mains and branches:
 - 1. Brazed. AWS A5.8/A5.8M CuCP copper/silver/phosphorous alloy, minimum 1485 degree F liquidus.
 - 2. Solder shall be rated for recommended joint clearance of 0.002" to 0.006".
 - 3. Silver content shall be 5-15%, except 6% silver alloys are not acceptable.
 - 4. Typical products are Harris Product Group 'Stay-Silv 15', 'Stay Silv 5' and 'Dynaflow'.

C. CHILLED WATER PIPING, ABOVE GROUND

- 1. Floor distribution piping 2 inch and smaller and all Runouts to terminal equipment shall be copper tube.
- 2. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black; using one of the following joint types:
 - a. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.

- b. Threaded Joints: ASTM B 16.3, malleable iron fittings.
 - c. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings. Refer to "UNIONS, FLANGES, AND COUPLINGS" for acceptable manufacturers and housing type.
 - d. Joints:
 - i. Pipe sizes 2 inch and smaller: Threaded.
 - ii. Pipe sizes 2-1/2 inch & larger and all concealed above non-accessible ceilings: AWS D1.1, welded.
3. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using the following joints and fittings:
- a. Fittings: Solder type ASME B16.18 cast/bronze/brass or ASME B16.22 wrought copper fittings, unless otherwise noted.
 - b. Joints:
 - i. Coil connections, and within equipment cabinets:
 - 1. Soldered ASTM B32 lead and antimony free solder, 96 Sn/4 Ag (tin-silver) alloy with zinc fluoride flux.
 - 2. Typical product is Harris Product Group 'Stay -Brite' with 'Staya-Clean' flux.
 - ii. Couplings, Tees and elbows in piping mains and branches:
 - 1. Brazed. AWS A5.8/A5.8M BuCP copper/silver/phosphorous alloy, minimum 1485 degree F liquidus.
 - 2. Solder shall be rated for recommended joint clearance of 0.002" to 0.006".
 - 3. Silver content shall be 5-15%, except 6% silver alloys are not acceptable.
 - 4. Typical products are Harris Product Group 'Stay-Silv 15', 'Stay Silv 5' and 'Dynaflow'.

D. CHILLED AND HEATING WATER, BURIED

- 1. Manufacturers:
 - a. Thermacor FERRO-THERM

- b. Thermal Piping Systems
 - c. Perma-Pipe XTRU-Therm
 - d. Rovanco Insul-8
2. Outer conduit shall be a high density polyethylene (HDPE) jacket conforming to ASTM D-1248, Type 3, Class C specifications. The HDPE jacket shall be seamless throughout, minimum thickness throughout, with minimum thickness of 150 mils.
 3. Factory fittings shall be prefabricated, preinsulated to minimize the number of field welds. Fittings shall be provided with one-piece molded HDPE fitting covers. Factory fittings shall be welded by butt fusion or extrusion welding process. Hot air welding or taping shall not be allowed in the factory or field. The manufacturer shall install end seals that provide a permanent water and vapor seal on the ends of each piping section.
 4. Manufacturer closure kits shall be utilized in the field to secure joints. Straight run joints shall be insulated using polyurethane foam to the thickness specified and jacketed with an electro-fusion welded split sleeve. No heat shrink materials will be accepted as the primary sealing method. Each joint shall be pressure tested at 5 psi for 15 minutes. Upon completing the pressure test, the field joint shall be insulated and patch welded over the sleeve opening. All joint closures and insulation shall occur at straight sections of piping.
 5. All underground hydronic system piping shall be insulated with rigid 2-pound density polyurethane foam conforming to ASTM C 591, and coefficient of thermal conductivity (K-factor) not higher than 0.16 at 75°F per ASTM C 518. Insulation thickness shall be per ASHRAE 90.1, minimum.
 6. Foam insulation shall completely fill space between carrier pipe O.D. and jacket I.D.
 7. Sleeves shall be furnished by the manufacturer with insulation kits and installed watertight by the contractor.
 8. Install a copper wire embedded in the foam insulation of each length of pipe to provide a means for leak detecting the piping system.
 9. Terminate outer jackets 4" beyond the inside face of building walls or floors, and provide mastic sealant to protect the end of the factory installed insulation.
 10. Carrier Pipe (Steel):
 - a. ASTM A 53/A 53M, grade B, ERW Schedule 40, black.
 - b. Fittings: ASTM A 234/A 234M, wrought steel welding type.
 - c. Joints: AWS D1.1, welded.
 11. Carrier Pipe (Polypropylene); for alternate field installation of HDPE jacketing and insulation same as described above:
 - a. Carrier Pipe Manufacturers: Aquatherm Blue Pipe, Pestan Mechanical Pipe, Nupi Americas Niron.

- b. When using Polypropylene a trace wire must be used.
 - c. Pipe: shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.
 - d. Fittings: shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.
 - e. Polypropylene Fittings: Butt fusion or fusion outlet fittings shall be used for fusion weld joints between pipe and fittings.
 - f. Mechanical fittings and transition fittings shall be used where transitions are made to other piping materials or to valves and appurtenances.
 - g. Polypropylene pipe shall not be threaded. Threaded transition fittings per ASTM F 2389 shall be used where a threaded connection is required.
12. Bolster Padding: 1-1/2 inch thick, minimum, flexible expansion pads for external expansion compensation of fittings. Pads shall extend to cover the inside and outside radius of the fittings.

E. PIPE ANCHORS

- 1. Prefabricated steel pipe anchors shall be provided where shown or required by the piping expansion analysis. Anchor plate shall be 1/2-in. thick minimum, welded to the carrier pipe and insulated. Anchor plate shall extend a minimum of 2-1/2-in. beyond the casing diameter on all sides and provided with a high temperature mastic corrosion coating.
- 2. Each anchor assembly shall be poured within a concrete thrust block for firm anchorage into trench sidewalls and bed. Concrete block shall extend a minimum of 12-in. beyond all sides of the anchor plate, and at least 36-in. length. Refer to detail on Drawings.

F. CONDENSER WATER PIPING, BURIED

- 1. Ductile Iron Pipe:

- a. Ductile Iron Mechanical Joint Pipe, Flexible Restrained: AWWA C151/A21.51, with working pressure of 350 psi.
- b. Fittings: AWWA C110, ductile iron, standard thickness.
- c. Perma-Pipe, direct burial pre insulated piping.

2. Pipe Joints:

- a. Flexible restrained joints and jointing materials shall meet the requirements of ANSI/AWWA C111.
- b. Restraint devices shall consist of multiple gripping wedges incorporated into a follower gland meeting the requirements of ANSI/AWWA C110/A21.10. The devices shall have a working pressure rating of 350 psi.
- c. Coating: All wedge assemblies shall be phosphate washed and coated with minimum of two coats of thermoset epoxy coating. All casting bodies shall be phosphate washed and coated with polyester based powder.
- d. Gaskets for all mechanical joints shall be designed to allow the gasket to deflect approximately 30% during assembly of the joint.
- e. Mechanical joint restraints shall be MEGALUG with EBBA-Seal mechanical joint gaskets, by EBBA Iron Inc.

G. UNDERGROUND WARNING TAPE

- 1. Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in minimum 4-inch width rolls, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.
- 2. Warning tape shall read "CAUTION - BURIED PIPING BELOW" or similar wording at minimum 18-inch intervals.

H. CONDENSER WATER PIPING, ABOVE GRADE

- 1. Steel Pipe: ASTM A53/A53M, Schedule 40, black.

I. EQUIPMENT DRAINS AND OVERFLOWS

1. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:

J. PIPE HANGERS AND SUPPORTS

1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Manufacturers: B-Line, Grinnell, Globe or Michigan. Figure numbers are for Michigan.
3. Copper Pipe Support: As Specified above, copper plated where tube is not insulated.
4. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
5. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
6. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

K. UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

1. Unions for Pipe 2 Inches and Less:
 - a. Ferrous Piping: 150 psig malleable iron, threaded.
 - b. Copper Pipe: 400 psig WOG @ 275 degrees F, Brass O-Ring type with EPDM O-Ring , brass nut and tailpiece. Threaded or soldered with reduced size end connection as required by component connection. Apollo UA, FDI UP
 - c. Test Plug tappings may be included on union tailpieces to provide the test plugs specified at piping components.
2. Flanges for Pipe 2 Inches and Greater:
 - a. Ferrous Piping: 150 psig forged steel, slip-on, unless noted otherwise.
 - b. Gaskets: 1/16 inch thick composition sheet type gasket with aramid fiber and NBR binder. Gasket material shall be asbestos-free conforming to ASTM B16.5-2013, selected for the pressure, temperature, and service of the specific joint. Garlock BLUE-GARD 3000, TEADIT NA1001, or similar.
3. Grooved and Shouldered Pipe End Couplings for pipe over 2 inches: Acceptable for use on chilled and condenser water piping exposed in mechanical rooms:

- a. Housing Clamps: ASTM A-47-77 Malleable or ASTM A-536-77 ductile iron to engage and lock, rigid clamshell, bolt-on clamp. Manufacturers: Gruvlok 7000 (Anvil), Grinnell 772, Victaulic 107/W07.
- b. Gasket: Synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D-2000.
- c. Basis of Design for rigid couplings/ joints:
 - i. 2-1/2" through 8": Victaulic Style 107H Installation ready rigid coupling for direct stab installation without field disassembly. Gasket shall be grade "EHP" EPDM compound designed for operating temperatures from -30 deg F to +250 deg F.
 - ii. 10" through 12": Victaulic Style 07 ZeroFlex. Standard rigid coupling. Gasket shall be grade "E" EPDM compound designed for operating temperatures from -30 deg F to +230 deg F.
 - iii. 14" and larger: Victaulic Style W07 Advance Groove System (AGS) rigid coupling. Coupling housings designed with AGS wedge-shaped profile to engage the mating pipe or component wedge-shaped AGS grooves. Housings include lead-in chamfer to accommodate a wide range of initial pipe positions and provide a rigid joint that corresponds with support spacing as defined by ASME B31.1 and B31.9.
- d. Basis of Design for flexible couplings/ joints:
 - i. 2-1/2" through 8": Victaulic Style 177 Installation ready flexible coupling for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound designed for operating temperatures from -30 deg F to +250 deg F.
 - ii. 10" through 12": Victaulic Style 77 standard flexible couplings. Gasket shall be Grade "E" EPDM compound designed for operating temperatures from -30 deg F to +230 deg F.
 - iii. 14" and larger: Victaulic Style W77 Advance Groove System (AGS) flexible coupling. Coupling housings designed with AGS wedge-shaped profile to engage the mating pipe or component wedge-shaped AGS grooves. Housings include lead-in chamfer to accommodate a wide range of initial pipe positions and allow for linear and angular movement, vibration attenuation, and stress relief.
- 4. Dielectric Connections: Dielectric nipple with galvanized or plated steel threaded ends. FDI-DN, Perfection, Pro Hydronic Specialties.

L. GLOBE OR ANGLE VALVES

- 1. Up To and Including 2 Inches:

- a. Manufacturers: Crane Model 7, Hammond IB413-T, Kitz 09, Milwaukee 590-S, Nibco T235, Stockham B-22 .
- b. 300 psig WOG, bronze body, bronze trim, union bonnet, rising stem and cast or malleable iron handwheel, inside screw , renewable composition disc and bronze seat, threaded ends.

M. BALL VALVES

1. Up To and Including 2 Inches:

- a. Two Piece Manufacturers: Apollo Model 70-100, Crane 9301, Flow Design HB/HC, Hammond 8201, Milwaukee BA200, Nibco T580, Stockham T255, Watts B6000.
- b. 400 psig WOG, Bronze two piece body, full port, chrome plated brass ball, reinforced teflon seats and stuffing box ring, blow-out proof stem design, adjustable packing gland, zinc coated steel lever handle with vinyl hand grip with memory stops on balance valves, threaded ends .

N. BUTTERFLY VALVES (OVER 2 INCHES)

1. Manufacturers: Centerline Model 200, Crane 12, Grinnell 8000, Hammond 5111, Milwaukee WA, Mueller 66M, Nibco WD-2000-3, Pratt BF, Stockham LG551.
2. Location: Use where specifically shown on Drawings, Detail or Flow Diagram. Refer to Legend for butterfly valve symbol.
3. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
4. Disc: Aluminum bronze.
5. Operator: Infinite position lever handle with memory stop.

O. SPRING LOADED CHECK VALVES (OVER 2 INCH)

1. Manufacturers: Centerline Model CLC, Duo-Check G12HMP, Hammond IR9253, Marlin HZNSF, Metraflex 700, Milwaukee 1400, Muessco 91AP/92AP, Stockham WG970..
2. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

P. FLOW INDICATOR-BALANCERS

1. Manufacturers: B&G Circuit Setter, AAF #6000, Taco ACUF, Illinois #6000, Flow Set -F,HCI Terminator, Florater, Gerand, Armstrong "CBV", Wheatley "GS", Pro Hydronic Specialties "CBV".

Q. PREPARATION

1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
2. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
3. Remove scale and dirt on inside and outside before assembly.
4. Prepare piping connections to equipment using jointing system specified.
5. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
6. After completion, fill, clean, and treat systems. Refer to Section 23 2500 for additional requirements.
7. Connections to existing systems: Exact location of piping, direction of flow and fluid being handled shall be confirmed by the Contractor prior to installing new piping to assure compatibility of system, fluid being pumped, and pipe sizes

R. INSTALLATION

1. Install in accordance with manufacturer's instructions.
2. Route piping in orderly manner, parallel to building structure, and maintain plumb and level, unless noted otherwise.
3. Maintain 4 inch clearance between pipe and fittings after insulation.
4. Install piping to conserve building space and to avoid interfere with use of space.
5. Group piping at common elevations.
6. Maintain top of piping level with eccentric reducers. Arrange to drain at low points.
7. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
8. Grooved Joints:

- a. Install in accordance with the manufacturer's latest published installation instructions.
 - b. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
9. Install valves with stems upright or horizontal, not inverted.
10. Unions: Provide unions at locations specified and at all locations to permit removal of equipment and ATC control valves for service. Install in correct direction with brass nut upstream. Do not install unions to expedite pipe assembly. Use flanges or grooved coupling for unions for pipes sizes over 2 inch.
11. Dissimilar Metals (Dielectric): Provide dielectric nipples to provide separation between ferrous and nonferrous piping/fittings. Install on ferrous side of connection. Do not install dielectric unions. Dielectric connection shall be comprised of dielectric nipple or thread-to-sweat brass adapter or brass valve. Install unions specified with dielectric nipple where separation is required at a union.
12. Steel Pipe Nipples: All thread (close) nipples are prohibited. Nipples 1-1/2 inch and smaller and attached to larger pipes shall be schedule 80 and attached by the use of threadolet.

SECTION 23 2114 – HYDRONIC SPECIALTIES**A. AIR/DIRT SEPARATOR**

1. Manufacturers:
 - a. Armstrong; Model DAS: www.armstrongpumps.com.
 - b. Spirovent: www.spirotherm.com.
 - c. Thrush; Model Aar-O-Vent: www.thrustco.com.
 - d. Taco; Model 4900: www.taco-hvac.com.
2. Coalescing type air and dirt eliminator, fabricated steel rated for 150 psig working pressure. The unit shall include internal bundle to suppress turbulence and provide high efficiency, venting chamber and vent valve mechanism.
3. Air separator shall be capable of removing 100% of free and entrained air, and up to 99.6% of dissolved air in the system fluid.
4. Provide pipe connections for hydronic system inlet and outlet, venting, and drain/blowdown.

SECTION 23 2123 – HYDRONIC PUMPS**A. MANUFACTURERS**

1. Aurora:
2. Bell & Gossett, a Xylem Inc. brand:
3. Peerless:
4. Taco:

B. HVAC PUMPS - GENERAL

1. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
2. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

SECTION 23 2140 - UNDERGROUND HYDRONIC DISTRIBUTION SYSTEMS-STEEL PIPE**A. SCOPE OF WORK**

1. The Contractor shall provide all labor, equipment, materials and incidentals necessary to install the underground chilled water and heating water distribution systems. These systems include but are not limited to: factory fabricated conduit piping, equipment room entry, utility trench construction, thermal insulation, piping supports, fittings, and accessories. These systems shall be installed and tested as shown on the Contract Drawings and as specified herein.

B. PERFORMANCE REQUIREMENTS

1. Provide a complete prefabricated conduit system for steel piping including jacket, carrier piping, insulation, fittings and installation accessories.
2. The hydronic water system is designed for not less than 125 psig and an operating temperature between 40 and 250 degrees F. System components shall be suitable for maximum working pressure of ANSI Class 150. (150 psig SWP).
3. The hydronic water system is a fully welded system that expands and contracts within the ground as operating temperatures vary.

C. QUALITY ASSURANCE

1. Country of Fabrication:
 - a. All piping, fittings, and piping accessories not manufactured, fabricated, and/or assembled in the United States of America or Canada must be manufactured, fabricated, and/or assembled by an ISO 9001 registered corporation.
 - b. Submit ISO 9001 registration certificates for all corporations where the piping, fittings, and piping accessories are not manufactured, fabricated, and/or assembled in the United States or Canada.
 - c. For all piping, fittings, and piping accessories not fabricated in the United States or Canada, submit an independent test report for all materials to be provided.
 - d. No piping, fittings, and piping accessories manufactured, fabricated, and/or assembled in China including Taiwan are permitted to be provided in this project Contract.
2. Manufacturer Certification: The prefabricated pipe manufacturer shall provide a certificate stating that the direct buried piping system was installed in accordance with the manufacturer's recommendations.

D. DELIVERY, STORAGE, AND PROTECTION

1. Ship the underground chilled water and hot water premanufactured piping and conduit system with plastic pipe end covers secured with tape on the piping prior to shipment from the factory. Bag type covers are not acceptable.
2. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

E. UNDERGROUND HYDRONIC PIPING

1. Manufacturers:
 - a. Thermacor FERRO-THERM
 - b. Thermal Piping Systems
 - c. Perma-Pipe XTRU-Therm
 - d. Rovanco Insul-8
2. Outer conduit shall be a high density polyethylene (HDPE) jacket conforming to ASTM D-1248, Type 3, Class C specifications. The HDPE jacket shall be seamless throughout, minimum thickness throughout, with minimum thickness of 150 mils.
3. Factory fittings shall be prefabricated, preinsulated to minimize the number of field welds. Fittings shall be provided with one piece molded HDPE fitting covers. Factory fittings shall be welded by butt fusion or extrusion welding process. Hot air welding or taping shall not be allowed in the factory or field. The manufacturer shall install end seals that provide a permanent water and vapor seal on the ends of each piping section.
4. Manufacturer closure kits shall be utilized in the field to secure joints. Straight run joints shall be insulated using polyurethane foam to the thickness specified and jacketed with an electro-fusion welded split sleeve. No heat shrink materials will be accepted as the primary sealing method. Each joint shall be pressure tested at 5 psi for 15 minutes. Upon completing the pressure test, the field joint shall be insulated and patch welded over the sleeve opening. All joint closures and insulation shall occur at straight sections of piping.
5. All underground hydronic system piping shall be insulated with rigid 2-pound density polyurethane foam conforming to ASTM C 591, and coefficient of thermal conductivity (K-factor) not higher than 0.16 at 75°F per ASTM C 518. Insulation thickness shall be as listed below:
 6. 4-inch and under pipe outer diameter - 1-1/2 inch thick insulation, minimum.

7. 6-inch pipe outer diameter - 1-1/2 inch thick insulation, minimum.
8. 8-inch pipe outer diameter - 1-1/2 inch thick insulation, minimum.
9. Foam insulation shall completely fill space between carrier pipe O.D. and jacket I.D.
10. Sleeves shall be furnished by the manufacturer with insulation kits and installed watertight by the contractor.
11. Install a copper wire embedded in the foam insulation of each length of pipe to provide a means for leak detecting the piping system.
12. Terminate outer jackets 4" beyond the inside face of building walls or floors, and provide mastic sealant to protect the end of the factory installed insulation.
13. Carrier Pipe:
 - a. ASTM A 53/A 53M, grade B, ERW Schedule 40, black.
 - b. Fittings: ASTM A 234/A 234M, wrought steel welding type.
 - c. Joints: AWS D1.1, welded.
14. Bolster Padding: 1-1/2 inch thick, minimum, flexible expansion pads for external expansion compensation of fittings. Pads shall extend to cover the inside and outside radius of the fittings.

F. PIPE ANCHORS

1. Prefabricated steel pipe anchors shall be provided where shown or required by the piping expansion analysis. Anchor plate shall be 1/2-in. thick minimum, welded to the carrier pipe and insulated. Anchor plate shall extend a minimum of 2-1/2-in. beyond the casing diameter on all sides and provided with a high temperature mastic corrosion coating.
2. Each anchor assembly shall be poured within a concrete thrust block for firm anchorage into trench sidewalls and bed. Concrete block shall extend a minimum of 12-in. beyond all sides of the anchor plate, and at least 36-in. length. Refer to detail on Drawings.

G. UNDERGROUND WARNING TAPE

1. Manufacturers:
 - a. Brady Identoline
 - b. Seton 210

c. Water Works Ind, Inc.

2. Provide detectable aluminum foil plastic-backed tape or detectable magnetic color-coded polyethylene plastic tape for warning and identification of buried piping.
3. Provide tape in minimum 4-inch width rolls, color coded for the utility involved, with warning and identification imprinted in bold black letters
4. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.
5. Warning tape shall read "CAUTION - BURIED PIPING BELOW" or similar wording at minimum 18-inch intervals over the entire tape length..

H. PIPE SLEEVES

1. Fit all pipes passing through building walls and floors, with shop fabricated pipe sleeves or core drill with mechanical link seals. Extend each sleeve through its respective wall and cut flush on inside and outside surfaces. Provide sleeve size based on recommended link seal size for pipe or conduit being installed. Pipe sleeve shall be fabricated from Schedule 40, galvanized steel pipe conforming to ASTM A-53, Grade B.
2. Attach leak plate around center of pipe sleeve unit prior to delivery. Install a mechanical type interlock seal, Buna-N links shaped to fill the annular area between the sleeve and pipe or conduit. Link type seal shall be installed on interior end of pipe sleeve.

I. PREPARATION

1. The Contractor shall survey and lay out the new underground utility distribution route. Advanced trench excavation and physically locate underground utilities is advised to keep within the project schedule. Discovery of any unforeseen site conditions shall be reported to Architect as soon as they are encountered.
2. Exact location of piping, direction of flow and fluid being handled shall be confirmed by Contractor prior to installing new piping to assure compatibility of system, fluid being pumped, and pipe sizes

J. INSTALLATION

1. Install in accordance with manufacturer's instructions.

2. Provide all work, labor, materials and equipment to construct the underground utility distribution system into a complete, convenient and operating system.
3. Group piping with other site piping work whenever practical.
4. Establish elevations of buried piping to ensure not less than 4.0 ft. of cover.
5. Route pipe in straight line unless noted otherwise.
6. Slope pipe as shown on profiles to match final elevations without dips or crowns in the piping.
7. Maintain 4 inch clearance between pipe conduits, minimum.
8. Install pipe to allow for expansion and contraction without stressing pipe or joints.
9. Provide for pipe movement by installing bolster padding as indicated on the shop drawings.
10. Install piping straight and true to bear evenly on trench floor.
11. Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ANSI B31.3, except as modified herein.
12. Protection against Hazardous Conditions: The Contractor shall notify Architect if a hazardous condition exists or conditions for a potential hazardous situation arises. If, in the opinion of Architect, a hazardous condition exists, work shall cease until such condition has been corrected.
13. Cleaning of Piping: Keep the interior and ends of new piping and existing piping affected by the Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.

K. EXCAVATION AND BACKFILL

1. The Contractor shall excavate a minimum of 200 linear feet of trench prior to welding piping to fully assess field conditions.
2. Trenching:

- a. Notify the Design Professional of unexpected subsurface conditions.
- b. Cut trenches wide enough to allow inspection of installed utilities.
- c. Hand trim excavations. Remove loose matter.
- d. Remove large stones and other hard matter which could damage piping or impede consistent backfilling or compaction.
- e. Remove excavated material that is unsuitable for re-use from site.
- f. Remove excess excavated material from site.
- g. Do not remove or damage any shrubbery, landscape, or trees except as specifically shown on plans. Notify Design Professional of any and all discrepancies.

3. Dewatering:

- a. Contractor shall furnish all labor, materials, and equipment to keep the work free of water either from surface sources or from underground sources, or from both. The selection of the equipment and method of the removal of the water shall be the sole responsibility of the Contractor. The Contractor shall be responsible for all damage incurred in handling site water conditions.

4. Backfilling:

- a. Backfill to contours and elevations indicated on the site drawings using unfrozen materials.
- b. Employ a placement method that does not disturb or damage other work.
- c. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- d. Place and compact bedding courses on trench bottoms and where indicated. All trenches shall be excavated a minimum of 6-inches below pipe bottoms and refilled with sand, tamped to stabilize base, and then covered with 12-inch minimum cover of clean sand. The sand shall be compacted to 95% standard Proctor dry density prior to installation of piping. Trench bottoms shall form a straight line free of dips or humps with no offsets in any plane other than shown on the drawings. The initial 2-feet of backfill over piping shall be placed in 4-inch layers and hand tamped. The remainder of backfill may be machine tamped.
- e. Compaction density unless otherwise specified or indicated shall be not less than 90% of maximum dry density.

L. PIPE AND FITTINGS

1. General

- a. Inspect, test, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for connections. Reducing branch connections in steel piping may be made with forged branch outlet reducing fittings for branches two or more pipe sizes smaller than mains. All changes in direction shall be made with factory-fabricated welded pipe fittings, and all elbows shall be long radius. Tees are used on the outlets, but the use of fittings formed from pipe sections shall not be permitted.
 - b. All pipe shall be accurately cut to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Excessive cutting or other weakening of structural members to facilitate piping installation shall not be permitted. Pipe ends shall have burrs removed by reaming and pipe shall be installed to permit free expansion and contraction without damage to joints.
 - c. Pipe nipples 6 inches long and shorter shall be Schedule 80 pipe. Make changes in piping sizes through tapered reducing pipe fittings.
2. Fittings and End Connections: Install threaded fittings and end connections for sizes less than one inch; threaded or socket-welding or butt welding fittings and end connections for sizes 1 to 2 inches; threaded connections for threaded valves, traps, strainers, and threaded connections to equipment; butt welded fittings and end connections for sizes 2.5 inches and larger; and flanged connections for flanged valves, and flanged connections to equipment as otherwise specified.

M. WELDING

1. Welding Responsibility

- a. Responsibility of Contractor for Fusion Welding:
 - i. The Contractor is entirely responsible for the quality of the welding required for the underground piping distribution system.

2. Qualifications of Welders:

- a. Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform to ANSI B31.1 for the qualification of procedures, welders and welding operators. The Contractor shall be required to follow the qualification of procedures by destructive testing as outlined in paragraph QW302 of Section IX of the ASME Boiler and Pressure Vessel Code. The welders shall be certified under rules of the National Certified Pipe Welding Bureau and qualified by either the National Certified Pipe Welding Bureau or an

independent testing laboratory. Copies of the welder's certificates shall be made available to the Owner and Design Professional upon request.

- b. Documentation of the welding procedure and the welder qualification shall be presented in the form of a Welding Procedure Specification (WPS), and Procedure for Qualification. The welder or welding operator must submit a welder certification verifying his qualification to the procedure. The Welding Procedure Specification (WPS) shall meet the requirements of this specification.

3. Beveling:

- a. Field bevels and shop bevels shall be done by mechanical means. All beveling shall conform to the Welding Procedure Specification (WPS).

4. Welding Rings:

- a. Welding rings shall not be used on this project.

5. Erection:

- a. Piping shall not be split, bent, flattened, or otherwise altered either before, during, or after installation.
- b. During erection care shall be taken to remove all dirt, scale, and other foreign matter from inside the piping by use of a pipe swab or pipe "pig" before tying in sections, valves, or fittings.
- c. Where the pipe temperature falls to 32 degrees F or lower, the pipe shall be heated to approximately 100 degrees F for a distance of 1 foot on each side of the weld before welding, and the weld shall be finished before the pipe cools to 32 degrees F.

6. Defective Welds:

- a. Defective welds shall be replaced and re-inspected at no additional cost to the Owner. Repairing defective welds by adding weld material over the defect or by peening will not be permitted.
- b. Welding repairs will be performed in accordance with an approved welding repair procedure. The repair procedure shall be submitted to the Engineer for approval before performing repairs.
- c. When the quality of a welder's work appears to be below the requirements of the acceptance criteria, the inspector shall require the welder to demonstrate his ability to produce sound welds by means of complete requalification.

7. Electrodes:

- a. All low hydrogen electrodes shall be stored in a storage oven that is kept free of moisture and dampness during fabrication operations.
- b. Low hydrogen electrodes shall not remain out of the storage oven for more than four (4) hours at a single time.
- c. If the electrodes are placed back into the storage oven, they shall remain for a minimum of 24 hours before being used.
- d. Electrodes that demonstrate contamination, loss of coating or any other form of damage shall be discarded.

N. PROTECTIVE COATING

1. Damaged Materials:

- a. Fittings, couplings, irregular surfaces, damaged areas of pipe coating, and existing piping affected by the Contractor's operations shall be clean, dry, grease free, and primed before application of tape.
- b. Pipe coating and adhesive undercoat surfaces to be wrapped with tape shall be primed with a compatible primer prior to application of tape. Primer shall be as recommended by tape manufacturer and approved by pipe coating manufacturer.
- c. Waterproof shrink sleeves may be provided in lieu of tape and shall overlap the pipe coating not less than 6 inches.

2. Pipe Coating:

- a. Residual material from pipe coating shall be pressed into the break or trimmed off.
- b. Apply tape spirally with one-third overlap as tape is applied.
- c. A double wrap of one full width of tape shall be applied at right angles to the axis to seal each end of the spiral wrapping.
- d. All damage to the piping shall be repaired in accordance with the manufacturer's recommendations.

3. The Finishing Coating:

- a. Stretch and apply first layer of tape to conform to component's surface.
- b. Apply and press a second layer of tape over first layer of tape.

4. Flange, Valve, and Irregular Surface Coating:
 - a. Apply coal tar base coating to a minimum dry film thickness of 30 mils.

O. FLUSHING STANDARDS AND SPECIFICATIONS FOR WATER DISTRIBUTION SYSTEM CARRIER PIPING

1. Fill and flush with clean water.
2. Refill with clean water, then add cleaning chemicals as recommended by the chemical water treatment vendor, supplied and supervised by the water treatment vendor. Refer to Section 23 2500.
3. The piping shall be initially cleaned utilizing a high pressure "hydro-jet" process. The equipment shall be capable of providing a minimum of 50 GPM at 2000 PSIG. The piping shall be cleaned in one direction to allow debris and water to exit in one location. This cleaning procedure shall be performed twice until the flush water runs clear.
4. Install chemicals and circulate water, using temporary pumps as required, in each system for 48 hours. Minimum water velocity is 6 feet per second.
5. At the end of each 48 hours, remove and clean strainers. Blow-off low points.
6. Do on-line flushing using a fast "feed and bleed" procedure for 24 hours. Be sure all parts of the system are on-line during the cleaning. Circulate all dead legs of the system. Provide temporary piping crossovers as required.
7. Do final system drain and blow off low points.
8. When cleaning is completed, fill systems with clear and clean water, and notify Owner and Design Professional of completion of these steps.
9. Use and disposal of chemicals shall comply with local, state, and federal regulations.
10. The contractor is responsible for monitoring the draining procedures to prevent flooding on the site.

P. BURIED UTILITY WARNING TAPE

1. Bury tape with the painted side up at a depth of 6-inches above top of sand backfill. Locate a second tape buried at 6-inches below grade where top of pipes are buried at 6-ft. or greater depth.

Q. PIPING TESTS - VISUAL EXAMINATION (VT)

1. General: Visually examine all pipe welds per ASME B31.1. As described below, visual examination of welds may be performed by the Construction Manager or an independent testing agency.
2. Welding Tests: Twenty-five percent (25%) of all field welds shall be inspected using this method.
3. Acceptance Standards:
 - a. The acceptance standards for visual examination shall be as defined in ASME B31.1. The following indications are unacceptable:
 - i. Cracks-external surface.
 - ii. Undercut on surface which is greater than 1/32 inch deep.
 - iii. Weld reinforcement greater than that specified in Table 127.4.2. of ASME B31.1.
 - iv. Lack of fusion on surface.
 - v. Incomplete penetration (applies only when inside surface is readily accessible).
 - vi. Any other linear indications greater than 3/16 inch long.
 - vii. Surface porosity with rounded indications having dimensions greater than 3/16 inch or four or more rounded indications separated by 1/16 inch or less edge to edge in any direction. Rounded indications are indications which are circular or elliptical with their length less than three times their width.
 - b. In addition, acceptance will also be based on the proper lay-out, materials, and methods, as specified.
4. Failed Welds:
 - a. All welds not passing visual examination shall be repaired or replaced at no expense to the Owner.
 - b. Repair shall be performed using the qualified welding procedures applicable to the original weld.
5. Reporting:
 - a. Reports for visual examinations of welds shall be required for all piping larger than 3 inch NPS except for vent and drain services. Reports performed for visual examinations are not required to be submitted, but shall be kept available for review at any time by the Owner or Engineer.
 - b. Each weld report shall include the following:
 - i. Date of weld examination.

- ii. Type of examination.
- iii. Examiner's name.
- iv. Welders' names including all persons who worked on the weld and their work involved.
- v. Piping system.
- vi. Weld location.
- vii. Weld procedure and materials.
- viii. Materials and dimensions of items that were welded.
- ix. Visual examination results.

6. Examiners' Qualifications:

- a. Contractor personnel may perform visual examinations as long as the persons have passed the Contractor's welding quality control program that satisfies the requirements of ASME B31.1.

7. Visual Examination Requirements:

- a. Welds designated for visual examination shall be examined as follows:
 - i. Before welding - for compliance with requirements for joint preparation, alignment and fit-up, cleanliness, condition of welding equipment, quality and condition of base and filler materials to be used, and preheat, when required.
 - ii. During welding - for cracks, conformance to the qualified welding procedure, quality of individual weld passes, interpass temperature, placement and sequencing of individual weld passes, and backgouged surfaces.
 - iii. After welding - for cracks, contour and finish, bead reinforcement, undercutting, overlap, size of fillet welds, finished weld appearance, weld size, weld length, dimensional accuracy of weldment, and monitor post weld heat treatment.
- b. The inspector shall initial and date each field weld using a paint pen for marking on the outer casing.
- c. Records of visual examinations must be kept as described in this Section.

8. Examiner's Scope:

- a. Visual examinations to be performed by the Construction Manager may be performed and interpreted by an employee of the Construction Manager, provided that each individual is certified as specified. As an option, the Construction Manager may obtain the services of an independent testing agency to perform these examinations.
- b. A welder who has performed any work with regard to a specific weld shall not perform the visual examination of the same weld unless approved by the Construction Manager's welding quality control program.

R. PIPING TESTS - PRESSURE TESTING OF UTILITY PIPING

1. General:

- a. Tests shall be conducted before, during, and after the installation of the system.
- b. All instruments, equipment, facilities, and labor required to properly conduct the tests shall be provided by the contractor.
- c. Test pressure gages shall have dials indicating not less than 1-1/2 times or more than 2 times the test pressure.
- d. Provide 48 hours notification to the Design Professional and the KSU Facilities Group site representative in advance of each pressure test.
- e. Any deficiencies shall be corrected at Contractor's expense. Failures to correct any deficiencies will be cause for rejection of the system.

2. Field Tests: The following field tests shall be conducted on the piping system. If any failure occurs, Contractor shall make such adjustments or replacements as Architect may direct, and the tests shall be repeated until satisfactory installation and operation are achieved.

a. Hydrostatic Tests:

- i. Test piping system hydrostatically using water not exceeding 100 degrees F.
- ii. Conduct tests in accordance with the requirements of ANSI B31.1. Test pressure shall be 150 psig.
- iii. Test the piping system after the lines have been cleaned and before any insulation covering has been applied in areas of field welds and the underground conduit system.
- iv. Before making tests, remove or valve off from the system any apparatus that may be damaged by the test pressure.
- v. Install calibrated test pressure gages in the system to observe any loss in pressure.

- vi. Maintain the required test pressure for a minimum of four (4) hours.
 - vii. Inspect all joints and connections for leaks. Perform tests after installation and prior to acceptance.
 - viii. Air testing of carrier piping is not permitted.
- b. Joint Closure Tests:
- i. Test jacket closure at joints with air pressure at 5 psi for a minimum of 15 minutes. Follow installation and testing procedures as recommended by the manufacturer.

S. VERIFICATION OF FINAL ELEVATIONS

1. Prior to covering the top of piping with backfill, but after all temporary supports have been removed, pipe bedding installed and initial backfilling completed, the Construction Manager shall measure and record the elevation of the top of the casing installed at each elbow or change in direction. These measurements shall include each building entrance location. These measurements shall be checked against the contract drawings and recorded by the Construction Manager for documentation to the Owner.
2. The Construction Manager shall measure and record physical dimensions of the piping to a known and durable surface or corner so the piping can be located in the future. These dimensions shall be provided in several locations to adequately identify the pipe routing.
3. The Construction Manager shall measure and record the top elevation of any piping or ductbank that intersects the underground piping route.
4. All elevations shall be recorded using a surveyor's level and survey rod.
5. The Construction Manager shall produce a drawing of the underground utility piping that shows the recorded installation conditions.

T. MANUFACTURER'S FIELD SERVICES

1. A MANUFACTURER'S REPRESENTATIVE of the piping system used shall inspect the installation of the distribution system and shall provide Architect for Owner a certificate on the manufacturer's letterhead stating that the pipe is installed in accordance with the manufacturer's recommendations and provide the manufacturer's warranty.
2. The representative shall be a factory-trained technician with a minimum of two years' experience.
3. The representative shall meet with the installer and confirm that the manufacturer's installation instruction have been read and understood.

4. The technician must observe the following critical periods of construction:
 - a. Unloading of the piping system.
 - b. Welding of at least one hydronic pipe connection and fitting.
 - c. Hydrostatic and air tests of the carrier piping.
 - d. Assembly and testing of one jacket field joint.
 - e. Preparation of pipe bed and the initial backfilling operation.
5. A field report shall be submitted for each site visit documenting the progress of the installation with photographs, and noting any deficiencies. Submit two copies of each report to the Construction Manager, one copy to the Owner, and two copies to the Design Professional.

SECTION 23 2141 UNDERGROUND HYDRONIC DISTRIBUTION SYSTEMS-POLYPROPYLENE**A. SCOPE OF WORK**

1. Polypropylene piping shall be priced as an Alternate for the underground chilled water distribution system.
2. The Contractor shall provide all labor, equipment, materials and incidentals necessary to install the underground chilled water distribution systems. These systems include but are not limited to factory fabricated piping, equipment room entry, utility trench construction, piping supports, fittings, and accessories. These systems shall be installed and tested as shown on the Contract Drawings and as specified herein.

B. PERFORMANCE REQUIREMENTS

1. Provide a complete system for the underground PP piping including carrier piping, fittings and installation accessories.
2. The hydronic water system is designed for not less than 125 psig and an operating temperature between 40 and 250 degrees F.
3. The hydronic water system is a fully heat fusion welded system that expands and contracts within the ground as operating temperatures vary.

C. QUALITY ASSURANCE

1. Country of Fabrication:
 - a. All piping, fittings, and piping accessories not manufactured, fabricated, and/or assembled in the United States of America or Canada must be manufactured, fabricated, and/or assembled by an ISO 9001 registered corporation.
 - b. Submit ISO 9001 registration certificates for all corporations where the piping, fittings, and piping accessories are not manufactured, fabricated, and/or assembled in the United States or Canada.
 - c. No piping, fittings, and piping accessories manufactured, fabricated, and/or assembled in China including Taiwan are permitted to be provided in this project Contract.
2. Manufacturer Certification: The pipe manufacturer shall provide a certificate stating that the direct buried piping system was installed in accordance with the manufacturer's recommendations.

D. DELIVERY, STORAGE, AND PROTECTION

1. Ship the underground hydronic piping with plastic pipe end covers secured with tape on the piping prior to shipment from the factory. Bag type covers are not acceptable.
2. Accept valves on site in shipping containers with labeling in place. Inspect for damage and store in a protected location.

3. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

E. EXISTING PROJECT CONDITIONS

1. Verify the size and flow direction of any connections to existing piping prior to performing any work.
2. Sequence installation to ensure piping connections are achieved in an orderly and expeditious manner.

F. UNDERGROUND HYDRONIC PIPING

1. Manufacturers:
 - a. Aquatherm Blue Pipe
 - b. Pestan Mechanical Pipe
 - c. Nupi Americas - Niron
2. POLYPROPYLENE (PP-R) PIPE AND FITTINGS
 - a. Pipe shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.
 - b. Fittings shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.
 - c. Polypropylene Fittings: Butt fusion or fusion outlet fittings shall be used for fusion weld joints between pipe and fittings.
 - d. Mechanical fittings and transition fittings shall be used where transitions are made to other piping materials or to valves and appurtenances.
 - e. Polypropylene pipe shall not be threaded. Threaded transition fittings per ASTM F 2389 shall be used where a threaded connection is required.
 - f. Polypropylene pipe shall include a fiberglass-reinforced layer to reduce thermal expansion/contraction.
3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

4. Plastic-to-Metal Transition Fittings

- a. PP-R one-piece fitting with stainless steel insert and one PP-R fusion weld joint end.

5. Pipe Wall Sizing: SDR-11.

G. UNDERGROUND WARNING TAPE

1. Manufacturers:

- a. Brady Identoline
- b. Seton 210
- c. Water Works Ind, Inc.

2. Provide detectable aluminum foil plastic-backed tape or detectable magnetic color-coded polyethylene plastic tape for warning and identification of buried piping.
3. Provide tape in minimum 4-inch width rolls, color coded for the utility involved, with warning and identification imprinted in bold black letters.
4. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.
5. Warning tape shall read "CAUTION - BURIED PIPING BELOW" or similar wording at minimum 18-inch intervals over the entire tape length.

H. PIPE SLEEVES

1. Fit all pipes passing through building walls and floors, with shop fabricated pipe sleeves or core drill with mechanical link seals. Extend each sleeve through its respective wall and cut flush on inside and outside surfaces. Provide sleeve size based on recommended link seal size for pipe or conduit being installed. Pipe sleeve shall be fabricated from Schedule 40, black steel pipe conforming to ASTM A-53, Grade B.
2. Install a mechanical type interlock seal, Buna-N links shaped to fill the annular area between the sleeve and pipe. Link type seal shall be installed on interior end of pipe sleeve.

I. PREPARATION

1. The Contractor shall survey and lay out the new underground utility distribution route. Advanced trench excavation and physically locate underground utilities is advised to keep within the project schedule. Discovery of any unforeseen site conditions shall be reported to the Design Professional as soon as they are encountered.
2. Exact location of piping, direction of flow and fluid being handled shall be confirmed by Construction Manager prior to installing new piping to assure compatibility of system, fluid being pumped, and pipe sizes

J. INSTALLATION

1. Install in accordance with manufacturer's instructions.
2. Installers shall be trained and certified to install the pipe according to the manufacturer's guidelines. Contact the manufacturer's representative for training.
3. Provide all work, labor, materials and equipment to construct the underground utility distribution system into a complete, convenient and operating system.
4. Group piping with other site piping work whenever practical.
5. Establish elevations of buried piping to ensure not less than 3.0 ft. of cover.
6. Route pipe in straight line unless noted otherwise.
7. Install fittings for changes in direction and branch connections.
8. Slope pipe as shown on profiles to match final elevations without dips or crowns in the piping.
9. Maintain 4 inch clearance between pipe conduits, minimum.
10. Install pipe to allow for expansion and contraction without stressing pipe or joints.
11. Install piping straight and true to bear evenly on trench floor
12. Protection against Hazardous Conditions: The Contractor shall notify the Design Professional if a hazardous condition exists or conditions for a potential hazardous situation arises. If, in the opinion of the Design Professional, a hazardous condition exists, work shall cease until such condition has been corrected.
13. Cleaning of Piping: Keep the interior and ends of new piping and existing piping affected by the Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.

K. EXCAVATION AND BACKFILL

1. The Contractor shall not have more than 200 linear feet of trench open at any given time, except with the Design Professional's approval.
2. Trenching:
 - a. Notify the Owner of unexpected subsurface conditions.
 - b. Cut trenches wide enough to allow inspection of existing installed utilities.
 - c. Hand trim excavations. Remove loose matter.
 - d. Remove large stones and other hard matter which could damage piping or impede consistent backfilling or compaction.
 - e. Remove excavated material that is unsuitable for re-use from site.

- f. Remove excess excavated material from site.
- 3. Dewatering:
 - a. Contractor shall furnish all labor, materials, and equipment to keep the work free of water either from surface sources or from underground sources, or from both. The selection of the equipment and method of the removal of the water shall be the sole responsibility of the Contractor. The Contractor shall be responsible for all damage incurred in handling site water conditions.
- 4. Backfilling:
 - a. Backfill to contours and elevations indicated on the site drawings using unfrozen materials.
 - b. Employ a placement method that does not disturb or damage other work.
 - c. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
 - d. Place and compact bedding courses on trench bottoms and where indicated. All trenches shall be excavated a minimum of 6-inches below pipe bottoms and refilled with sand, tamped to stabilize base, and then covered with 6-inch minimum cover of clean sand. The sand shall be compacted to 95% standard Proctor dry density prior to installation of piping. Trench bottoms shall form a straight line free of dips or humps with no offsets in any plane other than shown on the drawings. The initial 2-feet of backfill over piping shall be placed in 4-inch layers and hand tamped. The remainder of backfill may be machine tamped.
 - e. Compaction density unless otherwise specified or indicated shall be not less than 95% of maximum dry density.

L. INSTALLER QUALIFICATIONS

- 1. Responsibility for Fusion Welding: The Contractor is entirely responsible for the procedures and quality of the fusion welding required for installation of the underground piping distribution system.
- 2. Heat fusion joints shall be made by trained, experienced operators that can demonstrate the installation of acceptable heat fusion joints using the joining procedures and joining equipment.
- 3. Documentation of the fusion welding procedure and the operator qualifications shall be written certification that within the last 12 months the operator has received training in the fusion procedures and equipment that is appropriate for the pipe sizes being joined, and that joints made during the training were tested and found to be acceptable.

M. PIPE AND FITTINGS

- 1. General
 - a. Inspect, test, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for all branch connections. All elbows shall be long radius.

- b. Ream ends of pipes and tubes and remove burrs.
 - c. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - d. Fusion Joints: Fusion join polypropylene pipe in accordance with ASTM D2657, ASTM F 2389, and the manufacturer's instructions.
 - e. The butt fusion equipment used in the joining process shall be capable of meeting all conditions recommended by the pipe manufacturer, including temperature requirements, alignment, and interfacial fusion pressure.
 - f. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
2. Carrier pipe joining shall be accomplished using an authorized butt fusion welding machine preheated to the correct pipe temperature for fusion welding. All heating surfaces shall be clean and free of dirt and residue before applying to ends of pipe to be joined. After heating, the softened ends are pressed together by the machine and held until the joint has hardened. The butt fusion joint shall have a weld strength equal to or greater than the tensile strength of the piping material. Improperly accomplished, uneven, or joints with questionable appearance shall be cut out and re-joined. Transitions to other piping materials shall be accomplished using suitable flanged adapters.
 3. End Connections: Flanged connections of PP piping system shall be provided with a flange adapter where connected above grade to building systems steel piping.

N. UNDERGROUND VALVES

1. Set valves on solid bearing with concrete base as detailed.
2. Provide valve with square operating nut and provide extension to underneath bottom of C.I. valve box cover.
3. Center and plumb valve box over valve. Set box cover flush with concrete pad on finished grade.
4. Placement of valve stations shall be approved by the Architect Design Professional for final coordination with the site landscape design.

O. FLUSHING STANDARDS AND SPECIFICATIONS FOR WATER DISTRIBUTION SYSTEM CARRIER PIPING

1. Fill and flush with clean water.
2. Refill with clean water and circulate, using temporary pumps as required, in each system for 48 hours. Minimum chilled water velocity is 6 feet per second.
3. At the end of each 48 hours, remove and clean strainers. Blow-off low points.
4. Do final system drain and blow off low points.

5. When cleaning is completed, fill systems with clear and clean water, and notify CCS of completion of these steps.
6. Use and disposal of chemicals shall comply with local, state, and federal regulations.
7. The contractor is responsible for monitoring the draining procedures to prevent flooding on the site.
8. Introduce closed system treatment from the campus Central Energy Plant chilled water piping loop connection, supplied and supervised by the water treatment vendor. Refer to Section 23 2500.

P. BURIED UTILITY WARNING TAPE

1. Bury tape with the painted side up at a depth of 6-inches above top of sand backfill. Locate a second tape buried at 6-inches below grade where top of pipes are buried at 6-ft. or greater depth.

Q. PIPING TESTS - VISUAL EXAMINATION (VT)

1. General: Visually examine all fusion pipe welds. As described below, visual examination of welds may be performed by the Construction Manager or an independent testing agency.
2. Acceptance Standards: The acceptance standards for visual examination of the heat fusion joints shall be in accordance with the ASTM Standard and the pipe manufacturer's fusion procedure guidelines.
3. Failed Heat Fusion Welds:
 - a. All heat fusion welds not passing visual examination shall be repaired or replaced at no expense to the Owner.
4. Reporting:
 - a. Reports for visual examinations of fusion joints shall be required for all piping. Reports performed for visual examinations are not required to be submitted, but shall be kept available for review at any time by the Owner or Design Professional.
 - b. Each fusion joint report shall include the following:
 - i. Date of examination.
 - ii. Examiner's name.
 - iii. Fusion operator's names including all persons who worked on the fusion joint and their work involved.
 - iv. Piping system.
 - v. Fusion joint location.
 - vi. Materials and dimensions of items at each joint.
 - vii. Visual examination results.

5. Visual Examination Requirements:

- a. Joints designated for visual examination shall be examined as follows:
 - i. Before fusion welding - for compliance with requirements for joint preparation, alignment and fit-up, cleanliness, condition of fusion equipment.
 - ii. After fusion welding - for finish and appearance of the melt bead in accordance with industry standard quality requirements for heat fusion joints.
- b. Records of visual examinations must be kept as described in this Section.

6. Examiner's Scope:

- a. Visual examinations to be performed by the Construction Manager may be performed and interpreted by an employee of the Construction Manager, provided that each individual is certified as specified. As an option, the Construction Manager may obtain the services of an independent testing agency to perform these examinations.

R. PIPING TESTS - PRESSURE TESTING OF UTILITY PIPING

1. General:

- a. Tests shall be conducted after the installation of the system.
- b. All instruments, equipment, facilities, and labor required to properly conduct the tests shall be provided by the contractor.
- c. Test pressure gages shall have dials indicating not less than 1-1/2 times or more than 2 times the test pressure.
- d. Provide 48 hours notification to the Design Professional and Kennesaw State University site representative, and the project CCS in advance of each pressure test.
- e. Any deficiencies shall be corrected at Construction Manager's expense. Failures to correct any deficiencies will be cause for rejection of the system.

2. Field Tests: The following field tests shall be conducted on the piping system. If any failure occurs, Construction Manager shall make such adjustments or replacements as the Design Professional may direct, and the tests shall be repeated until satisfactory installation and operation are achieved.

- a. Hydrostatic Tests:
 - i. Test piping system hydrostatically using water not exceeding 100 degrees F.
 - ii. Conduct tests in accordance with the requirements of ASTM F 2389.

- iii. Before making tests, remove or valve off from the system any apparatus that may be damaged by the test pressure.
- iv. Install calibrated test pressure gages in the system to observe any loss in pressure.
- v. Inspect all joints and connections for leaks. Perform tests after installation and prior to acceptance.
- vi. While still accessible all piping shall be pressure/leak tested to the manufacturer's standards. Tests shall be carried out using water. The test pressure shall be as indicated in the pressure leak testing procedures required by the manufacturer. Any leaks detected shall be repaired at the contractor's expense by removing the leaking part and replacing with new parts welded per the pipe manufacturer's guidelines.
- vii. The piping system shall be restrained from uncontrolled movement in the event of a failure.

S. VERIFICATION OF FINAL ELEVATIONS

- 1. Prior to covering the top of piping with backfill, but after all temporary supports have been removed, pipe bedding installed and initial backfilling completed, the Construction Manager shall measure and record the elevation of the top of the piping installed at each elbow or change in direction. These measurements shall include each building entrance location. These measurements shall be checked against the contract drawings and recorded by the Construction Manager for documentation to the Owner.
- 2. The Construction Manager shall measure and record physical dimensions of the piping to a known and durable surface or corner so the piping can be located in the future. These dimensions shall be provided in several locations to adequately identify the pipe routing.
- 3. The Construction Manager shall measure and record the top elevation of any piping or ductbank that intersects the underground piping route.
- 4. All elevations shall be recorded using a surveyor's level and survey rod.
- 5. The Construction Manager shall produce a drawing of the underground utility piping that shows the recorded installation conditions.

T. MANUFACTURER'S FIELD SERVICES

- 1. A MANUFACTURER'S REPRESENTATIVE of the piping system used shall inspect the installation of the distribution system and shall provide the Design Professional for the Owner a certificate on the manufacturer's letterhead stating that the pipe is installed in accordance with the manufacturer's recommendations and provide the manufacturer's warranty.
- 2. The representative shall be a factory-trained technician with a minimum of two years' experience.

3. The representative shall meet with the installer and confirm that the manufacturer's installation instruction have been read and understood.
4. The technician must observe the following critical periods of construction:
 - a. Unloading of the piping system.
 - b. Fusion Welding of at least one hydronic pipe connection and fitting.
 - c. Hydrostatic tests of the carrier piping.
 - d. Preparation of pipe bed and the initial backfilling operation.
5. A field report shall be submitted for each site visit documenting the progress of the installation with photographs, and noting any deficiencies. Submit two copies of each report to the Construction Manager, one copy to the CCS, and two copies to the Design Professional.

SECTION 23 2500 – HVAC WATER TREATMENT

A. QUALITY ASSURANCE

1. Chemical treatment company shall be subcontracted directly by the general contractor. The chemical treatment company may not be subcontracted by the mechanical contractor.

B. GLYCOL

1. Type: Propylene glycol.

C. PREPARATION

1. Systems shall be operational, filled, started, and vented prior to cleaning. Heating and cooling closed loop systems shall contain 20% propylene glycol by volume to prevent bacteria growth.
2. Place terminal control valves in open position during cleaning.

D. INSTALLATION

1. Install in accordance with manufacturer's instructions.
2. Contractor to provide/add propylene glycol during final system filling to achieve 20% propylene glycol mixture in heating and cooling closed loop systems.

E. MANUFACTURERS FIELD SERVICES

1. Provide services of factory trained representative to inspect the piping installation and test the cleanliness of the project's piping systems and make-up water system before chemical treatment. Representative shall drain low points and check system strainers for cleanliness and ensure piping systems are clean and ready for chemical treatment.
2. Factory trained representative shall start-up and calibrate chemical feed controls provided under this Section.
3. Factory trained representative shall test each systems chemical treatment prior to the Observation for Material Completion. Provide owner operator training for the chemical feed and its operation.
4. Demonstrate system operation to Owner and instruct Owner in required maintenance.
5. Provide start-up certificate certifying that the piping systems have been cleaned and treated as specified in the format prescribed by the General Conditions.

6. Utilize the state contracted vendor for these tasks.
7. Must utilize KSU's current water treatment vendor.

SECTION 23 3100 – HVAC DUCTS AND CASINGS

A. MATERIALS

1. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
2. Provide Paint-Grip finish on exposed galvanized ducts for field painting.
3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - b. VOC Content: Not more than 250 g/L, excluding water.
 - c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.

B. DUCTWORK FABRICATION

1. General:
 - a. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
2. No variation in duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.
3. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
5. Exposed Duct:
 - a. Exposed duct in finished spaces shall be medium pressure Spiral duct and fittings.
 - b. Exposed duct finish shall be factory phosphatized for field painting.
 - c. Provide segmented standing seam elbows on exposed ducts in finished spaces.

C. LAUNDRY DRYER VENT DUCTWORK

1. Construct manufactured spiral duct with fabricated fittings, with the interior free of sheet metal screws and obstructions. Secure with rivets. Seal duct joints with duct sealer.

D. FUME HOOD EXHAUST

1. General: Stainless Steel duct from fume hood to exhaust fan, unless noted otherwise. Round Ductwork shall conform to SMACNA Round Industrial Duct Construction Standards, 2nd Edition. Rectangular duct shall conform to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
2. Continuous welded joints. No screws or rivets shall be used to fasten duct together.
3. Grind welds to be smooth with adjacent material and polish
4. Flanged connections shall have acid resistant gaskets.
5. Round Manual Volume Dampers: Figure No. 2-14.C, type 304 stainless steel with locking quadrant.
6. Duct below ceilings shall be satin brushed finish with longitudinal joint against wall and stainless steel hangers.

SECTION 23 3600 – AIR TERMINAL UNITS

A. SINGLE-DUCT, VARIABLE-VOLUME UNITS

1. Manufacturers:

- a. Titus ESV or equal
- b. Other acceptable manufacturers offering equivalent products: Greenheck, Carrier, Envirotec SDRWC, Johnson Controls, Krueger LMHS, Metal-Aire, Tempmaster, Trane VC, Tuttle&Bailey SDV.

2. General:

- a. Factory-assembled, AHRI 880 rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
- b. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

3. Airflow Sensor:

- a. Factory furnished and mounted multi-point, flow ring or cross arrangement inlet averaging sensor which will provide a differential pressure signal that represents actual air flow within an accuracy of +5% regardless of inlet configuration.
- b. This accuracy shall be maintained when inlet duct varies from straight up to 90 elbow entrance conditions for both flexible and rigid metal duct applications. Straight inlet duct shall not be required for specified accuracy.

4. Hot Water Heating Coil

- a. Coils shall be two row coils, minimum. Double pass is preferred but should be reviewed and approved by KSU Plant Ops

5. Controls:

- a. Digital: Factory mount DDC controller and damper actuator supplied by building automation control manufacturer within unit mounted enclosure.
- b. Control Sequence:
 - i. Refer to See Section 23 0994.

B. FAN-POWERED SERIES UNITS

1. Manufacturers

- a. Titus TQS. Straight through design.
- b. Other acceptable manufacturers offering equivalent products: Carrier, Krueger QFC, Metal-Aire Series 400 FCI, Tuttle&Bailey FPC, Nailor 35P, Trane Model VP.

2. General:

- a. Factory-assembled and wired, AHRI 880 (I-P) rated, horizontal fan-powered terminal unit with blower, blower motor, mixing plenum, and primary air damper contained in a single unit housing.

3. Series Units:

- a. General:
 - i. Factory assembled and wired, AHRI 880 rated, horizontal fan powered terminal unit with blower, blower motor, mixing plenum, and primary air damper contained in a single unit housing.

4. Airflow Sensor:

- a. Factory furnished and mounted multi-point, flow ring or cross arrangement inlet averaging sensor which will provide a differential pressure signal that represents actual air flow within an accuracy of +5% regardless of inlet configuration.
- b. This accuracy shall be maintained when inlet duct varies from straight up to 90 elbow entrance conditions for both flexible and rigid metal duct applications. Straight inlet duct shall not be required for specified accuracy.

5. Hot Water Heating Coil:

- a. Base performance data on tests run in accordance with AHRI 410.

6. Electrical Requirements:

- a. Single-point power connection.
- b. Equipment wiring to comply with requirements of NFPA 70.

7. Controls:

- a. Digital: Factory mount DDC controller and damper actuator supplied by building automation control manufacturer within unit mounted enclosure.
- b. Control Sequence: See Section 23 0994.

SECTION 23 4000 – HVAC AIR CLEANING DEVICES

A. DISPOSABLE, EXTENDED AREA PANEL FILTERS(EAPF)

1. Manufacturers: Air Guard, CamFil-Farr 30/30,Purolator.
2. Media: UL 900 Class 2, pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid .
 - a. Nominal size: 24 x 24 inches.
 - b. Nominal thickness: 2 inches.
3. Minimum Efficiency Reporting Value (MERV): 8 and “A” rating, when tested in accordance with ASHRAE Std 52.2.

B. EXTENDED SURFACE HIGH EFFICIENCY MINI-PLEAT FILTERS (ESHF)

1. Manufacturers: Eco-Air EcoCell Minipleat, CamFil-Farr Opti-Pac.
2. Media: Pleated, water-resistant glass fiber or synthetic fiber with fire retardant and moisture resistant bonding agents. Provide separators to maintain the pleat configuration.
 - a. Frame: Moisture resistant Cardboard.
 - b. Nominal size: 24 x 24 inches.
 - c. Nominal thickness: 4 inches.
3. Minimum Efficiency Reporting Value: MERV – 12 and “A” rating when tested in accordance with ASHRAE 52.2.

C. FILTER GAGES

1. Manufacturers:
 - a. Dwyer Instruments, Inc.: www.dwyer-inst.com/#sle
 - b. H.O. Trerice Co: www.trerice.com/#sle
 - c. Weiss Instruments: www.weissinstruments.com/#sle
2. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

SECTION 23 5216 – CONDENSING BOILERS

A. MANUFACTURERS

1. Cleaver Brooks ClearFire.
2. Fulton Model Endura+.
3. Lochinvar Corporation; Model Crest.

B. MANUFACTURED UNITS

1. The boiler shall be of the packaged, factory fabricated and assembled type complete with burners, fuel train, controls, heat exchanger, insulation, housing, relief valve, and items required for a ready-to-operate installation. The boiler shall be a modulating, high mass, condensing design for firing natural gas and shall be power vented. The boiler shall fit through a standard 3' doorway without disassembly.
2. The boiler shall be a sealed combustion system, taking only outside air for combustion with plastic schedule 80 PVC pipe. The exhaust vent shall be piped with a double-wall flue-gas conduit fabricated from 316L or Duplex stainless steel, suitable for condensing equipment producing flue gas temperatures not exceeding 550 deg. F utilizing 20% glycol solution.

C. BOILER CONSTRUCTION

1. The pressure vessel and burner components shall be fabricated of carbon steel, type 316L stainless steel, or cast aluminum. The heat exchanger shall be tubular 316L or duplex stainless steel.
2. Jacket: Plastic or galvanized steel with factory applied baked enamel, insulated with foil faced fiberglass insulation.

D. FACTORY INSTALLED CONTROLS

1. Operating Controls: Pre-wired, factory assembled electric controls to be panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls and also located to prevent possible damage by water according to CSA requirements. Electrical power supply shall be 120 volts, 60 cycle, single phase. Option for internal or external (0-10) VDC control.
2. Boiler Management System:
 - a. The boiler manufacturer shall supply as part of the boiler package a completely integrated boiler management system to control all operation and energy input of the multiple boiler heating plant. The system shall be comprised of a

microprocessor based control to communicate with the standalone boiler control panels. The controller shall have the ability to operate all boilers and associated isolation valves installed in the plant, and shall be interfaced with the DDC - Building Automation System (BAS).

SECTION 23 5239 - FIRE-TUBE BOILERS

A. MANUFACTURERS

1. Cleaver-Brooks: www.cleaver-brooks.com/#sle.
2. Hurst Boiler Manufacturing; Model 400: www.hurst.com.
3. Superior Boiler Works, Inc.: www.superiorboiler.com/#sle.

B. MANUFACTURED UNITS

1. Description: Factory assembled, factory fire tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.
2. Unit: Mount on integral structural steel frame base and include integral forced draft burner, burner controls, boiler trim, refractory, insulation and jacket.
3. Boiler shall be three-pass, wetback design with not less than five square feet of heating capacity per rated boiler horsepower.
4. Boiler shall be equipped with a single point power connection, with all starters and relays mounted in the boiler control panel.

C. FUEL BURNING SYSTEM

1. General: Forced draft automatic burner integral with front head of boiler designed to burn natural gas and No. 2 oil, shall have modulating firing rate control with low fire ignition position, and maintain fuel-air ratios automatically without the use of VFD for fuel and air.
2. Natural Gas Consumption meter:
 - a. Manufacturers:
 - i. Badger; Model OGT: www.cleaver-brooks.com.
 - ii. Sponsler, Inc.; Model 5000.
 - b. Precision turbine type meter suitable for natural gas with stainless steel case for flanged mounting and hermetically sealed frequency/pulse transmitter.
 - c. Provide meter with totalizer to record fuel consumption.
 - d. Provide DDC monitoring points.
 - e. Maximum Operating Pressure: 30 psi.

- f. Accuracy: 1-1/2 percent.
- g. Maximum Counter Reading: 10 million standard cubic feet(scf).
- h. Size: 1/2 inch.

SECTION 23 6416 – CENTRIFUGAL WATER CHILLERS

A. MANUFACTURERS

1. Daikin McQuay: www.daikinmcquay.com
2. Trane Inc.: www.trane.com.
3. York: www.york.com
4. Carrier

B. CHILLERS

1. Chillers: Factory assembled and tested, packaged, water cooled, chillers consisting of centrifugal compressors, compressor motor, condenser, evaporator, variable frequency drive motor controller, refrigeration accessories, instrument and control panel including gages and indicating lights, auxiliary components and accessories, and motor starters.
2. Rating: Conform to AHRI 550/590 (I-P).
3. Conform to ASME BPVC-VIII-1 for construction and testing of centrifugal chillers.
4. Conform to ASHRAE Std 15 for safe construction and operation of centrifugal chillers.
5. Upon chiller startup an eddy current test is required to establish a baseline for the system

C. COMPRESSORS

1. Refrigerant: Factory pre-charge unit.

D. EVAPORATOR

1. Provide hinged marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping.
2. Insulate evaporator and cold surfaces with 0.75 inch minimum thick flexible expanded polyvinyl chloride insulation with maximum K value of 0.28.
3. Construction and materials shall conform to ASME BPVC-VIII-1 or ASHRAE Std 15 as applicable to chiller manufacturer and chiller model.

4. CONDENSERS

- a. Provide hinged marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping.
- b. Construction and materials shall conform to ASME BPVC-VIII-1.

E. PURGE SYSTEM (LOW PRESSURE REFRIGERANT)

1. Provide purge system for machines using low pressure refrigerants incorporating a low temperature refrigeration system to automatically remove non-condensables, water and air.

F. REFRIGERANT RELIEF

1. Low pressure refrigerants:
 - a. Each refrigeration machine shall be provided with a dual, two-stage relief system which shall protect the machine from refrigerant losses. The relief system shall have two (2) relief devices in series separated by a pressure-rated chamber.
 - b. The primary relief may be rupture-disc type of relief; however, if a rupture-disc is provided for the primary relief, it shall be of the non-fragmenting type.
 - c. The pressure chamber shall be provided with a pressure gage and shall be monitored with an automatic alarm (pressure switch) to indicate loss of seal in the first relief. The secondary relief valve shall be, as a minimum, spring-loaded and of the re-seating type.
2. High pressure refrigerants: Each refrigeration machine shall be provided with a resettable relief system which shall protect the machine from refrigerant losses.
3. The relief system shall be ASME certified and conform to the latest edition of ANSI B9.1 "Safety Code for Mechanical Refrigeration" and shall comply with ASHRAE 15.

G. REFRIGERANT MONITOR

1. Manufacturer: MSA-Chillguard 5000, Bacharach HGM, Yokogawa.
2. Provide an multizone, multi-gas monitor.
3. Provide concentration sensor and controls to initiate an alarm when ambient refrigerant concentration reaches 50 PPM (R123) or 1000 PPM (R134A).
4. Unit shall have remote sensor and shall be compound specific.

5. Monitor shall be provided by chiller manufacturer to sequence the control functions specified under Section 23 0994. The monitor shall include BACnet interface card for connection into building DDC controls for alarm, operation, and malfunction notifications.
6. Provide multiple remote visual/audible alarm annunciation devices with manual reset. Locate outside each entry door of the Chiller Mechanical Room, and inside the Chiller Mechanical Room.
7. Provide live test of refrigerant monitor, including operation of involved dampers, fans, strobes and audible alarms.

H. VARIABLE SPEED DRIVE (VSD), UNIT MOUNTED

1. Furnish chiller with factory-mounted, liquid-cooled variable speed drive (VSD) shipped completely factory-assembled, wired, and tested.
2. Specifically design VSD to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. VSD control logic is to optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If surge is detected, VSD surge avoidance logic is to make adjustments to move away from and avoid surge at similar conditions in the future.

SECTION 23 6417 – MAGNETIC BEARING CENTRIFUGAL WATER CHILLERS**A. MANUFACTURERS**

1. Daikin McQuay.
2. York.
3. Trane.
4. Multi-Stack.
5. Carrier

B. CHILLERS

1. Chillers: Factory assembled and tested, packaged, water cooled, chillers consisting of centrifugal compressors, compressor motor, condenser, evaporator, refrigeration accessories, instrument and control panel including gages and indicating lights, auxiliary components and accessories, and motor starters.
2. Chillers shall have a direct drive, magnetic bearing, completely oil-free, compressor(s).
3. Each compressor shall have a variable frequency drive operating in conjunction with inlet guide vanes for optimized unit part load efficiency.
4. Unit shall be arranged in a stacked shell arrangement to minimize floor space.
5. Provide isolation valves and condenser volume to hold full refrigerant charge in the condenser during servicing or provide a separate pump-out system and storage tank sufficient to hold the charge of the largest unit being furnished.
6. Units shall have Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than prescribed by ASHRAE Std 90.1.
7. Rating: Conform to AHRI 550/590.
8. Conform to ASME (BPV VIII, 1) for construction and testing of centrifugal chillers.
9. Conform to ASHRAE Std 15 for safe construction and operation of centrifugal chillers.
10. Unit shall be manufactured for field disassembly into multiple sub-components of compressor and evaporator/condenser shells for entry into building and re assembly in the mechanical room.
11. Upon chiller startup and eddy current test is required to establish a baseline for the system.

C. COMPRESSORS

1. Factory pre-charge unit.

D. EVAPORATOR

1. Provide hinged marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping.
2. Insulate evaporator and cold surfaces with 0.75 inch minimum thick flexible expanded polyvinyl chloride insulation with maximum K value of 0.28.
3. Construction and materials shall conform to ASME (BPV VIII, 1) or ASHRAE Std 15 as applicable to chiller manufacturer and chiller model.

E. CONDENSERS

1. Provide hinged marine type water boxes, machine welded to heat exchanger with tapped drain and vent connections, and flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant and removable without disturbing water piping.
2. Construction and materials shall conform to ASME (BPV VIII, 1).
3. Check if manufacturer can get end bells pre covered in marine epoxy to provide protection before corrosion starts. Also sacrificial anodes.

F. REFRIGERANT RELIEF

1. High pressure refrigerants: Each refrigeration machine shall be provided with a resettable relief system which shall protect the machine from refrigerant losses.
2. The relief system shall be ASME certified and conform to the latest edition of ANSI B9.1 "Safety Code for Mechanical Refrigeration" and shall comply with ASHRAE 15.

G. REFRIGERANT MONITOR

1. Monitor shall be provided by chiller manufacturer.

2. Provide an multizone, multi-gas monitor.
3. Provide concentration sensor and controls to initiate an alarm when ambient refrigerant concentration reaches 50 PPM (R123) or 1000 PPM (R134A).
4. Provide list test of refrigerant monitor, including operation of involved dampers, fans, strobes and audible alarms.
5. Unit shall have remote sensor and shall be compound specific.
6. Monitor shall be provided by chiller manufacturer to sequence the control functions specified under Section 23 0994. The monitor shall BACnet interface card for connection into building DDC controls for alarm, operation, and malfunction notifications.

H. VARIABLE SPEED DRIVES (VSD), UNIT MOUNTED

1. Furnish chiller with factory-mounted, liquid-cooled variable speed drive (VSD) shipped completely factory-assembled, wired, and tested.
2. Specifically design VSD to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. VSD control logic is to optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If surge is detected, VSD surge avoidance logic is to make adjustments to move away from and avoid surge at similar conditions in the future.

SECTION 23 6516 – INDUCED DRAFT COOLING TOWERS**A. STEEL TOWERS**

1. Manufacturers:
 - a. Baltimore Aircoil Company; Model PT-2.
 - b. EVAPCO, Inc.; Model UT.
 - c. SPX; Model MD.
2. The cooling tower shall be designed for quiet operation, and shall produce an overall level of sound not higher than 77 dB(A) measured at 5 ft. from the fan discharge. Sound levels shall be independently verified by a CTI-licensed sound test agency to ensure validity and reliability of the manufacturers published values. Measurement and analysis of the sound levels shall be conducted by a certified Professional Engineer in Acoustical Engineering. Sound pressure levels shall be measured and recorded in the acoustic near-field and far-field locations using ANSI S1.4 Type 1 precision instrumentation and in full conformance with CTI ATC-128 test code published by the Cooling Technology Institute (CTI). All low sound options shall be CTI certified for thermal performance.
3. Construction:
 - a. Except where otherwise specified, all components of the cooling tower shall be fabricated of heavy-gauge 301L or 304 stainless steel. All cut edges shall be cleaned prior to assembly. All fasteners shall be stainless steel.
4. Framework and Casing: Heavy gauge steel with sheets installed vertically with waterproof flanges.
5. Louvers: Corrugated fiberglass reinforced plastic or poly-vinyl chloride.
6. Fan: Propeller-type, incorporating wide-chord acoustic geometry, corrosion resistant marine grade aluminum or FRP blades. Blades shall be resiliently mounted to fan hub and individually adjustable. Fan blades shall be open cavity with suitable drainage to avoid accumulation of moisture. Foam filled blades are not allowed due. Maximum fan tip speed shall be 10,000 ft./min.
 - a. Motor: Single speed totally enclosed air over (TEAO) type with special moisture protection, mounted on welded steel frame in fan deck. Motor shall be suitable for use with a variable frequency inverter duty drive controller.
7. Fan discharge sound attenuation package.
8. Access: Large access doors at both ends of tower to eliminators and air plenum.
9. External Service Platform with Ladder. OSHA compliant platform consisting of handrail, galvanized steel grating, and framework attached to tower assembly. Mounting channels shall be stainless steel. Provide lockable ladder security cover, stainless steel or aluminum construction.

10. Internal Working Platform.

11. Safety: Safety railings, and ladder with safety cage from grade to fan deck.

12. Distribution Basin:

- a. The hot distribution basin shall be of stainless steel, Type 301L or 304 construction, gravity type basin utilizing weirs and plastic metering orifices, with flow control valves and covered with removable or sliding basin covers.

13. Collection Basin (Concrete sump; preferred):

- a. Stainless steel with depressed center section, designed to support tower for mounting over concrete sump.
- b. 18 gauge, 301L or 304 stainless steel, air stops shall be provided to prevent bypass of air below fill material. Baffle shall be provided at bottom of fill unless upper cold basin floor fill support will prevent air bypass under fill during full flow conditions
- c. Tower shall fit on concrete basin as shown on Drawings. Provide shop drawing of exact dimensions for basin fabrication.

14. Fill Device:

- a. Fill device shall be mounted in concrete sump and is specified in another section.
- b. Attempt to re-direct condensate water back to tower sump.

15. Hardware, nuts, bolts, and washers: Stainless steel.

16. Accessories

- a. Removable davit crane and base.
- b. Vibration Limit Switches.

SECTION 23 7313 – CENTRAL STATION AIR-HANDLING UNITS - FAN ARRAY**A. MANUFACTURERS**

1. Dimensions of units shown on drawings are based upon the composite dimensions of the following manufacturers.
2. Pre-approved Manufacturers:
 - a. Aeon
 - b. Carrier
 - c. Climatecraft
 - d. Daikin
 - e. JCI Inc.
 - f. Seasons-4
 - g. Trane Company
 - h. TMI-Climate Solutions
 - i. Xetex

B. GENERAL DESCRIPTION

1. Factory fabricated, applied air handling units with components scheduled housed within modules for field assembly into an complete air handling system.
2. Fabrication: Conform to AMCA 99 and ARI 430.
3. Units shall be fabricated using frame and panel construction with removable casing panels. Each section shall be capable of complete dis-assembly, including frame.

C. CASING

1. Construction: Fabricate each section of frame and panel construction capable of disassembly with removable panels, double wall construction with connection pieces for field assembly with gasketing between assembled sections.
2. Insulation: Closed cell foam.
 - a. Minimum 2-inch thick panels.

- b. Minimum R-13 insulation.
 - c. Unit casing shall be designed so that casing and doors will not condense moisture when the air temperature leaving cooling coil is 54 DB and the mechanical room condition on the unit exterior is 85DB/72WB.
3. Walk-in Access Doors: 30 inch wide and 60 inch height, minimum, of galvanized steel insulated sandwich construction, for flush mounting, with hinges, gasket, latch, and handle assemblies. Provide door handles operable from interior and exterior of the unit. Provide on service side of each section of each air handling unit and on both sides of filter sections and coil sections of units more than 4-feet in width. The door frame shall be foam filled, with a built in thermal break barrier and dual full perimeter gasket. The door hinge assembly shall be completely adjustable. There shall be a minimum of two handles per door. Provide ETL, UL 1995, and CAL-OSHA approved tool operated safety latch on all fan section access doors. Access doors in the all sections shall be provided with a 10 x 10 dual thermal pane safety glass window, UV rated.
4. Lights: Provide in all accessible sections suitable for damp locations with wire guards, factory wired to switch with pilot light mounted on casing exterior.
5. Finish:
- a. Outdoor Units:
 - i. Coat external surface of unit casing with primer and minimum 1.5 mil, enamel paint finish.
 - b. Indoor Units:
 - i. Provide exterior, galvanized steel panels without paint.
6. Factory Base Rail: Provide factory base rail, minimum 6-in. height, or additional sufficient height to raise the unit condensate connections to provide height for trap as detailed on Drawings and routing of pipe to the floor drains indicated.

D. FANS

1. General: All fans shall meet the airflow performance specified and shall not exceed the motor horsepower specified in the schedule. Fan framing assemblies shall be fabricated from structural steel. Fan assemblies shall be independently isolated with factory rubber-in-shear or spring vibration isolators. Vibration isolators shall be mounted to a structural angle on the fan base assembly. Fans shall be selected for the altitude at which the fan will be located.
2. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.
3. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

4. All motors shall be standard pedestal mounted type, ODP or TEAO, T-frame motors.

E. FAN ARRAY ASSEMBLY

1. The fan arrays shall consist of multiple, direct driven, arrangement of 4 plenum fans constructed, at a minimum, per AMCA requirements for the duty specified. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. Number of fans in array shall be greater or equal to the number scheduled. The array shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan peak static pressure producing capability at the specified fan/motor speed. Each fan/motor cartridge shall be dynamically balanced to meet AMCA Standard 204-05, category BV-3, to meet or exceed Grade G6.3 residual unbalance. Manufacturer shall provide sound data for the entire fan array system. Fan data for individual fans is not acceptable
2. The fan array shall consist of multiple fan and motor "cubes" or steel frame with isolated fan assembly, spaced in the air way plenum cross section to provide a uniform air flow and velocity profile across the entire air way plenum cross section and components contained therein. Each fan cube shall be individually wired to a factory installed MCP (motor circuit protector) panel. The control panel will contain individual motor circuit protectors with auxiliary contacts (BAS contacts), pilot light per fan to indicate fan on-off operation. Variable frequency drives shall be furnished by the manufacturer and field installed and wired by the contractor.
3. Provide a complete spare fan/motor assembly for emergency replacement, one for each type of assembly provided on the unit. Provide two blank-off maintenance plates sized to cover and isolate a fan/motor cube if a fan is down.

F. MOTORS

1. Motors shall be premium efficiency, IEEE inverter duty rated with appropriate winding insulation to meet NEMA MG 31, part 1 requirements. All motors shall be furnished with integral shaft grounding rings.
2. Maximum fan motor size shall be as scheduled for unit.

G. COILS

1. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations. Provide casing seals where pipe connections extend through casing.
2. Drain Pans:

- a. Drain pan on unit floor shall be insulated double wall welded 16 gauge 304 stainless steel, pitched for flow to drain connection, sloped in two planes.
 - b. Pan design shall pass the requirements of ASHRAE Std. 62R.
 - c. Provide a minimum of 1-inch from the bottom of the coil casing to the drain pan so the drain pan can be visually inspected and physically cleaned without bypassing airflow, including underneath the coil, without removal of the coil.
 - d. All drain pan connections shall be to the same side of the unit as the coil connections.
3. Coil Capacity: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
4. Water Cooling Coils:
 - a. Casing: Die formed channel frame of 304 stainless steel.
 - b. Configuration: Row depth shall be a minimum of 6 rows. Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.
 - c. Face Velocity: Cooling coil face velocity shall not exceed 500 feet per minute.
 - d. Re-direct condensate water to tower if feasible.

H. FILTER AND AIR CLEANER SECTION

1. Filter Section: Section with filter guides, access doors from both sides with latching handles, for side loading with gaskets, blank-off plates and casing access door(s).
2. Prefilters (EAPF): 2-inch deep disposable, extended area panel filters.
3. Filter (ESHF): 4 inches deep disposable, extended surface high efficiency panel filters.
4. Filter Gauges: Provide for each filter module.
 - a. Manufacturers:
 - i. Dwyer Instruments Inc.
 - ii. H.O. Trerice Co..
 - iii. Weiss Instruments.
 - b. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

- c. Accessories: Static pressure tips with integral compression fittings, 1/4 inch aluminum tubing, 2-way or 3-way vent valves.
- d. Filter Sizes: Minimize filter sizes required per unit (single filter size preferred), maximum two filter sizes per unit.

I. AIRFLOW MEASUREMENT

- 1. Flow Meter:
- 2. Each fan shall include a piezometer type flow meter.

J. TURNING AND DISCHARGE PLENUM SECTION

- 1. Provide plenum to efficiently turn and discharge air.

K. CONTROLS

- 1. VFD's, starters, disconnects, and control panels are not to be unit mounted.

L. ROOF MOUNTING CURB

- 1. Include roof curb and required accessories for each roof mounted unit.

M. ACCESSORY SECTIONS

- 1. Access Service Section: Provide a full size, 24-inch long, insulated access sections with walk-in style access doors on service side of unit to provide service access to/ inspection of internal components.

N. DAMPERS

- 1. Leakage: Class 1; [8.0] CFM/Sq.FT.inch maximum at 4-inch W.G. pressure difference.
- 2. Performance: Test in accordance with AMCA 500-D.

O. LIGHTS AND RECEPTACLES

- 1. Each compartment shall be provided with lighting arranged for safety and servicing of unit.

2. Lighting fixtures shall be an enclosed and gasketed, vapor-tight, surface mounted fluorescent fixture with glass or acrylic lens and lens guards.
3. Surface mount light switches in type FS box with weather-proof cover.
4. Receptacles: Provide two prewired GFI protected 120v power receptacles. Locate on each side of air unit, below light switches.

P. ELECTRICAL CONTROL CABINET

1. General:
 - a. All equipment provided with unit shall be electrically-self-contained. All electrical and controls components necessary for proper operation shall be furnished, installed, wired and ready for operation.
2. Electrical Raceways and Wiring:
 - a. All wiring shall be routed in conduit raceway. Exposed wiring is not allowed.
 - b. All wiring shall terminate at a wiring terminal.
3. Variable Frequency Controllers:
 - a. Provide multiple Variable Frequency Drive Controllers to start and run all motors in the fan array unit. Each drive shall be capable of operating maximum 50% of the fans in the total fan array.
 - b. Drives shall be field installed and wired.
 - c. Drives shall meet the equipment and installation requirements of Section 23 0514 - Variable Frequency Controllers.

SECTION 23 8130 – DUCTLESS SPLIT SYSTEM AIR CONDITIONERS (DAC-* & DCU-*)**A. MANUFACTURERS**

1. Mitsubishi .
2. LG.
3. Daikin.
4. Trane.
5. Hitachi.
6. JCI.

B. AIR CONDITIONING UNITS

1. Description: Packaged, ductless split air conditioning or heat pump system consisting of interior and exterior units and controls .

C. ACCESSORIES

1. Factory condensate pump.

DIVISION 26 – ELECTRICAL

A. OWNER'S DESIGN CRITERIA:

1. General: Where requirements of these specifications exceed specified codes and ordinances, conform to these specifications.
2. All materials and equipment must be UL-listed, and lighting fixtures and controls should be DLC-listed to ensure high energy efficiency and performance.
3. Jurisdiction: Where codes or guides refer jurisdiction to local governing code officials, such official in this procedure shall be the State Fire Marshal.

Conform to the International Energy Conservation Code (IECC), current Edition, with all applicable Georgia State Amendments. Prioritize incorporating energy-efficient lighting systems tied into building automation systems to exceed standard energy conservation measures

4. Fire Prevention: Conform to Georgia State Minimum Standard Fire Prevention Code (International Fire Code), current Edition, with all Georgia State Amendments.

Conform to the Georgia State Minimum Standard Building Code (International Building Code), 2021 Edition, including all Georgia State Amendments.

Conform to the National Electrical Code (NEC), current Edition, incorporating advanced electrical systems that enhance operational reliability and promote energy efficiency.

5. Life Safety: NFPA 101 - Life Safety Code current edition.
6. Fire Alarm: Conform to the 2013 Edition of NFPA 72 - National Fire Alarm and Signaling Code.

SECTION 26 0500 – GENERAL ELECTRICAL REQUIREMENTS

A. GENERAL

1. This document contains design and construction requirements for electrical aspects of construction and renovation projects for Kennesaw State University and is intended for use by engineers involved in such projects. The engineer is expected to use his own specifications and to provide design work in accordance with his standard practice subject to the requirements stated in this guide. This document does not address all aspects of electrical construction. It addresses only those items for which Kennesaw State University Facilities has a specific standard, preference, or methodology.
2. Electrical systems must adhere to campus-wide standards that prioritize flexibility and ease of maintenance. The design should accommodate changes in electrical requirements and facilitate seamless operations for technicians, minimizing equipment upgrades and downtime. Systems should be intuitive for new personnel, ensuring consistent functionality and reliability across the building's lifespan.
3. Where budgets are inadequate for the scope of electrical work as required by the project program and as outlined herein, notify Design and Construction of the condition and provide recommendations for reconciling the scope and budget in order to meet electrical requirements.

B. DOCUMENTATION AND TRAINING

1. Complete documentation consisting of all operating and maintenance manuals for equipment installed as well as as-built prints, an updated riser diagram, short-circuit and coordination study reports and arc-flash hazard study reports shall be delivered to the Owner.
2. Provide a report of protective device settings and copies of all test reports.
3. Provide training by a manufacturer's authorized service technician for switchgear, switchboards, fire alarm systems, variable frequency drives, lighting control and programmable dimming systems, engine-generator sets, and transfer switches. The contractor shall provide an orientation session for the Owner's personnel in which all aspects of the electrical system are addressed, and video recorded for future reference.
4. Training for lighting control systems must be provided within a timeframe specified by the Facilities/Plant Operations team. Sessions should be scheduled to ensure comprehensive instruction.
5. A qualified manufacturer's service representative—not a sales representative—must conduct training for each specified piece of equipment.
6. The Contractor must provide training materials/documents, organized with an index for easy reference.

SECTION 26 0505 – SELECTIVE DEMOLITION FOR ELECTRICAL**A. GENERAL**

1. Coordinate all outages with the owner prior to disabling the system.
2. Remove, relocate, and extend existing installations to accommodate new construction.
3. Remove abandoned wiring to source of supply.
4. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
5. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
6. Disconnect and remove abandoned panelboards and distribution equipment. Abandoned in place is not an option.
7. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
8. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
9. Repair adjacent construction and finishes damaged during demolition and extension work.
10. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
11. Remove all low voltage cabling. No unterminated low voltage cabling may remain above the ceiling.
12. Where breakers become open from demolition, turn to the OFF position and label as spare (in pencil) in the panel schedule.

SECTION 26 0513 – MEDIUM-VOLTAGE CABLES**A. MANUFACTURERS**

1. Southwire or equivalent.

B. CABLE

1. All conductors to be installed in the primary system shall be #500 kcmil copper.
2. Medium Voltage Cable: UL 1072, ICEA S-97-682 and ICEA S-93-639 cross-linked polyethylene insulated cable.
 - a. Cross -linked polyethylene insulation shall be minimum 220 mil. thick, 133% level, tree retardant.
 - b. Voltage: 15 kV, grounded, for operation on 12,470Y/7200 volt, 3 phase, 4-wire, 60 cycle, grounded neutral system.
 - c. Conductor: Copper, concentric, stranded, with foil conductor shield.
 - d. Construction: Single conductor with copper tape shield.
 - e. Thermal Rating: 105C normal service and 140C emergency service
 - f. Insulation Jacket: Each cable shall have a PVC jacket overall.

C. ACCESSORIES

1. Connections and Terminations: Terminate primary cables with preformed, self-potting, waterproof, track resistant, shielded connectors and terminators designed for use on single conductor, 15 KV, polyethylene insulated, URD type cable having an extruded semi-conducting jacket and concentric grounded neutral wires as specified herein. When assembled and ready for operation, all cable connectors and terminations shall be submersible. Each terminator and connector shall have a test point.
 - a. 600 Amp Devices: Style/model numbers shown are for ESNA devices. Equal devices by RTE or GE are acceptable.
 - i. 600 Amp permanent straight splice: Style 650S
 - ii. 600 Amp splice system: Style 650LR with tee bodies, dead-end plugs, end caps, connecting plugs, spanner wrench, 600A/200A reducing plug, and other parts as required. Elastimold vault saver splices may be used with prior approval from the Architect.
 - iii. 600 Amp permanent wye splice: Style 650Y.
 - iv. 600 Amp straight splice assembly tool: Style 650ATY.
 - v. 600 Amp deadbreak elbow connectors: Style 650LR elbow connector, complete with K650 RTW reducing tap well, #1601A41B6 loadbreak bushing insert, and

#160DRGABG insulated cap with ground lead. Each elbow connector shall have a voltage test point.

vi. 600 Amp in-oil apparatus bushing: Style 600S1 or 600T1.

vii. Drain Shield Connecting Device: Style 21MA or 31 MA.

viii. Deadfront Elbow Arrester: RTE 3237015C MOV type; 9kV on 15kV grounded wye system, type 12kV on 15kV delta system.

2. Fireproofing Tape: Provide for all cables exposed in manholes and switching cubicles.

D. FIELD QUALITY CONTROL

1. After the cables have been installed, terminated, and plugged and before they are spliced into campus system and are energized, the following preparations and tests shall be made.

- a. Disconnect all equipment before conducting tests.
- b. Clean all manholes and equipment of mud, dirt and debris before testing.
- c. Terminations shall be cleaned and plugged to prevent erroneous readings. Corona-proof conductor ends of cables by taping to sufficient level to prevent corona. Where cables terminated in 600 amp Elastimold terminators or connectors, install end caps in the Elastimold fittings before testing.
- d. Ground all conductors except the one to be tested (hereinafter referred to as "the cable").
- e. Megger (megohm test) all cable to be tested. Three consecutive, identical readings, 10 seconds apart, shall be taken before, and three after a hi pot test.
- f. Hi-pot test shall consist of applying 80% of the factory DC test voltage to each cable before energizing. Test voltage shall be applied between phase conductor and grounded concentric neutral. Negative side shall be applied to the cable.
- g. Bring D.C. voltage up to test level in five or more steps, reading the stabilized leakage in microamps at each level.
- h. Hold voltage at test level for 15 minutes and read leakage in microamps at 30 second intervals for first 2 minutes, then at one minute intervals to the end of the 15 minute period.
- i. Bring the test set voltage quickly to zero and record the decay voltage at 30 seconds and at one minute.
- j. Disconnect test set from cable and megger. CAUTION: Make certain cable is fully discharged by grounding and use rubber gloves in handling tested cables. Following these tests, a hazardous voltage may be present on the cable.
- k. Test each remaining cable in the conduit in the same manner.

- I. Record all data pertaining to the circuit and plot leakage against applied voltage; and leakage against time at the test voltage (dielectric absorption).
- m. Cables shall be checked for continuity and cable identification tag installed prior to energizing or splicing into the existing underground primary system to prevent

SECTION 26 0519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**A. CONDUCTOR AND CABLE APPLICATIONS**

1. General:
 - a. All conductors shall be copper and made in the USA.
2. Metal-clad cable is permitted only as follows:
 - a. Concealed in walls - transition to EMT homeruns out of the wall. For lighting circuits concealed above ceilings, EMT to the first light, then MC between fixtures on that circuit.

B. ALL CONDUCTORS AND CABLES

1. Conductor Color Coding:
 - a. Color code conductors as indicated. Maintain consistent color coding throughout the project.
 - b. Color Coding Method: Integrally colored insulation.
 - c. Color Code:
 - i. 480Y/277 V, 3 Phase, 4 Wire System:
 1. Phase A: Brown.
 2. Phase B: Orange.
 3. Phase C: Yellow.
 4. Neutral/Grounded: Gray.
 - ii. 208Y/120 V, 3 Phase, 4 Wire System:
 1. Phase A: Black.
 2. Phase B: Red.
 3. Phase C: Blue.
 4. Neutral/Grounded: White.
 - iii. Equipment Ground, All Systems: Green.
 - iv. Isolated Ground, All Systems: Green with yellow stripe.

C. INSTALLATION

1. Circuiting Requirements:

- a. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted

SECTION 26 0526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**A. GENERAL**

1. Grounding and bonding is important, especially in the data closets.
2. Provide ground bars adjacent to any new switchboard (service entrance) and in all data rooms. Each ground bar in the data room shall be bonded together and tied into the ground bar adjacent to the switchboard with nothing less than #1 AWG copper wire.
3. Clearly mark any grounding triads on the as-built drawings.

SECTION 26 0534 – CONDUIT**A. GENERAL**

1. Conduit shall be made in the USA.
2. Colored Conduit:
 - a. Fire Alarm: RED
 - b. Emergency systems: YELLOW
 - c. Data: ORANGE
 - d. Security: GREEN
 - e. Building Automation Systems: LIME GREEN
3. Route neatly with building lines, parallel and perpendicular.
4. MC cable may be used in the walls - transition to EMT for homeruns.
5. Colored MC Cable:
 - a. Fire Alarm: RED
 - b. Emergency systems: YELLOW
 - c. Data: ORANGE
 - d. Security: GREEN

SECTION 26 0537 – BOXES**A. GENERAL**

1. Paint box covers according the service inside:
 - a. Fire Alarm: RED
 - b. Emergency systems: YELLOW
 - c. Data: ORANGE
 - d. Security: GREEN
 - e. Building Automation Systems: LIME GREEN
2. Label boxes with circuit number visible from below (handwritten with permanent marker is acceptable).

SECTION 26 0553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS**A. GENERAL**

1. Provide engraved plastic permanent labels on all electrical equipment, indicating NAME and FED FROM information - black on white for normal, red on white for emergency circuits.
2. Provide circuit information on all receptacles and light switches. Use self-adhesive machine generated stickers. Format is "LRI-3". Black on white for normal, Red on White for emergency.
3. Any duplex receptacle installed that is GFCI/ARCI protected shall be identified and labeled.
4. Panel Schedules should include room numbers for any receptacles.
5. Main electrical rooms shall have riser diagrams displayed on the wall.

SECTION 26 1201 – PAD-MOUNTED TRANSFORMERS

A. GENERAL

1. At the Kennesaw campus, KSU owns the transformers and distribution across the campus. Any new building will have to coordinate with the school to determine which circuit to connect. On this campus the Contractor shall provide pad mounted transformers as described on the drawings and in these specifications. All cost associated shall be part of the project.
2. At the Marietta campus, the power company owns the primary and transformers. Contractor would be responsible for only the secondary conductors from the transformer into the main service gear.

B. ACCEPTABLE MANUFACTURERS:

1. Pad-Mount Transformers: ABB, General Electric Co., Cooper.
2. Primary Bushings: Elastimold or RTE.
3. Loop-Feed Switch: General Electric Co., ABB, or Cooper.
4. Pressure-Relief/Air bleed Device: Qualitrol, Beta, or approved equal, meeting or exceeding ANSI C57.12.25, Section 6.4.5.
5. Top Mounted Pressure-Relief Device (300 KVA and Larger Transformers): Qualitrol #208-60 or approved equal.
6. Oil-Immersed Metal Oxide Distribution Arrester: General Electric "Tramquell 1A1". Cooper Power Systems Type AZU, or ABB.
7. Magnetic Overcurrent Indicators: McGraw-Edison Type MHS; H. Horstman Type 317.60X, or RTE Type MRB.
8. Secondary Spade Covers: W.H. Salisbury Co. #SC-4 Homac Mfg. Co. "SB" Series, or approved equal.

C. MATERIALS:

1. Transformers shall be new, factory-tested, three-phase, pad -mount type, oil-filled, complete with accessories, and have olive, "grass", or "telephone" green color finish. Compartment and tank shall have factory applied undercoating.
2. A primary loop-feed, loadbreak oil switch assembly, consisting of two (2) 2-position ON-OFF devices, shall be provided (integrally through 500 KVA) in the primary of each new three-phase, pad-mount transformer, with all controls accessible in the high voltage compartment. A 4-position switch with closed transition is acceptable; without closed transition, is not.
3. Primary Fusing: A combination (series connection) of an oil-immersed, current-limiting fuse and a Bay-O-Net, oil-immersed, dual-element expulsion fuse, coordinated to provide full range protection, with the expulsion fuse, clearing low-current faults or overloads, and the current limiting fuse clearing high-current faults up to 50,000 amperes rms. sym. shall be provided for each phase of the transformer primary. Bay-O-Nets shall be located so that expulsions will not create gas pockets across any phase to phase or phase to ground terminals which might

initiate arcing. Fuses shall be coordinated with specified internal lightning arresters to prevent nuisance fuse blowing as a result of current developed in the transformer due to discharge voltage of the arrester saturating the transformer core. Fuse sizes shall be as recommended by the transformer manufacturer.

4. Bushings:

- a. Six (6) 600 amp deadbreak primary bushings for use on 15 KV Class apparatus, arranged to form a "V" configuration, shall be provided in the primary compartment for receiving dead-front cable connectors. At least six (6) parking stands shall be located in the primary compartment and shall be so arranged that any terminated cable can be disconnected from its bushing and placed on a stand-off plug or a grounding plug mounted in the respective parking stand without straining the cable. Primary bushings must accept and interface with either Elastimold 650 LR or RTE "Bol-T" 600 amp elbow connector or Elastimold 600 BE bushing extender.
- b. Secondary of transformer shall be connected through low voltage bushings with tinned copper terminal spades, each having NEMA spaced holes, (4-thru 15 KVA, 6-thru 500 KVA, and 8*-750 KVA & larger). Bushing shall be arranged for clearance and cabling from below. A minimum of six inches (6") shall be maintained between the tank wall and the center of the terminal hole nearest the tank.
- c. Primary and secondary bushings shall be field replaceable, externally clamped type, compatible and interfaced to accept cable terminations specified elsewhere herein.
- d. Provide with insulated steel support system, 125# min./spade.

5. E. Insulating Oil:

- a. In lieu of mineral oil, the transformer shall be filled with non-toxic Cooper FR3 seed based oil (or equivalent).

6. Transformer Accessories:

- a. Furnished by transformer manufacturer with or on unit:
 - i. Top-mounted access cover.
 - ii. Primary bushing dust covers, 6-each.
 - iii. NEMA accessory group consisting of 1" drain and 1/2" sampling devices, thermometer, and oil level gauge. Thermometer and oil gauge to be located in secondary compartment and drain/sampling device in primary compartment, except when secondary breakers or panels are specified herein or scheduled on the drawings and obstruct safe viewing or resetting, all shall be located in the primary compartment.
 - iv. Combination pressure-relief/air-bleed device, with 9-11 psi relief pressure rating, 7 or less psi closing pressure rating, and resistant housing such as brass or stainless steel, with O-ring seal and 1/4"-18NPT pipe threads, located in the secondary compartment, except when secondary breakers or panels are

specified herein, or scheduled on the drawings and obstruct safe inspection, testing, or use, shall be located in the primary compartment.

- v. Pressure relief device with 10 psi maximum relief pressure and enclosed in tamper-proof metal enclosure located on top of transformer tank on all transformers 300 KVA and larger.
- vi. Manual tap changer for de-energized operation shall be located in the primary compartment.
- vii. Set of controls for primary loop-feed switch shall be located in the primary compartment.
- viii. Phase and switch identification.
- ix. Stainless steel nameplate with schematic diagram and other data.
- x. Installation, operating & maintenance instructions (complete set secured in waterproof holder inside secondary compartment door).
- xi. Parking stand brackets (at least one per cable termination).
- xii. Grounding pads (2 per compartment).
- xiii. Oil fill plug.
- xiv. Oil fuse drip tray.
- xv. Spare fuses on the order of 10%, but in no case less than three (3) of any type or rating for entire project.

b. Contractor shall provide and install in the field the following items:

- i. Stand-off insulator plugs, 3 each; dummy receptacle with test point, 3 each; and studs as required.
- ii. Ground cable bus, extended the entire length of the high-and-low voltage compartments.
- iii. Secondary Lightning Arrester: Install inside secondary compartment to protect each phase.
- iv. Magnetic overcurrent indicators, 3 each, set at * amps, one per phase, for quick identification of cable or equipment faults or severe overloads. Install on "source" side primary cables as recommended by instructions accompanying indicators; otherwise, install over cable over concentric neutral at tie back, above collected wires from concentric. Indicator shall be manually resettable and removable without having to de-energize the circuit. Where a special tool is required to reset devices, provide one per 3-phase installation and provide storage or hanging facilities.
- v. Concrete pad.

- vi. Secondary spade covers to prevent accidental contact with energized spade connections.
 - vii. Secondary metering when and where shown on the drawings or specified herein.
 - viii. Plug-on elbow mounted end-of-line lightning arresters, one set per radial.
(Total of six (6) per loop.)
 - 1. *McGraw "MHS"- 450
 - 2. *RTE "MRB"- 400
7. All tap changers shall:
- a. Be externally operated.
 - b. Have the same BIL rating when operated at each tap setting.
 - c. Be provided with positive stops to identify the highest and lowest tap positions.
 - d. Be located in the high voltage terminating compartment.
 - e. Be designed to prevent accidental operation by requiring a preliminary step such as loosening a set screw before the tap position can be changed. This positive locking device shall be clearly visible to field personnel operating the tap changer.
 - f. Have either a permanent clearly marked indicator plate or tap positions stenciled on the transformer tank with oil resistant material.
 - g. Have all components constructed of corrosion resistant material.
 - h. Be designed for operation using hot line tools.
 - i. Rotate in a clockwise direction from the high tap voltage to a lower tap voltage in the high voltage winding.
8. Metal oxide varistor distribution under oil surge arresters shall be provided for each primary phase and be integrally connected and shall be located in oil filled compartment.

D. RATING:

- 1. Pad-Mount Transformers:
 - a. Capacity: Self-cooled continuous KVA rating indicated on the drawings.
 - b. Phase/Frequency: Three/60 hertz.
 - c. Temperature Rise: 65°C.
 - d. BIL: 95 KV min. Primary: 30 KV min. secondary.

- e. Primary Voltage: 12,470 Grd Y/7,200, 3-phase, 4-wire.
- f. Secondary Rating: 480 Grd Y/277 volts, 4-wire as scheduled or indicated on the drawings. Secondary spades shall be compatible with transformer capacity at full load.
- g. Taps: Four (4) two and one-half percent (2-1/2%) rated taps in high voltage winding, two (2) above and two (2) below normal voltage.

2. Integral Loop-Feed Switch:

- a. Maximum Capacity: 400 amps RMS Continuous and Load Switching.
- b. Phase/Frequency: Three/60 hertz.
- c. BIL: 95 KV minimum.
- d. Voltage: 15.5 KV nominal.
 - i. $\pm 10\%$ of guaranteed average.
 - ii. $\pm 7\frac{1}{2}\%$ of tolerance.
- e. Momentary Make-&-Latch and fault close: 12,000 amps RMS SYM (20,000 amps ASYM).
- f. 60Hz One Minute Withstand: 34 KV
- g. Number of Load break Operations at Continuous Amps: 25
- h. No-Load Mechanical Operation: 500
- i. Fault Operations: 2

3. Integral Oil-Immersed Distribution Lightning Arrester:

- a. Arrester Rating 9KV rms.
- b. Maximum Continuous Voltage Capacity --- 7.65 KV rms. (L-G).
- c. Equivalent Front-of Wave Protection Level*--35.3 KV-Crest, or less.
 - i. Level* ----- 35.3 KV-Crest, or less.
- d. Maximum Discharge Voltage (KV Crest) at Indicated Impulse Currents Using 8 x 20 Microsecond Current Wave:
1.5KA-26.3 KV; 5KA-29.3 KV; 10KA-31.5 KV; 20KA-35.9 KV

4. Secondary Breakers:

- a. Ampacity: As shown on drawings.
- b. Poles: 3 poles.

- c. Interrupting Rating: As specified herein.
- 5. Insulating Liquid (Oil)
 - a. 30KV dielectric strength when tested per ASTM D877.
 - b. *Equivalent FOW protection level is the discharge voltage for a 10 KA current wave which as a voltage move cresting in 0.5 micro-seconds.

E. FABRICATION AND MANUFACTURER:

1. Transformer construction shall be tamper-resistant with no externally removable fastening devices. Low voltage (secondary) air filled terminal compartment shall be located on the right and shall be accessible through a hinged steel door with pad-lockable handle and three-point latches. High voltage (primary) air filled terminal compartment shall be located on the left and shall be accessible through a hinged door only after the secondary compartment door has been opened, and secured by a slotted, hex-head captive bolts. Primary and secondary compartments shall be separated by a barrier. Doors and sills shall be removable to facilitate rolling and skidding the transformer unit into place over conduit stub-ups, making connections, and pulling-in cables.
2. The primary loop-feed switch shall be a three-phase, gang operated, disconnecting device and shall interrupt all three phases simultaneously. Operation shall be for loop-and solid tap, for through feed, alternate feed or sectionalizing. After withstanding or closing-in on maximum rated fault current, the load break oil switch shall be operable in normal manner and capable of carrying its rated load current without exceeding temperature rise limitation. Connections to primary transformers shall be integral with the construction of a complete pad-mount transformer unit. Construction shall be dead-front. All operating mechanisms and contacts shall be arranged for inspection, maintenance, or replacement and contacts shall be silver plated.
3. Transformers shall have either a five (5) legged core or a triplex design.

F. SECONDARY ARRESTERS:

1. Arresters shall be a sturdy, weatherproof, service-proven device to immediately drain lightning surges, harmlessly to ground (earth), discharging a surge in a fraction of a second, repeatedly, with no maintenance required.
2. For 3-phase applications, one 3-pole, 4-wire system, three 2-pole, 3-wire 650-volt class device shall be used.
3. Devices shall be U.L. & CSA listed and labeled, with approximately 18" leads, pre-stripped, and operated effectively when mounted in any orientation.
4. Arrester shall be furnished by manufacturer with mounting bracket.
5. Connection diagrams and installation instructions shall be provided by manufacturer with each device.

G. END-OF-LINE PRIMARY SURGE ARRESTERS (E.L.L.A'S)

1. Plug-on elbow mounted E.L.L.A.'s shall be 15KV class, dead-front, 9KV rated, metal oxide varistor elbow assembly, for plugging into 600 amp reducing tap well device. Each arrester shall be furnished by the manufacturer with a 36" long bare stranded woven copper grounding cable connected to bottom end of arrester.

H. PREPARATION

1. The earth upon which transformer pad is to sit shall be leveled and compacted to receive the pad. Earth form may be used below grade in firm soil such as clay; otherwise, use wood or metal forms above and below grade

I. INSTALLATION/APPLICATION/PERFORMANCE

1. Install pad-mounted transformer at location(s) indicated on the drawings on a steel-reinforced concrete pad.
 - a. Obtain exact dimensional data from transformer manufacturer and size pad accordingly.
 - b. Two inches (2") of the pad shall be exposed above finished grade in paved areas, and four inches (4") in unpaved areas unless noted otherwise on the drawings
 - c. Transformer pads poured at the site shall be allowed to cure a minimum of three (3) days before the transformer is installed thereon.
 - d. Location of transformer pad shall be such that transformer shall not be located nearer than ten feet (10') to any building unless located next to an approved fire wall with doors, windows, or other openings not closer than ten feet (10') on either side, or over. At least two feet (3') shall be left for maintenance and operation.
 - e. Overall dimensions of transformer pad shall allow six inches (6") all around beyond furthest horizontal projection of transformer.
2. Primary and secondary cables and conduit shall be installed either before or after transformer is set and leveled on pad. When terminated, each primary cable shall be arranged so that it can be moved in an arc from its respective incoming phase bushing to the same phase outgoing bushing and visa-versa without stretching, deforming, or damaging cable in any way.
3. Make secondary cable connections to transformer using compression 2-hole spade connectors which are compatible with secondary cable conductor and transformer spades.

J. SPARES

1. Spare fuses on the order of three (3) each of every different size and type installed on this project shall be furnished, tagged with description and location(s) used, and turned over to the Owner's representative at the time of final review of construction and prior to final payment.

K. SECONDARY ARRESTERS:

1. Install secondary lightning arrester (s) inside secondary compartment of each pad-mounted transformer and connect to protect each phase in accordance with instructions furnished with arrester.

L. END-OF-LINE PRIMARY LIGHTNING ARRESTERS (E.L.L.A'S):

1. Install plug-on elbow mounted E.L.L.A.'s inside the primary compartment of pad-mounted transformer. Plug into 600 amp reducing tap well*, one for each phase (two sets of 3 for each loop).
2. Bond grounding cable connected to arrester to ground bus.
3. When 600 amp apparatus cable connectors are specified herein or indicated on the drawings, provide 600 amp to 200 amp transition for each connection to receive the end-of-line, plug-in elbow arrester:
 - a. Remove insulating plug with its cap from 600 amp connector and store in air-tight heavy-duty plastic bag inside primary compartment.
 - b. Provide reducing tap well*, Elastimold Style 600RTW or RTE Cat. No. 2637241B01M.
 - c. Provide 200 amp loadbreak bussing plug insert*, Style1601-3R RTE Cat. No. 2604797B01M.
 - d. Clean and silicon lubricate all mating parts.
4. Install parking stand mounted E.L.L.A.'s inside the primary compartment of pad-mounted transformer(s) designated on the drawings. Plug designated cable 200 amp loadbreak elbows into 200 amp arrester bushing when indicated on the drawings, one for each phase (one set of 3 for each end of loop).
5. Device must be approved by the manufacturer to mate with their particular cable connector. Verify.

SECTION 26 2413 – SWITCHBOARDS

A. GENERAL

1. Double Ended Switchgear with a tie breaker will be utilized with each section being feed from a transformer.
2. Spare switchgear breakers of each ampere size will be provided to KSU, shop stock.
3. Where possible, distribute building power loads by separating Receptacle, Lighting and HVAC loads.
4. Provide power meters to monitor Receptacle, Lighting and HVAC loads individually. The total building load should also be monitored and available for review. Acceptable meters include:
5. Values for kW, kWh, pF, kVA, KVAR shall be obtained in 15 min increments, totalized, and transmitted via open BACnet/IP protocol to the campus Energy Dashboard Software Platform, as well as the building management server.
6. All data should be accessible via the campus Energy Dashboard Software Platform. See Appendix for more details on this system.

SECTION 26 2416 – PANELBOARDS

A. GENERAL

1. Refer to electrical metering standards for distribution of building power loads by separating receptable, lighting and HVAC.
2. Provide power meters to monitor each of these loads individually. The total building load should also be monitored and available for review. Acceptable meters include:
 - a. Values for kW, kWh, pF, kVA, KVAR shall be obtained in 15 min increments, totaled, and transmitted via BACNET protocol to the campus Energy Dashboard Software Platform, as well as the building management server.
3. Provide power meters to monitor each of these loads individually. The total building load should also be monitored and available for review.
4. All data should be accessible via the campus Energy Dashboard Software Platform. See Appendix for more details on this system.
5. All auxiliary service loads such as dining, restaurants, retail, and event power shall have their own dedicated panel boards and associated metering as stated above.
6. Provide updated breaker schedule to be located inside panel door.

SECTION 26 2417 – SURGE PROTECTIVE DEVICES (SPDS)

A. GENERAL

1. Provide Surge Protective Devices on the main switchboard and any receptacle panels serving sensitive loads.

SECTION 26 2726 – WIRING DEVICES**A. GENERAL**

1. Wiring devices shall match color. Receptacles, light switches, low voltage switches, wall mounted occupancy sensors, etc. shall be the same color with the same type of trim or cover.
2. For new construction, devices and covers shall be white. Provide submittals data indicating this color prior to purchasing.

SECTION 26 3213 – ENGINE GENERATORS**A. GENERAL**

1. All new generators shall be natural gas fired.
2. Provide Level II sound enclosures (75db at 23ft) when adjacent to buildings with learning spaces inside.
3. Connect generator to Building Management system, to allow for remote monitoring. Typical monitoring points include engine hours, % loaded, and maintenance reminders. Any alarm at the generator shall be transmitted to the Facilities group via the BMS.
4. Connect all associated ATS's to building management system such that the Facilities group is alerted when the ATS has transferred both to and from emergency power.
5. Connect a power meter to the generator when applicable to allow load tracking. Meter must be open BACnet and connected to BMS monitor runtime.
6. Acceptable generator manufacturers include:
 - a. Caterpillar
 - b. Cummins
 - c. Kohler
7. Items to be placed on generator power:
 - a. Life Safety Egress lighting
 - b. Data room receptacles
 - c. Data room cooling
 - d. Designated research equipment
 - e. Fire pump
 - f. At least one elevator. If only one elevator is selected, priority should be given to the service elevator.
 - g. All life safety equipment (fire alarms, area of rescue phones, access controls, security cameras, etc.)

SECTION 26 4110 – FACILITY LIGHTNING PROTECTION**A. GENERAL**

1. All new building construction projects are required to have a lightning protection system.
2. Conductors to be copper cable of size and weight to achieve system certification. Aluminum conductors may be used only where necessary to prevent dissimilar metals from interacting.
3. Down conductors to be concealed within partitions, chases, column enclosures, cast-in-place concrete columns, etc.
4. Where accessible to personnel walking across the roof, use blunt tip rods.
5. Where lightning rod base plates and cable support base plates are provided on roofing, parapets and/or cap flashing comply with roof membrane manufacturer's recommendations for mounting and sealing base plates in a manner that does not void the roof system warranty.
6. Where lightning rod base plates and cable support base plates are provided on roof top equipment, comply with equipment manufacturer's recommendations for mounting and sealing base plates in a manner that does not void the equipment warranty.
7. Construction Documents shall indicate a general lightning rod layout that includes an approximate count of rods and downlead locations for the contractor to price. During the submittal process the contractor shall provide the designer with shop drawings which indicate exact quantities and locations.
8. To be included in the O&M manuals: Contractor to obtain and provide KSU a copy of the Underwriters Laboratories, Inc. UL Inspection Certificate.
9. WWhen installing new roof top equipment, extend lighting system to protect new equipment.

SECTION 26 5100 – INTERIOR & EXTERIOR LIGHTING

A. GENERAL

1. All new lighting shall be LED type, both interior and exterior. Fluorescent lamps and HID are not allowed without special permission from the Facilities group.
2. There are two site lighting standards - one for the Kennesaw Main campus and one for the Marietta campus. See the Appendix for cutsheets for each.
3. The preferred lamp color choice is 4100k inside, 5000k outside.
4. To allow for easy maintenance, do not place lights directly over stairs or any location which would make it difficult to replace bulbs.
5. Separate lighting loads from receptacle and HVAC loads to allow for it to be metered separately.

B. EXTERIOR LIGHTING

1. Kennesaw Campus

- a. Pedestrian Walkway Lighting - Holophane Utility Arlington LED, ARUE2-P40-40K-AS-GL3-BK-S, pole Holophane Hamilton HL-A-14-F5J-16-P07-ABG-BK.
- b. Vehicular Traffic & Surface Parking Lighting – Cree BXSP-C-HT-2ME-E-40K-UL-SV, poles to match existing.

2. Marietta Campus

- a. Pedestrian Walkway Lighting – RAB Lighting ALED-5T-52, poles to match existing.
- b. Vehicular Traffic & Surface Parking Lighting – RAB Lighting RWLED-3T-125, poles to match existing.

SECTION 26 5200 – SENSOR LIGHTING CONTROLS AND LIGHTING DESIGN

- 1. Preferred Vendors (Refer to Appendix for model numbers and links to lighting fixture selection and controls selection):**
 - a. Acuity NLight**
 - b. Sensors and Switches**
- 2. Manual and Dimmable Lighting Controls**
 - a. Provide manual dimming in offices, conference rooms, classrooms, and personal-use spaces
- 3. 0-10V Dimming**
 - a. All fixtures and sensors shall use 0-10V dimming for demand response and energy efficiency per ANSI/ASHRAE/IES Standard 90.1.
- 4. Occupancy and Daylight Sensors**
 - a. Install dual-technology occupancy/vacancy sensors in classrooms, offices, storage rooms, restrooms, hallways, and common areas.
 - b. Install daylight sensors in large public-use spaces, such as lobbies, to regulate artificial lighting based on natural light availability. Do not install in areas where the end user requires manual adjustability of lights (e.g., conference rooms, offices, etc.).
- 5. Exterior Lighting Controls**
 - a. Control exterior lighting with photocells or an astronomical time clock per IDA guidelines.
- 6. Device Connectivity and Installation**
 - a. Networkable lighting controls shall connect to a building controller for remote programming, monitoring, and override control in hallways, classrooms, and large public spaces
 - b. Standalone controls shall be used in offices, storage closets, restrooms, IT spaces, and MEP rooms.
 - c. Wireless controls may be used in areas where the installation of wired controls is not feasible due to electrical infrastructure limitation or where running wiring would cause significant disruption or cost.
 - d. The building controller shall use BACnet/IP or BACnet/MSTP for BAS integration. If a controller is not included in the project scope, devices must be network-ready for future integration.
- 7. Lighting Design**

a. Photometric Evaluations and Lighting Optimization

- i. Conduct photometric assessments per IES guidelines for new construction and original design specs for retrofits
- ii. Engineer-stamped drawings are required for full-building, full-floor, or >5,000 sq. ft. lighting replacements.
- iii. Evaluate whether fixtures can be removed to reduce wattage and improve design clarity by eliminating unnecessary or inefficient lighting layouts.

b. Fixture Type Replacement and Modifications

- i. Select the most cost-effective replacement option by considering a like-for-like fixture or evaluating whether using the existing ceiling grid (2x2 or 2x4) would be more feasible. For example, installing a like-for-like fixture in a hard ceiling may be more practical than cutting and reinstalling drywall.

c. Emergency Drivers and Night Lights

- i. Install emergency drivers as per the original design for egress lighting in accordance with NFPA 101: Life Safety Code.
- ii. Maintain night lights per original design following KSU EHS guidelines.
- iii.

8. Do not place these spaces on automatic shutoff:

- a. Data closets
- b. Electrical rooms
- c. Mechanical rooms

Office rooms

- d. Any space where inadvertent lighting shutoff would endanger the occupant.

1. SUBMITTAL REQUIREMENTS

- 1. Submit manufacturer's occupancy sensor layout shop drawings for the Facility Group review prior to installation. These drawings should provide information on the coverage spacing for each occupancy sensor type used.

DIVISION 27 – COMMUNICATIONS

A. OWNER'S DESIGN CRITERIA:

1. ANSI/BICSI N1 - Standard for Installing Building Telecommunications Cabling; National Electrical Contractors Association; 2019.
2. NFPA 70 - National Electrical Code, 2017 Edition; National Fire Protection Association.
3. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2015.
4. TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard; Telecommunications Industry Association ; Rev C, 2009 (with Addenda; 2012).
5. TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; Rev C, 2009 (with Addenda; 2014).
6. TIA/EIA-568-B.3 - Commercial Building Telecommunications Cabling Standard - Part 3: Optical Fiber Cabling Components Standard, and Addendum 1 - Additional Transmission Performance Specifications for 50/125 um Optical Fiber Cables.
7. TIA-569-C - Commercial Building Standard for Telecommunications Pathways and Spaces; Rev C, 2012 (with Addenda; 2013).
8. TIA-606-B - Administration Standard for the Telecommunications Infrastructure; Rev B, 2012.
9. TIA-607-B - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; Rev B, 2012 (with Addenda; 2013).
10. ANSI/J-STD-607 - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications ; Rev A, 2002.
11. GTDM - State of Georgia Telecommunications Design Manual; latest edition.

SECTION 27 0001 – AUDIO VISUAL SYSTEMS

A. GENERAL

1. See Appendix for KSU Audio Visual Equipment Design-Build Requirements.

SECTION 27 1006 – TELCOM/DATA INFRASTRUCTURE REQUIREMENTS

A. GENERAL.

- a. See Appendix for KSU Telecommunications-Data Specifications

SECTION 27 1300 – OUTSIDE PLANT (OSP) CABLING, PATHWAYS, AND COMPONENTS**A. GENERAL**

1. All new building on campus require a fiber connection to the campus loop. Coordinate exact locations with KSU UITs during the Design Development phase.
2. See Appendix for more details on site related fiber requirements.

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

A. OWNER'S DESIGN CRITERIA:

1. NFPA 70 - National Electrical Code, Current Adopted Edition.
2. NFPA 72 - National Fire Alarm Code, Current Adopted Edition.
3. NFPA 101 - Life Safety Code, Current Adopted Edition.

SECTION 28 1000 – ELECTRONIC ACCESS CONTROL SYSTEMS

Please reference Door Access- Exhibit E

SECTION 28 2000 – VIDEO SURVEILLANCE

A. GENERAL

1. Coordinate camera locations with the KSU Public Safety during the Design Development phase.
2. Minimum Recommended Standards
 - a. Entrances/Exits: One camera per location. In the event of a wider than usual entry way, such as an area that has a line of 6+ doors or a divider/column that would impede viewing by a single camera, a second camera should be considered
 - b. Stairwells: One camera per floor per stairwell. Cameras are typically located just outside the stairwell unless there is an emergency exit within, in which case the camera needs to be inside the stairwell and able to view the egress point
 - c. Elevators: Cameras inside elevators for new constructions only. Otherwise, they are located one per elevator lobby, per floor. If there is a divider/column that impedes viewing or elevators on both sides of the lobby, a second camera should be considered
 - d. External:
 - i. Loading Docks: At least one camera per location, unless there are 3+ docking ports or a divider/column that impedes viewing of the entire dock. Number of cameras dependent on visibility challenges and size of loading area
 - ii. Heavy Foot Traffic Areas: One camera per location, dependent on visibility and area being covered
 - e. Others:
 - i. Parking Lots: One camera per vehicle entry/exit point, dependent on lighting and area being covered
 - ii. Cash Registers: If KSU owned, one camera per register. If the registers are directly next to each other, one camera can monitor two registers
 - iii. High Value Physical Assets: one camera at entry points (example: computer lab)
 - iv. High Value Financial Instruments: dependent on layout, generally though a minimum of one camera per: transaction point, internal counting/processing point, and storage location (example: Bursar's Office)
3. Installation Preparation:
 - a. Ethernet cables should be in a conduit anywhere it may be visible
 - b. Exterior conduit should terminate in a weatherproof junction box
 - c. Power source required for cameras greater than 30" from any MDF/IDF

- d. Day/night lighting conditions should be conveyed in project scope

SECTION 28 3100 – FIRE ALARM SYSTEM**A. GENERAL**

1. The KSU Kennesaw and Marietta campus sole source standard for Fire Alarm systems is the Notifier Inspire series that can be integrated with the Connected Life Safety Services (CLSS) platform through the CLSS gateway.
2. Install all new systems according to NFPA 72 and the latest adopted life safety code.
3. Elevator shafts should only use smoke and or heat detection as required by code.
 - a.

SECTION 28 5001 – DISTRIBUTED ANTENNA SYSTEMS

A. EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM (BDA SYSTEM)

1. Provide a Distributed Antenna System (DAS) for any new building that is over 50,000 square feet. This system shall be integrated into the building fire alarm panel.
2. Cobb County is enforcing compliance with IFC 510, which requires any new building over 50,000 square feet to pass a field test when complete that shows good 1st Responder radio coverage through the structure. In order to accomplish this, a Distributed Antenna System (DAS) is required. As of this writing only the Notifier system was UL listed, although other manufacturers may be considered. A sample specification is provided below:
3. Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies as required by the local fire department and other agencies and authorities having jurisdiction. System users shall receive and transmit radio broadcasts from their portable radio units within the building. This shall be accomplished utilizing the following components:
 - a. Bi Directional Amplifiers (Signal Boosters)
 - i. Plenum rated Coaxial Cable
 - ii. Antennas
 - iii. Cable taps
 - iv. Connectors
 - v. Power dividers
 - vi. Other components and interconnecting circuitry as required
 - b. The system shall comply with the requirements of UL2524 1st Edition (pending) In-building 2-Way Emergency Radio Communication Enhancement Systems, NFPA 72 2010 Edition, NFPA 1221 2016 Edition and IFC 2018, as referenced.
 - c. The entire system shall meet with approval of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).
 - d. The work in this section shall include the responsibility for all filings with the AHJ. Where filings require an engineer's signature, documents shall be submitted for his review and signature. This responsibility shall include furnishing required quantities of floor plans, descriptive notes and/or specifications, wiring diagrams, shop drawings and amendment forms.
 - e. Early completion of the in-building emergency radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner

- f. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included as the part of the required work.
- g. The in-building emergency radio communication enhancement system shall use a UL2524 1st Edition (pending), NFPA-72 2010 Edition, NFPA 1221 2016 Edition and IFC 2018 compliant NOTIFIER® signal booster or approved equal.

4. Design requirements

- a. In-building emergency radio communication enhancement systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.
- b. Critical Areas such as emergency command center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 100% floor area radio coverage.
- c. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.
- d. The In-building emergency radio communication enhancement systems must provide the following signal strengths:
 - i. Downlink - Minimum signal strength of -95 dBm throughout the coverage area.
 - ii. Uplink - Minimum signal strength of -95 dBm received at the AHJ Radio System.
- e. The system shall be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.
- f. EC shall sub-contract an approved manufacturer or a qualified and approved vendor to supply, test and determine locations of components which are required for proper operation as well as to supply, deploy, test and certify the performance of the complete system. Vendor qualifications must be acceptable to the AHJ.
- g. All tests shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License. All testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must be acceptable to the AHJ.
- h. The system design shall be based on the NOTIFIER® line of Public Safety Signal Boosters UL2524 1st Edition (pending), NFPA-72 2010 Edition, NFPA 1221 2016 Edition, IFC 2018 Edition and FCC compliant to establish standards of quality for materials and performance. The naming of a specific manufacturer or catalog number does not waive any requirement or performance of individual components described in the specifications.

- i. The assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with all applicable sections of the National Electrical Code.
- j. Survivability from attack by fire shall meet NFPA 72, National Fire Alarm and Signaling Code, 2010 edition and NFPA 1221 2016 edition.
- k. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.
- l. Antenna isolation shall be maintained between the donor antenna and all inside antennas (D.A.S.) to a minimum of 20dB under all operating conditions

5. Technical Specifications and Performance Requirements

- a. The system specified shall be based upon NOTIFIER® line of Public Safety UL2524 1st Edition (pending), NFPA-72 2010 Edition, NFPA 1221 2016 Edition, IFC 2018 Edition compliant signal boosters
- b. The signal booster shall be a Class B Public Safety type as designated by the FCC and as required by the AHJ.
- c. The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA-72, 2010 edition and NFPA 1221, 2016 edition. The signal booster shall have both the primary and secondary power supplies built in a fully sealed NEMA-4 type approved enclosure.
- d. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.
- e. The signal booster shall be set and tuned by the equipment manufacturer to pass frequencies as specified by the local fire department.
- f. To reduce the possibility of unwanted interference affecting the operation of the system, signal boosters shall be band or channel selective type with a maximum 3dB channel bandwidth of 200KHz ($F_c \pm 100\text{KHz}$). Wide-band signal boosters shall not be accepted, unless required to cover multiple channels within the same band.
- g. Signal Boosters shall have oscillation prevention circuitry to protect the public safety radio system in case of signal booster malfunction.
- h. Signal Booster gain shall be rated at minimum of 80dB, and the gain shall be adjustable in a minimum of 25dB range. System gain shall be set and documented at the time of the final system test.
- i. Maximum Propagation delay of the signal booster system shall be 14 μs (microseconds) or as specified by AHJ.

- j. The signal booster system shall include built-in automatic alarming of malfunctions of the signal booster and battery system as per NFPA 1221 2016 Edition Section 9.6, NFPA 72, 2010 Edition, Sections 24.5.2.6.1, and 24.5.2.6.2. Aftermarket equipment add-ons and modifications to comply with this specification will not be accepted.
- k. A dedicated supervised monitoring panel shall be provided within the emergency command center or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
 - i. Normal AC power
 - ii. Signal booster trouble
 - iii. Antenna Failure
 - iv. Loss of normal AC power
 - v. Failure of battery charger
 - vi. Low battery capacity
- l. The signal booster system shall include a built-in NOTIFIER® addressable monitor module for NOTIFIER® Fire Alarm Panel connection for monitoring the signal booster.
- m. The vendor shall verify the system monitoring requirements with the AHJ prior to system installation. System monitoring shall be fully compliant with the AHJ requirements.
- n. External filters, attachments or other aftermarket modifications of the original equipment shall not be accepted.
- o. All signal booster components shall be contained in a NEMA4-type approved waterproof cabinet. All enclosures shall be painted red with signage in bright yellow or as required by AHJ

6. Installation Requirements

- a. Assembly and installation of all components of the Emergency Responder Communication Enhancement System shall comply with all applicable sections of the National Electrical Code, NFPA-70 and the National Fire Alarm and Signaling Code, NFPA-72, NFPA 1221 current enforceable editions.
- b. At least 2 independent and reliable power supplies shall be provided as specified in sections 2 and 3 below.
- c. The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and comply with NFPA-70 National Electrical Code, NFPA 72, National Fire Alarm and Signaling Code, 2010 edition and NFPA 1221 2016 edition.
- d. The emergency responder radio coverage enhancement system shall be equipped with a secondary source of power. The secondary source of power shall be a battery

system with a dedicated battery charger powered by a separate, dedicated twenty (20) ampere branch circuit. The secondary power supply shall supply power automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage enhancement system for a period of at least 24 hours. The battery system shall automatically charge in the presence of external power input. Battery charger and all other electronic components must be fully enclosed in a non-vented NEMA4 Type approved enclosure. Batteries shall be enclosed in a separate, vented NEMA 3R Type approved enclosure.

- e. The signal booster shall be designed to allow degraded performance in adverse conditions, such as high temperatures in the event of heat from a nearby fire, voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) are not acceptable. External UPS (Uninterruptable Power Supplies) are not acceptable. It is the purpose of this specification to assure the maximum possible level of communications to public safety personnel depending upon the signal booster, even to the extent of damaging the signal booster, as long as some communications benefit can be provided during the emergency.
- f. System design shall be such that neither the failure of the normal power source, the transfer to an emergency source, nor the re-transfer to the normal source shall cause a change in system status.
- g. The amplifier shall be housed in a 2-hour fire rated room or other suitable space as approved by the Engineer, or where specifically shown on the drawing.
- h. Radiating cable, if used, shall be run without conduit. All other cable can be run in conduit if required for mechanical protection of the cable or where specified by the electrical engineer.
- i. RF Coaxial Cable shall be a fire-resistant, low-smoke type, U.L. classified as plenum. The classification shall be clearly marked on the outer surface of the cable regular intervals.

7. Acceptance and Test Procedures

- a. Acceptance testing for an in-building radio system is required upon completion of installation.
- b. The coverage testing shall be done in accordance with NFPA 72, National Fire Alarm and Signaling Code, 2010 edition, NFPA 1221 2016 edition and as required by the local AHJ
- c. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.
- d. All test records along with system diagrams, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and other design data shall be submitted upon completion of the project.

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 1313 – CONCRETE PAVING

A. GENERAL

1. Asphalt and concrete pavement must conform to Georgia DOT Standards. Sub-base should be 6" GAB at a minimum.
2. Both walk designs should be built on 95% compacted earth, or suitable granular fill to match.
3. Expansion control and crack jointing shall be tooled in wet concrete, in panels nominally equal to the width of the sidewalk, as a minimum. Saw cutting of joints is not recommended.
4. The vehicular access walks shall be between 10 feet and 12 feet wide.
5. Medium to stiff broom finish, depending on walkway gradient, and perpendicular to path of travel. Apply 'Cure and Seal' or similar application after the concrete is finished. Backfill to grade with topsoil after forms are removed, and straw/seed per landscaping specifications.
6. Porous pavement to be used where appropriate to support storm water mitigation and reduce the campus' impervious surface area.
7. Runoff from the landscape should not cross porous pavement areas to avoid excess sediment build-up.

SECTION 32 1416 – BRICK UNIT PAVING

A. GENERAL

1. Use of permeable pavers are encouraged as appropriate and should be discussed with the PDC Project Team.

SECTION 32 1700 – PAVING SPECIALTIES**A. GENERAL**

1. Street and parking lot layouts shall comply with standards of municipality in which project is located.
2. Select traffic pavement type for specific soil conditions and anticipated loading. Use Georgia Department of Transportation standard pavement specifications.

SECTION 32 3100 – FENCES & GATES

A. GENERAL

1. All chain link fencing should be black vinyl.

SECTION 32 3300 – SITE FURNISHINGS

A. GENERAL

See Appendix.

SECTION 32 8000 – IRRIGATION

A. GENERAL

1. Any irrigation design must be completed by a certified irrigation designer.

B. MANUFACTURERS

1. Rainbird, Maxicom, Hunter compatible, components.
2. Any Maxicom hardware must be installed by a certified installer.

C. LOCATIONS

1. 12-month drip in landscaped areas. Permanent irrigation only as required by project specific programmatic requirements
2. Provide for all landscaped areas
3. Provide drip irrigation in all planting areas against the building.
4. Provide sprinkler for turf grass
5. Fixed spray irrigation using standard 6" pop up sprinklers shall be installed in all annual and perennial beds.
6. Fixed spray or gear driven rotor sprinklers shall be installed in all turf areas. Type of head depends on size of area. Fixed sprays in turf areas must raise 6" minimum above grade.

D. COMPONENTS

1. All isolation valves shall be full port brass valves located inside a 10" valve box.
2. Install within 10" of the main isolation valve, a dual check backflow prevention device (use National Plumbing Code to specify specific type) inside a 12" valve box or suggested size box.
3. Master valve shall be installed after the backflow prevention device using a normally closed valve. This master valve shall be electrically operated with a minimum of #12 LJF wire, blue in color.
4. Flow meter shall be installed after the master valve using the manufacturing installation recommendations. The type of flow meter shall be determined by the designer. Flow meter must have the capability to communicate with the Maxicom Central Control System.
5. Brass quick connects shall be placed around the property allowing for easy access to water.
6. All electric valves shall be installed in a 10" valve box.
7. Communication wire must meet all Maxicom specifications.

8. Controller must have the ability to communicate with the Maxicom Cluster Control Unit, where applicable.
9. Drip irrigation shall be staked to stable ground every 4'.
10. All wire connectors must include a wire nut enclosed inside a waterproof gel.
11. Any above ground irrigation line must be installed using Sch. 40 PVC.
12. Install Sch. 80 PVC under roadways, walkways, etc.
13. All underground PVC irrigation lines shall be installed with a trace wire.
14. Underground sleeves shall be 4" schedule 80 and marked on each side of the concrete.

SECTION 32 9000 – PLANTING

A. GENERAL

1. To the fullest practical extent possible, add soil amendments to planting & turf areas in a manner recommended by KSU Plant Operations Grounds Department.
 - a. Soil amendments on plantings natures helper or black kow composted manure or equivalent organic
 - b. Lime applied at 10#/1000 square ft. As needed to adjust soil ph.
 - c.
2. Provide one (1) year maintenance contract
3. Consultants will provide a Plant List to ensure approval from both the Office of Sustainability and KSU Plant Operations Grounds Department. Refer to Appendix for KSU Preferred Plant List.
4. Do not plant in proximity of underground sewer lines.

B. TURFS AND GRASSES

1. Grass should be replaced between April 1 and September 1 as follows: Match existing turf with Tifton Tifway '419' Bermuda/TifTuf improved Bermuda grass sod or fine blade or medium blade zoysia grass sod. (Annual Rye grass may be used, 400 pounds per acre, only if restoration takes place outside of the above time frame). Match existing mulch with Hardwood Blend dyed Forest Brown (made by Wood Tech).

C. PLANTING ACCESSORIES

See KSU RR Outfitting Standards Appendix

DIVISION 33 – UTILITIES

SECTION 33 0010 – GENERAL UTILITY REQUIREMENTS

A. GENERAL

1. All devices containing significant amounts of oil (electrical transformers, generators, elevator pistons, etc.) to have EPA approved containment to prevent flow into storm drain systems.
2. Design drainage structures and surface runoff to remove water efficiently from the site with proper retention as required. Water runoff to be retained on site with an engineered underground structure with appropriate release rates (if needed). No above ground ponds or weirs are allowed unless approved by Owner in writing.
3. Use PVC outside sewer pipe- except under street or slab use ductile iron, concrete lined.
4. Provide Trace Tape for all underground utilities including fiber optic cable.
5. Street and parking lot layouts shall comply with standards of municipality in which project is located.

END

KSU Design and Construction Standards Appendix Documents

Door Access- Electronic Installation Guide.....	page 2
Audiovisual Design Build Specifications.....	page 7
Telecom/Data Infrastructure Specifications.....	page 43
Construction Waste Diversion Program.....	page 69
R&R Outfitting Standards.....	page 71
Utility Metering Standards.....	page 143
Indoor Environmental Quality Standards.....	page 147
Hot Work Permit Program.....	page 152
Contractor Safety Guidelines.....	page 167



Exhibit E – ELECTRONIC INSTALLATION GUIDE

About This Guide

This document was developed by Kennesaw State University (KSU) Campus Services Door Access as a guide to assist designers and contractors with the installation and wiring of electronic access control systems at KSU. This document serves to supplement official architectural specifications and drawings provided by the University, it does not replace them. In all places where specific part numbers are provided, no substitutions will be accepted without express written permission from the KSU Door Access Hardware Project Manager.

Questions should be directed to:

Brad Mattocks Door Access Hardware Project Manager jbm5141@kennesaw.edu	Russell Langley Director of Door Access rlangle6@kennesaw.edu

Access and Security Systems at Kennesaw State University

KSU uses Salto Systems as the campus standard electronic lock system. As such, many of the access control components are proprietary. Where part names and description indicate *Salto* only these components will function with this system. No substitutions are acceptable for these devices. Other components listed without a *Salto* designation are preferred but not required. All Salto components must be installed by a Salto certified technician. Documentation of the completion of Salto certification testing and completion should be supplied to KSU Door Access via Salto Systems INC.

Part(s) to be Supplied by The Contractor: Specifications should be provided to KSU for approval

Main Building Entrances:

- Salto CU42EOUS Network Controller(s)
- Salto 4200 Door Controller(s)
- Altronix Trove T1SAK3F4, T2SAK7F8, or T2SAK75F12 Power Supply and Enclosure
- Salto WRDB0A4B, WRDB0A4BK (keypad), or WRDB0M4B (mullion) (Card Reader)
- Recessed Door Position Switches: Assa Abloy DPS-M-GY/DPS-W-GY
- Junction Box: Wiegman SC060604RC
- Electronic Power Transfer Hinge: VonDuprin EPT-10
- Door loop (where EPT not applicable): Keedex K-DLA-24
- Exit Device/Crash Bar (where required): VonDuprin RXQEL98
- Plywood backing to mount enclosures (see mounting specs)
- 4x4 (2) straight wire way mounted above and below enclosures (see mounting specs)
- All required conduit (no exposed cabling is permitted)
- Smartwire cabling (Smartwire 4461030 or approved equivalent)



All Other Locations:

- Salto XS4+ wireless offline mortise Lock (building interior doors)
- Salto XS4 mini wireless offline cylindrical/tubular lock (student bedrooms)
- Salto XS4+ Wireless Online Mortise Lock & Gateway3 (building auxiliary entrance, data closets)
 - These locations/lock types require network data drop above door
 - Data drop should be specified in the low voltage plan
- Salto KPP-03/04 Von Duprin wireless interface kit (panic bar integration only)

Mounting Specifications

Each enclosure will have (1x) Salto CU42EOUS network controller and a maximum of (4X) CU4200 Door Controller boards. These boards can be attached to the Trove Enclosure Backplane standoff posts without any modifications. CU42EOUS and CU4200 controllers will be connected VIA RS485 with a minimum 22-gauge wiring. Each controller will terminate to individual fused 12VDC power.

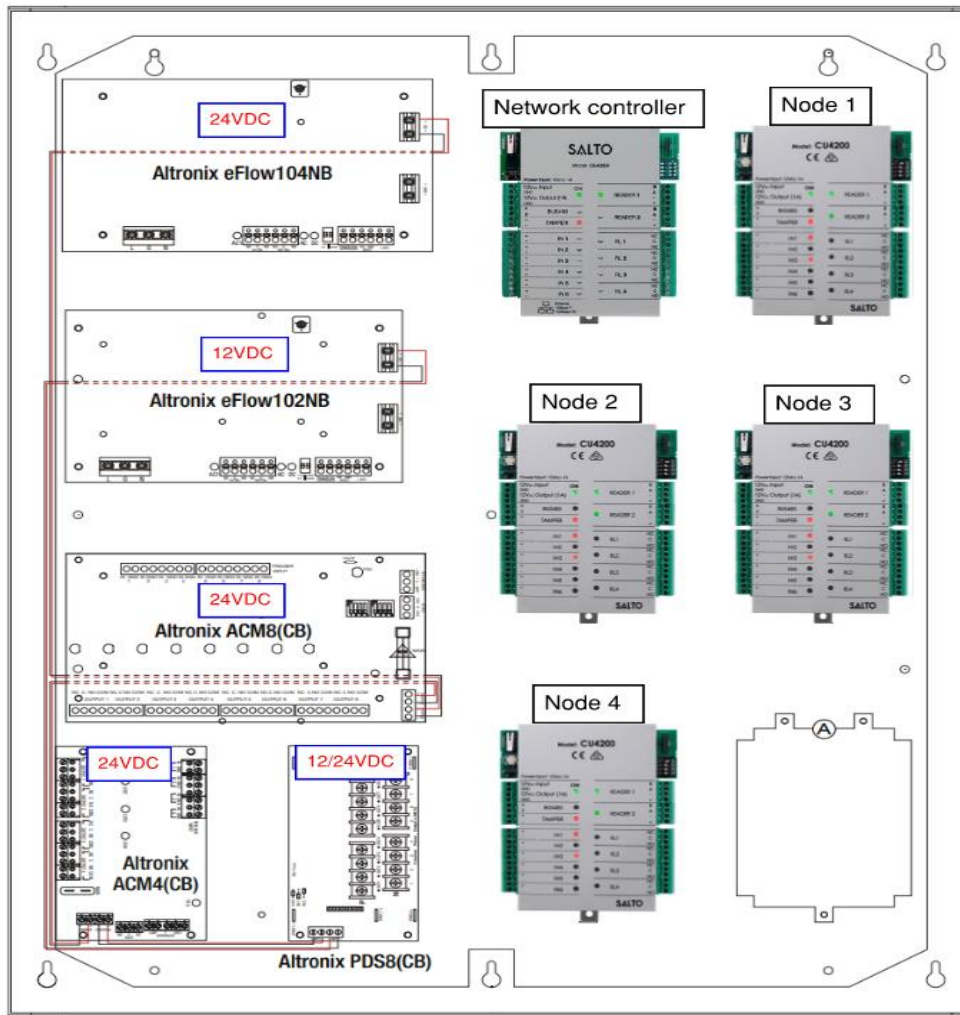
Trove enclosures contain a pre-configured Salto backplate for mounting controllers with no modification needed. Appropriate trove enclosure will be selected based on the number of doors needed for each enclosure. (See below)

Altronix Trove Model	Doors	Dimensions
T1SAK3F4	4	18" x 14.5" x 4.62"
T2SAK7F8	8	27.25" x 21.5" x 6.5"
T2SAK75F12	12	27.25" x 21.5" x 6.5"

Standard Panel Layout and Controller addressing should adhere to KSU standard referenced below.



Fig. 4



All electronic lock components (strike, crash bar, handle, etc.) must be 24VDC, Von Duprin products preferred. All power supplies must have an 8-fused output power distribution block. All card reader doors must have both door monitoring and a request-to-exit (REX) position switch, with a preference for lock components with a REX built-in. All door monitoring position switches installed at double doors are to be wired together as one point. All lock components must be fail-secure. Lock components may not be customized or altered without authorization from the KSU Door Access Department. All power supplies must have battery backup sufficient for 3-4 hours at 100% utilization. All motion sensors and door monitoring position switches are to be unsupervised.

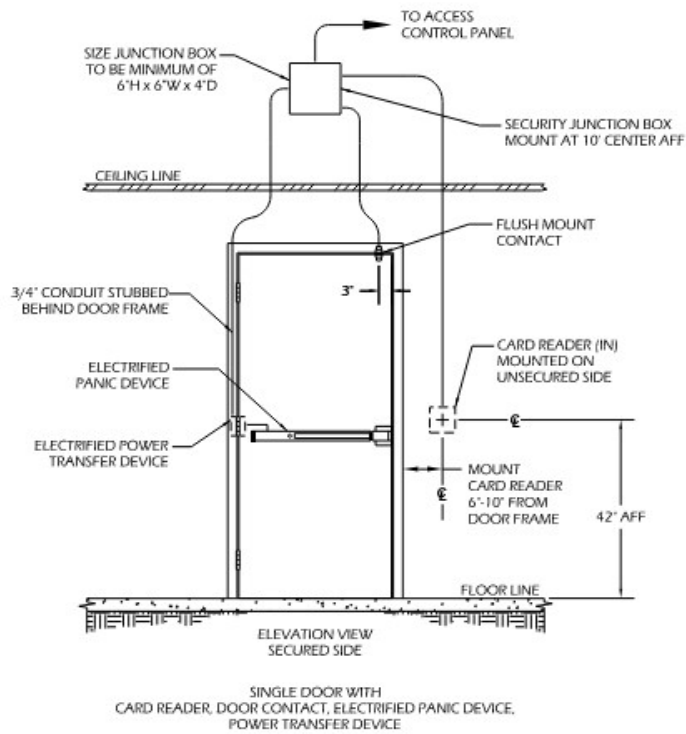
Door Detail Typical(s) provided Below:

Door Position Switch to be recessed 3/4" hole provided. All panic hardware shall have an integrated RX switch. All double-doors must have supplied key removable mullion.



KENNESAW STATE UNIVERSITY

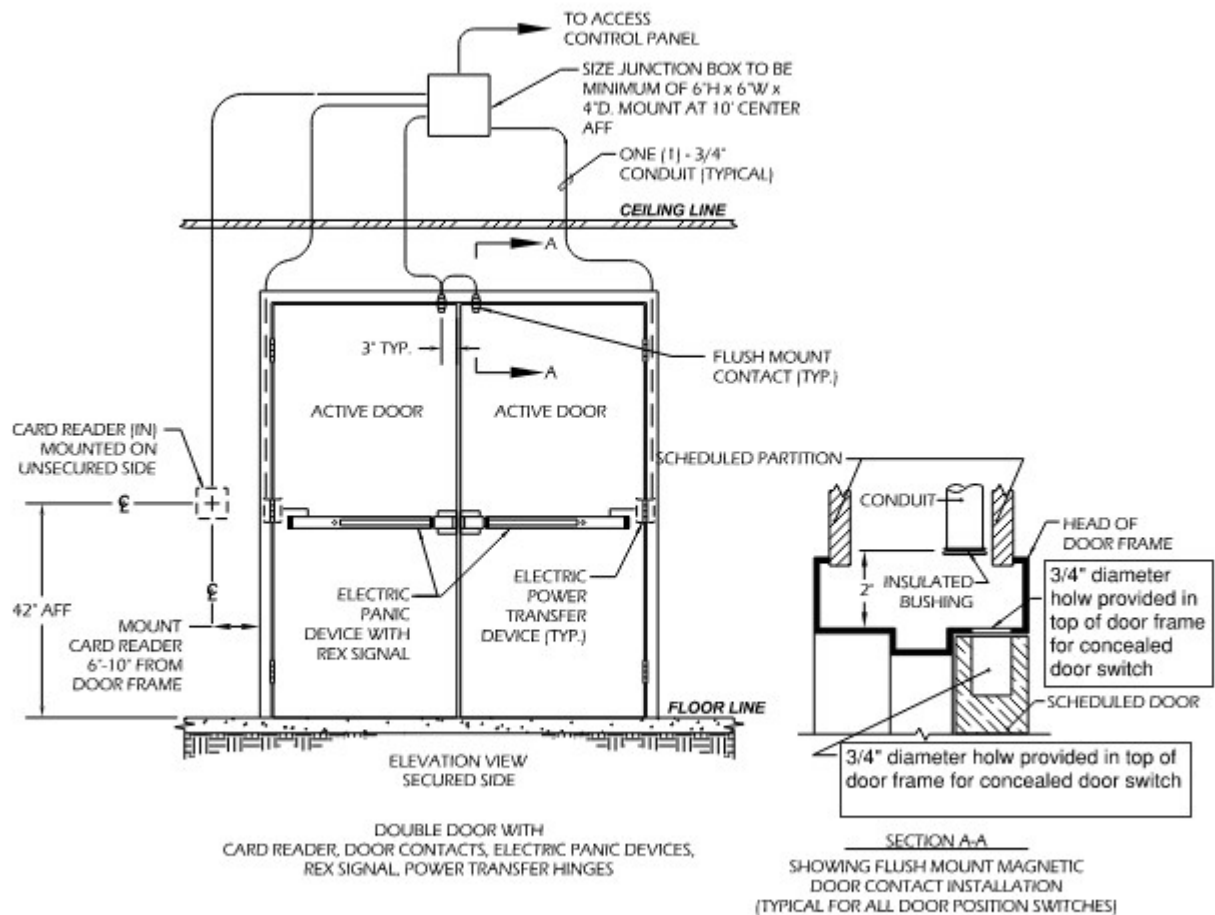
CAMPUS SERVICES
Door Access



DETAIL
NOT TO SCALE

5

SINGLE DOOR DETAIL



DETAIL
NOT TO SCALE

1

DOUBLE DOOR DETAIL



KENNESAW STATE
UNIVERSITY

KSU Requirements

Audiovisual Design Build Specifications

(REVISED 3/21/2024)

For Additional Information Please Contact:

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DESIGN BUILD REQUIREMENTS

KENNESAW STATE UNIVERSITY
AUDIOVISUAL SYSTEMS

Table of Contents for AV Project Requirements	Page
PART 1 - General.....	3
1.1. Background.....	3
1.2. Summary.....	3
1.3. Definitions	4
1.4. Base AV System Requirments	4
1.5. Alternate(s)	4
1.6. Regulatory Requirements	4
1.7. Related Work	4
1.8. References.....	5
1.9. Project/Site conditions	5
1.10. Requirements Specific to Project.....	6
1.11. Submittals	6
1.12. Warranty	8
PART 2 - Products	9
2.1. General	9
2.2. Device Plates.....	9
2.3. Fixed Installation Cable	9
2.4. Pre-Manufactured and Adapter Cables	11
2.5. Connectors.....	12
2.6. Racks, Consoles and Accessories	14
PART 3 - Execution.....	14
3.1. Preparation	14
3.2. Installation.....	14
3.3. Installation and Quality Control	15
Appendix A.....	18
1.1. Demarcation List.....	18
Appendix B.....	19
1.1. AV Weekly Status Report	19
Appendix C.....	21
1.1. AV Room Ready Conditions	21
Appendix D.....	22
1.1. system checkout Notification	22
Appendix F	25
1.1. Submittal Drawing Checklist.....	25

Appendix G.....	27
1.1. Suggested Equipment List.....	27
Appendix H.....	31
1.1. AV Programming and Configuration Guidelines.....	31

PART 1 - GENERAL

1.1. BACKGROUND

The development of any new facility is expected to help support the growing campus population and provide programming activities unique to the Kennesaw State community.

1.2. SUMMARY

- A. The work covered under this Section consists of furnishing all labor, materials and services to design, engineer, and install a complete audiovisual system as shown on the attached documents.
- B. These specifications and associated drawings do not represent a complete design for the AV systems described but are intended to provide minimum guidelines for functionality and quality. The AV integrator shall be fully responsible for final design, engineering and installation.
- C. The Integrator is responsible for assessing the conditions of the job site, and facilities for delivering, storing, placing, handling and installing of materials and equipment.
- D. Failure to assess the site conditions or failure to examine any and all construction documents will in no way relieve the Integrator from the requirement of furnishing all materials and equipment, or performing any work, that may be required to complete the work in accordance with the Construction Documents.
- E. Neglect of above requirements will not be accepted as reason for delay in the work or additional compensation.
- F. The Scope includes but is not limited to:
 - 1. Assessment of the new facility to confirm installed infrastructure will support the requirements of the new systems.
 - 2. Verification and documentation of technical and functional requirements
 - 3. Engineering, design and documentation to produce a fully functional system as per the requirements of the project
 - 4. Equipment and installation labor, including installation of Owner Furnished Equipment (OFE) for a fully functional system.
 - 5. Miscellaneous components, hardware, interconnections and terminations required for proper operation of all systems.
 - 6. AV cable installation within AV equipped room.
 - 7. Off-site rack build-up and system testing.
 - 8. On-site equipment installation, configuration and preliminary testing
 - 9. Final proof of performance testing
 - 10. One year warranty of the equipment and installation
 - 11. Test equipment, tools, ladders, lifts and scaffolding required for installation.
 - 12. Daily and final cleanup of debris caused by installation
 - 13. Complete As-Built Documentation of the system installation

14. AV system user training

1.3. DEFINITIONS

- A. Unless otherwise noted, the term Owner shall refer to Kennesaw State University (KSU) or assigned representative.
- B. Unless otherwise noted, the term Using Agency shall refer to KSU.
- C. Unless otherwise noted, the term Architect shall refer to Hughes Group Architects and/or the architect selected for the final design and build phase of the project.
- D. Unless otherwise noted, the term General Contractor (GC) shall refer to the GC selected for the final design and build phase of the project.
- E. Unless otherwise noted, the term Consultant shall refer to Waveguide Consulting Inc.
- F. Unless otherwise noted, the term Integrator shall refer to the AV Design-Build integrator hired to perform the work described in this statement of AV Requirements.

1.4. BASE AV SYSTEM REQUIREMENTS

- A. Appendix H is a narrative of KSU's AV requirements for this project: Audio Visual Program Report.
- B. AV systems designed for this project shall meet functional requirements as stated in appendix H.

1.5. ALTERNATE(S)

- A. Alternates shall be defined during the design phase to meet budget requirements.

1.6. REGULATORY REQUIREMENTS

- A. All equipment and installations under this contract shall conform to the following:
 - 1. ANSI/NFPA 70 National Electrical Code.
 - 2. ANSI/IEEE C2 National Electrical Safety Code TIA/EIA Standards 568 A (including TSB 67), 569 and 607.
 - 3. IEEE/ANSI 142 1982 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- B. Integrator shall be solely responsible to possess or obtain all permits and certificates required to complete this project.
- C. Integrator and employees shall perform all work in compliance with current Occupational Safety and Health Administration (OSHA) guidelines and regulations.
- D. The system designs shall conform to the following published standards:
 - 1. ANSI/INFOCOMM 1M-2009, Audio Coverage Uniformity in Enclosed Listener Areas
 - 2. ANSI/INFOCOMM 2M-2010, Standard Guide for Audiovisual Systems Design
 - 3. ANSI/INFOCOMM 3M-2011, Projected Image System Contrast Ratio

1.7. RELATED WORK

- A. The Integrator shall coordinate with other trades and interface with other base building systems to ensure proper integration and operation of AV systems. The

Integrator should request from the Owner, General Contractor or Architect complete project design drawings and specifications to coordinate their work with the work of others.

- B. The Integrator shall coordinate with the General Contractor to establish AV room ready dates.
- C. A representative of the AV Integrator shall attend the regular construction meetings at the job site. This representative shall have the authority to make commitments on behalf of the AV Contactor.
- D. Refer to Appendix A for specific system demarcations between the Integrator and other trades.
- E. AV system and control system software.
 - 1. Integrator shall load software and configuration files into all programmable AV and control system devices.
 - 2. Integrator shall set up and configure all programmable AV and control system devices as specified in Paragraph 3.3.

1.8. REFERENCES

- A. InfoComm International; AV Installation Handbook - The Best Practices for Quality Audiovisual Systems, copyright 2008.
- B. IEEE 802.11G/802.11B Wireless Site Survey by AMX Corporation: Guide for Performing a Site Survey:
www.amx.com/techsupport/Applications/Wireless_Site_Survey_GuideAdobe.pdf
- C. Guide for Performing a Wireless Site Survey 2.4 GHz IEEE 802.11g/802.11b/802.15.4 by AMX Corporation:
www.amx.com/assets/whitePapers/AMX.Wireless.Site.Survey.Guide.pdf

1.9. PROJECT/SITE CONDITIONS

- A. Refer to the general construction documents for this project for coordination with other trades on this project.
- B. Coordinate all access to the site at all times with the General Contractor and the Owner.
- C. Adhere to the safety standards established by the General Contractor and the Owner while performing work on site.
- D. All employees of the Integrator shall wear identification clearly indicating the Integrator's company while on site.
- E. All employees of the Integrator shall comply with rules and policies established by the Owner.
- F. All vehicles of the Integrator or employees shall be parked in areas designated by the Owner.
- G. Store equipment in a manner that will not interfere with others. Coordinate secured storage at the site with the General Contractor and the Owner.
- H. Do not install equipment in any space not designated by the General Contractor as "AV room ready".
- I. Protect all work and equipment installed under this contract from damage by others.

- J. Protect all existing work in place by others from damage by the Integrator, the Integrator's agents/sub Integrators, or any employees, agents or sub Integrators of the Integrators vendors. The Integrator will be solely responsible for any/all damage to work in place by others.
- K. Keep areas around and inside of each piece of equipment and each rack free from dust, dirt and debris throughout the project. Equipment that is not properly maintained during installation shall be replaced at no cost to the Owner before final payment is made to the Integrator.
- L. All equipment and materials stored at the Integrators facility(s) or stored and/or installed at the project site will remain the property of the Integrator unless ownership is specifically assumed in writing by the Owner. The Integrator shall be solely responsible for the protection of all equipment from damage, theft or vandalism regardless of cause, until ownership is specifically assumed in writing by the Owner or the work described herein is accepted by the Owner at the time of official turnover.

1.10. REQUIREMENTS SPECIFIC TO PROJECT

- A. Refer to specific project requirements provided by the Owner and/or Construction Manager.

1.11. SUBMITTALS

- A. General – refer to submittal requirements in general conditions division 1.
- B. Weekly Status Reports:
 - 1. The Integrator shall provide weekly status reports to the owner using the "Weekly Status Report" form noted in Appendix B.
 - 2. Weekly status reports shall be provided at least one business day prior to each weekly Owner's meeting from the date of the Letter of Intent to Award until the Contract Closeout.
 - 3. These reports shall be provided to the Owner and Construction Manager or General Contractor via email.
 - 4. The Weekly Status Report shall not be used as an official means of communications. It does not replace any part of a submittal, request for information, proposed change order, report of field conditions, schedule issues, etc. No official response will be given to the Weekly Status Report.
- C. Project Plan Submittal:
 - 1. Submit project team list. Include names and all contact information (email address, cell phone, etc.) for the Integrator's Project Manager, Lead Engineer, Lead Installer and any other pertinent team members. Include names and contact information for all sub-contractors.
 - 2. Project schedule
 - a. Integrator shall revise and keep the schedule current and accurate throughout the project and shall publish updated schedules as required
 - b. Include shop rack assembly, on-site cable installation, all staging, on-site equipment installation and all Owner visits.
 - c. Schedule shall be coordinated with the general construction schedule and shall include the General Contactor's anticipated AV room ready dates.
 - d. Schedule shall meet the anticipated first use of the Owner with adequate time allowed for setup, verification and punch list correction of all systems.

- e. Indicate the sequence and anticipated dates of acquisition of major equipment and installation milestones.
 - f. Indicate the sequence of installation and completion by room and/or system.
 - g. Work shall not commence without the approval of the General Contractor and the Owner.
3. Include the following milestones in the project schedule.

Milestone / Deliverable

Notice to Proceed

Project Plan Submittal

Preliminary System Design Owner Review

Full Project Design Owner Review

Substantial Completion Check out - punch list
Phase 1

Final Completion Punch out Phase 1

Staff Training Phase 1

First Use Phase 1

Phase 1 Closeout

Substantial Completion Check out - punch list
Phase 2

Final Completion Punch out Phase 1

Staff Training Phase 2

First Use Phase 2

Contract Closeout

D. Project Record Documents Submittal

1. Within 14 days following Final Project Verification, the Integrator shall submit complete Project Record Documents.
2. Project Record Documents shall consist of:
 - a. Record Drawings.
 - 1) Drawings shall show the actual "As Built" condition of all AV systems.
 - 2) All calculated figures shall be replaced with field verified values.
 - 3) All equipment "as left" settings and adjustments shall be indicated on drawings.
 - 4) Coordinate with owner for additional requirements

- b. Product Information Binders shall consist of the following information, with section dividers.
 - 1) Title page and table of contents.
 - 2) Warranty Statement
 - 3) Coordinate with owner for additional requirements

1.12. WARRANTY

- A. Provide warranty repair or replacement for one year on all products provided by the Integrator (including products having a manufacturer's warranty of less than one year) and all Integrator workmanship at no additional cost, except in case of obvious abuse. Consumable items such as lamps, batteries, tapes, etc. are not covered.
- B. During the warranty period the Integrator shall:
 - 1. Provide telephone support within 1 hour of a call requesting service when such call is made during Integrator's normal hours of business.
 - 2. Provide on-site support within 24 hours of a call requesting service that was not corrected by telephone support.
 - 3. Repair or replace faulty items within 72 hours of on-site service or within manufacturers' specific repair program whichever is quicker.
- C. The Warranty Period will commence no sooner than the date of first beneficial use by the Owner or Using Agency (whoever is first) and no later than the date of Contract Closeout.

PART 2 - PRODUCTS

2.1. GENERAL

- A. Suggested Products are listed below and in Appendix G and establish minimum functionality and quality for the AV systems.
- B. B-stock, previously installed, refurbished or used equipment shall not be provided on this project.
- C. All products shall be new and under warranty at the time of installation.
- D. The Integrator shall provide all options, accessories and hardware necessary to meet the function of the design even if they are not specifically listed (e.g., rack mount kits, separate or additional power supplies, input modules, transformers, etc.).
- E. The Integrator is solely responsible for the completeness and accuracy of the system design and equipment specified.
 - 1. The attached Suggested Equipment List is the Consultant's good faith effort to provide examples of AV equipment based on the owners requirements.
 - 2. Determination of final equipment and quantities to meet the function described in appendix H shall be the sole responsibility of the Integrator.

2.2. DEVICE PLATES

- A. Wall / Floor/ Ceiling Mounted Device Plates:
 - 1. All plates shall be sized to cover the mounting box and rough opening.
 - 2. All text and graphics shall be engraved.
 - 3. Finish to be approved by Architect.
 - 4. Provide blank plates with approved finish for ALL AV System wall, floor and ceiling boxes that do not have receptacles.
- B. Rack Mounted Panels
 - 1. All text and graphics shall be engraved.

2.3. FIXED INSTALLATION CABLE

- A. General:
 - 1. Following are cable types for fixed installation within the base building raceway and within fixed AV equipment racks. Unless specifically noted elsewhere, these are NOT acceptable for user interface cables used in lecterns/ credenzas or for connection of portable equipment.
 - 2. Do not exceed cable manufacture's pull-force or bend radius recommendations.
 - 3. All cable used on this project shall be rated for plenum use unless specified otherwise.
 - 4. All speaker cable shall be sized by the Integrator to produce less than 1dB of loss in the speaker/cable circuit.
 - 5. All video cable shall be sized by the Integrator to meet the criteria listed in Paragraph 3.3.
 - 6. Integrator shall select the UTP cable type (Cat 5, Cat5e, Cat6, "media"/"low skew", etc.) for correct operation of AV over UTP equipment.
- B. Audio and/or Video over "media" installed UTP cable (NOTE: not for use in EIA/TIA rated applications): Four pair, solid conductor, #23 AWG UTP.

1. Extron XTP DTP 24P/1000 Plenum Rated
 2. Comparable product by Belden, Liberty, West Penn.
- C. Audio or Video over UTP portable patch cable: Four pair, stranded, #23 AWG UTP.
1. Liberty 24-4P-P-L5-* (* = color designator)
 2. Comparable product by Belden, Comm/Scope, West Penn.
- CI. EIA/TIA rated Category 6 UTP: Four pair, solid conductor, #23 AWG UTP.
1. Liberty 24-4P-P-L6-* (* = color designator)
 2. Comparable product by Belden, Comm/Scope, Extron, West Penn.
- CII. AMX or Crestron Control Cable: Two pair - one pair shielded, one pair unshielded. Unshielded pair #18 AWG; shielded pair #22 AWG. NOTE: Also acceptable for use within lecterns.
1. Liberty AXLINK-P
 2. Comparable product by West Penn Wire, Belden.
- CIII. Mic or Line Level Signal: Single twisted pair, overall shield, #22 AWG.
1. Liberty 22-2C-PSH-WHT
 2. Comparable product by West Penn Wire, Belden, Gepco.
- CIV. Mic or Line Level Signal with Pair for Contact closure: Two pair- one pair shielded, one pair unshielded. Both pair #22 AWG.
1. Liberty 22-2P-PINDSH-WHT
 2. Comparable product by West Penn Wire, Belden, Gepco.
- CV. Speaker Level: 18/2 UTP with overall jacket.
1. Liberty 18-2C-TTP-* (* = color designator)
 2. Comparable product by West Penn Wire, Belden, Gepco.
- CVI. Speaker Level: 14/2 UTP with overall jacket.
1. Liberty 14-2C-TTP-* (* = color designator)
 2. Comparable product by West Penn Wire, Belden, Gepco.
- CVII. Speaker Level: 12/2 UTP with overall jacket.
1. Liberty 12-2C-TTP-* (* = color designator)
 2. Comparable product by West Penn Wire, Belden, Gepco.
- CVIII. Speaker Level: 10/2 UTP with overall jacket.
1. Liberty 10-2C-TTP-WHT
 2. Comparable product by Belden.
- CIX. Wireless Mic Antenna Coax Cable (less than 75'): RG-58/U
1. Liberty RG58-CMP-WHT
 2. Comparable product by West Penn Wire, Canare, Gepco, Comm/Scope.
- CX. Base Band Video Cable: RG-59/U
1. Liberty RG59-CCTV-PL-WHT
 2. Comparable product by West Penn Wire, Belden, Canare, Gepco, Comm/Scope.
- CXI. CATV, MATV, or CCTV Trunk Line: RG-11/U Quad Shield
1. Liberty RG11-QUAD-PL-WHT

2. Comparable product by West Penn Wire, Canare, Gepco, Comm/Scope.
- O. CATV, MATV, or CCTV Drop Line: RG-6/U Quad Shield
 1. Liberty RG6-QUAD-CMP-WHT
 2. Comparable product by Belden, Canare, Gepco, West Penn Wire, Comm/Scope.
- P. Super High Resolution RGBHV Cable: Five (5) RG-59 super high resolution coax cables, in an overall jacket.
 1. Liberty RGB5C-20-CMP
 2. Five (5) Liberty 20-CMP-VID-COAX
 3. Comparable product by West Penn Wire, Belden. Canare, Gepco, Comm/Scope
- Q. Miniature High Resolution Cable: Five (5) miniature high resolution coax cables, in an overall jacket, terminated with BNC connectors. NOTE: This type cable is a high loss cable.
 1. Liberty RGB5C-25-CMP
 2. Comparable product by Extron, Belden, Canare, Gepco, West Penn Wire, Comm/Scope
- R. AES3: Single twisted pair, overall shield, #24 AWG, Non-Plenum.
 1. Liberty 24-*P-P-DIG-AUDIO
 2. Comparable product by Belden, Canare, Gepco, West Penn Wire, Comm/Scope
- S. HD, SDI, and video tie lines: RG-6/U
 1. Belden 1695A
 2. Comparable product by Liberty, Extron, Canare, Gepco, West Penn Wire, Comm/Scope
- T. General Control Cable: Plenum rated, AWG, number of conductors, pairs and/or shield depending on specific control function (e.g., IR, RS 232, RS 422, dry closure, etc.).
 1. Liberty model # as required to meet functionality
 2. Comparable product by Belden, Gepco, West Penn Wire, Comm/Scope
- U. Lectern, credenza, cart and portable cables:
 1. Use highly flexible, pre made or molded cables.
 2. Select AWG, number of conductors, pairs and/or shield as required depending on specific function.
 3. Acceptable Manufacturers: Bi Tronics, HOSA, Mogami, Extron, Canare, MarkerTek, Tek Net, Comprehensive or HAVE.
- V. Additional cable types as required. Cable type shall be approved by the Owner prior to use.
- 2.4. PRE-MANUFACTURED AND ADAPTER CABLES
 - A. HDMI Cables: Male to Male. Lengths as required.
 1. C2G Performance Series Ultra Flexible
 2. Comparable product by Extron.

2.5. CONNECTORS

- A. 1/4 Inch Cable Connectors: Non long frame type.
 - 1. Neutrik "NP" Series
 - 2. Comparable product by Switchcraft.
- B. BNC Cable Connectors: 3 piece, true 75Ω crimp type.
 - 1. Acceptable manufacturers: Kings, Liberty, Extron, Canare, ADC, Trompeter, Cambridge
 - 2. Connector shall be compatible with cable type.
- C. F Cable Connectors: True 75Ω crimp type.
 - 1. Acceptable manufacturers: Gilbert, Trompeter, T&B
 - 2. Connector shall be compatible with cable type.
- D. Loudspeaker Cable Connectors: 4 or 8 pole.
 - 1. Neutrik Speakon NL4FC or NL8FC
 - 2. Comparable product by Switchcraft.
- E. IHF (RCA) Audio Cable Connectors: For all IHF (RCA) audio jacks, gold center pin, spring type strain relief.
 - 1. Canare F 09
 - 2. Comparable product by Switchcraft.
- F. IHF (RCA) 75Ω Video Cable Connectors: For all IHF (RCA) video jacks.
 - 1. Canare RCAP C series
 - 2. Comparable product by Trompeter
 - 3. Connector shall be compatible with cable type and shall be installed using factory approved tool and die.
- G. XLR Cable Connectors: Number of pins as required.
 - 1. Black shell with gold pins, unless otherwise noted.
 - 2. Neutrik "XX" series
 - 3. Comparable product by Switchcraft
- H. 1/4 Inch Panel Connectors: All conductors shall be insulated from panel.
 - 1. Neutrik "NJ" series
 - 2. Comparable product by Switchcraft

- I. Recessed BNC Panel Connectors: Shield shall be insulated from panel, shell finish to match adjacent surfaces.
 - 1. Neutrik NBB75DFIB
 - 2. Comparable product by Canare
- J. Non-recessed BNC Panel Connectors: Shield shall be insulated from panel, shell finish to match adjacent surfaces.
 - 1. Neutrik NBB75FI
 - 2. Comparable product by Canare (with insulating washers) for floor boxes (non recessed).
- K. Recessed F Panel Connectors: Feed thru type, female to female. Shield shall be insulated from panel.
 - 1. Canare FJ JRU
 - 2. Comparable by Trompeter, ADC.
- L. Non-recessed F Panel Connectors: Feed thru type, female to female. Shield shall be insulated from panel.
 - 1. Canare FJ JR
 - 2. Comparable by Trompeter, ADC.
- M. Loudspeaker Panel Connectors: 4 or 8 pole.
 - 1. Neutrik Speakon NL4MP or NL8MP
 - 2. Comparable product by Switchcraft
- N. IHF (RCA) 75 Ohm Video Panel Connectors: Shield shall be insulated from panel. Color code as shown on the Drawings.
 - 1. Canare RJ RU
 - 2. Comparable product by Switchcraft.
- O. RJ 45 Panel Connectors: Recessed Cat 5 or Cat 5e compliant, 8 contacts, Latch hook Retention of RJ45 plugs, 110 Punch down IDC terminals on rear.
 - 1. Neutrik NE8FAV Y110
 - 2. Comparable product.
- P. XLR Panel Connectors: Black shell, gold pins.
 - 1. Neutrik "D" Series
 - 2. Comparable product by Switchcraft.
- Q. 3.5mm (1/8") Cable Connectors: Mini TRS for balanced mono audio or unbalanced 2 channel audio.
 - 1. Canare F-12
 - 2. Comparable product by Switchcraft.
- R. BNC Terminators: 75Ω, 1%.
 - 1. Canare BCP *
 - 2. Comparable product by Trompeter, ADC.
- S. Electrical/Electronic Hardware: Telco 66 type punch blocks are not acceptable. All materials located in plenum spaces must be plenum rated.
 - 1. Terminal barrier strips - provide marker strips
 - a. Phoenix UK

- b. Comparable product by Cinch, Beau.
- 2. Split ring punch block - provide marker strips
- 3. ADC ICON series
- 4. Comparable product by AVP, Switchcraft.

2.6. RACKS, CONSOLES AND ACCESSORIES

- A. All accessories shall be from the same manufacturer as the rack enclosure.
- B. Provide the following accessories for each rack provided.
 - 1. Side panels for each individual rack or for end racks of each group of racks.
 - 2. Fan tops to provide proper ventilation and solid rear door.
 - 3. Grounding stud in top rear of rack.
 - 4. Full height rear mounting rails
 - 5. Full height solid copper bus bar bonded to rack.
 - 6. Rack work light.
 - 7. Horizontal lacing bars (as required).
 - 8. Blank Panels as necessary to close front of rack.
 - 9. Vents, blowers, fans and fan packs as necessary to properly dissipate heat.
 - 10. Power distribution as required.
 - 11. Caster base as dictated by field conditions.

PART 3 - EXECUTION

3.1. PREPARATION

- A. Provide written notification to the Architect, GC and Owner of any problems impacting the Integrator's work. Failure of the Integrator to notify the Architect, GC and Owner in a timely manner of incomplete, inadequate, unfinished, or otherwise unacceptable pre requisite work by other trades in the base building infrastructure will not relieve the Integrator of the responsibility to complete the work under this contract.

3.2. INSTALLATION

- A. General:
 - 1. All equipment and enclosures described in this specification shall be installed plumb and square unless specifically detailed otherwise.
 - 2. All equipment, except that designated as movable, portable or loose equipment, shall be secured and permanently attached to racks or structure in a manner which will require the use of a tool (e.g., screw driver, nut driver, etc.) for removal.
- B. Equipment Racks, Consoles, Conduit, and Raceways
 - 1. Provide 1-1/4" EMT stubs, with insulated bushings to protect cable, into the above ceiling area for routing cable into equipment racks.
 - 2. Provide 1-1/4" EMT or ENT stubs to controller, input plate, or display back-box locations, with insulated bushings to protect cable, into the above ceiling area.
 - 3. Do not exceed 40% conduit fill. If fill level is exceeded, add additional 1" EMT or ENT. In cases where location is specified to be a 1-gang box, increase box size to accommodate number of conduit stubs.
- C. Labeling
 - 1. General

- a. Label type, text and graphics shall be approved by the Owner before fabrication of labeling, plates or other labeled items.
- b. All labels shall be legible.
2. Provide text/graphics engraved directly on receptacle plates, panels, and rack panels when specified.
3. For all installed wiring provide permanent labels.
 - a. Wire labels shall be one of the following types
 - 1) Self-adhesive label under clear heat shrink,
 - 2) Direct printed heat shrink
 - 3) Direct printed, self-adhesive, self-laminating
 - b. Provide wire labels on both ends of cable.

3.3. INSTALLATION AND QUALITY CONTROL

A. General

1. The Integrator shall plan for the following shop or site visits by the Owner:
 - a. Substantial Completion – Punch List Creation
 - b. Final Completion – Punch List Check-off
 - c. Training

B. System Requirements

All systems shall be designed and configured to the following criteria.

1. Audio
 - a. The Integrator shall adjust all AV sources to provide source to source variation of less than 3dB SPL (measured A-weighted slow).
 - b. Signal to noise ratio of the any complete audio path shall be greater than 60dB.
 - c. Total harmonic distortion of any complete audio path shall not exceed 0.1% Set the audio system to provide seat to seat variation of +/-4dB in the 2kHz octave band (measured A-weighted slow).
 - d. Audio path shall maintain absolute system polarity such that:
 - 1) Positive acoustic pressure at the front of all microphones creates a positive voltage at the positive terminal of all line outputs and a positive acoustic pressure at all loudspeakers.
 - 2) Positive voltage at the positive terminal of all line inputs creates a positive voltage at the positive terminal of all line outputs and a positive acoustic pressure at all loudspeakers.
2. Video
 - a. Set the brightness and contrast of displays using a pluge test or similar test pattern.
 - b. Setup color of displays using color bar test pattern.
 - c. Set displays to accommodate all anticipated display source resolutions.
 - d. Set projectors to accommodate all anticipated display source resolutions.
 - e. 4:3 and 5:4 aspect ratios presented on a 16:9, 16:10, or 15:9 display shall fill the screen height. This shall be accomplished with no external or internal scaling or stretching.
 - f. A display generated test pattern shall fill the screen and be plumb, square, and true.

- g. Video signals passing through UTP transmitters and receivers, computer interfaces, and other video processing equipment shall be adjusted so that the signals appear identical to signals directly connected to the display.
 - h. Set the outputs of scalers and scaling switchers to accommodate the anticipated resolutions to be used by the owner.
 - i. Set transition effects, switching modes, picture-in-picture (PIP), or other scaler/switcher display and codec settings as directed by Owner. Projected images shall be in focus, free of any keystone (no digital keystone allowed), free from any obstruction.
 - j. All images shall be free from ghosting or smearing.
 - k. Analog RGBHV signal amplitude through any signal path shall not exceed +/-3dB across the operational bandwidth up to 450 MHz.
 - 1) Cable type shall be selected to meet this requirement
 - 2) Video line drivers or peaking amplifiers shall be added only when signal loss due to cable length exceeds this requirement and cannot be corrected by selecting a lower loss cable.
 - 3) Video line drivers or peaking amplifiers shall be adjusted to provide the least amount of correction to bring the signal within this requirement.
3. Control Systems
- a. Control system shall be fully connected and communicating with all controllable devices.
 - b. Control system program shall be loaded and functional. Control system program shall be loaded into all controllable devices including touch panels.
 - c. Control of building or environmental systems shall be fully functional. All controllable devices and systems shall be controllable from the control system touch panel or button panel.
 - d. Control system graphic interfaces shall conform to the recommendations made by the ICIA working committee "Dashboard for Controls."
4. RF Systems
- a. RF system shall be free of noise and crosstalk
 - b. RF level at lowest and highest rated system channel shall be between +6dBmV and +12dBmV.
5. AV Wireless Ethernet
- a. Perform a wireless site survey to identify existing active wireless access points in the area along with channel allocations, SSID information and Security Information and determine the number and placement for additional types (802.11a, 802.11b/g, 802.11i, etc.) of access points, gateways and repeaters necessary to provide proper coverage and network performance throughout the facility for the wireless Ethernet devices in the system.
 - b. Develop and recommend a channel allocation map with non-overlapping channels for each area within the buildings to maximize wireless network performance.
 - c. Procedures for the wireless site survey are referenced in Paragraphs 1.8.C.

C. Substantial Completion

1. All AV systems that are a part of this project shall be completely installed and functional.
2. The Owner will create a punchlist of deficiencies that must be corrected by the Integrator as directed by the owner.

D. Final Completion

1. All items listed in the punchlist created during the Full Project Verification shall be corrected.
2. The Integrator shall demonstrate that all items in the punchlist have been corrected.

E. Training

1. The Integrator shall train designated representatives of the Owner and the Using Agency in the proper operation of the AV system.
2. Prior to training, the Integrator shall work with the Owner and/or Using Agency to develop a detailed training plan.

Appendix A

1.1. DEMARCATION LIST

- A. General: This Appendix Describes demarcation points in the Work to determine where the Integrator's responsibilities end in the specific instances noted below.
- B. Electrical System Connections: The Integrator shall coordinate with the General Contractor to extend the equipment rack AC power circuits and insulated ground wires into each equipment rack.
- C. Raceway (conduit and backboxes): The Integrator shall provide blank plates or panels for all AV floor, wall and ceiling boxes that are shown on the drawings, but do not have AV devices and/or connectors at this time. Colors and types shall be coordinated with the Architect. Devices and plates for other trades (HV power, voice/data, security, etc.) within the AV floor boxes are by others.
- D. Cabling: All audio, video and control cabling shall be provided, installed and terminated by the Integrator as noted on the Integrator's Construction documents. Voice/data cabling, unless specifically noted otherwise, are the responsibility of others.
- E. Cable Termination: Where cable installation is required, this will include wall and/or floor jacks, plates and terminations at room devices, and service loops at patch bay locations.
- F. Monitor Mounts: The Integrator shall install all monitor mounts as indicated on the approved shop drawings. Integrator shall verify location and structural suitability before attaching monitors and mounts.
- G. Custom Millwork & Furniture: AV equipment designated to be installed into custom millwork and/or furniture must be coordinated closely with the GC, the Architect, millworkers and the furniture suppliers. Where holes or other modifications to the millwork or furniture are required to support AV equipment installation, the Integrator shall document the complete requirements for modifications to be made by others. Documentation provided by the Integrator shall consist of drawings, sketches, product cutsheets and any other material required to clearly identify the complete requirements, including, but not limited to, equipment attachment, cable management, ventilation/cooling, electrical power distribution, etc.
- H. Any holes or other modifications to millwork or furniture provided by the integrator are the responsibility of the integrator.

Appendix B

1.1. AV WEEKLY STATUS REPORT

- A. The following form is the “AV Weekly Status Report”. The Integrator shall provide weekly status reports in this format or an equivalent format approved by the Owner.

AV WEEKLY STATUS REPORT

WEEK OF: _____

AV INTEGRATOR: _____ BY: _____

CLIENT / PROJECT NAME: _____

ROOM NAMES / NUMBERS: _____

Provide a summary for each of the following areas. Use additional sheets as needed.

General:

Purchases:

Assembly:

Field Conditions:

Issues of Concern:

Appendix C

1.1. AV ROOM READY CONDITIONS

- A. Before installing AV equipment on site, the following conditions must be met for each space where AV equipment is to be installed.
 - 1. All water piping completely installed and tested
 - 2. Dirt and dust sources removed. HVAC running with filters in place and AV-rooms "broom-clean"
 - 3. Major construction activities completed, especially activities that may create physical damage to equipment or racks such as:
 - a. Overhead work that may cause debris or dust
 - b. Chemical work such as concrete cleaning and finishing
 - c. Welding or grinding
 - d. Activities that may cause excessive vibration
 - 4. Building systems and finishes
 - a. Ceiling work completed (ceiling tiles installed, lighting installed and operational)
 - b. Shades and screens installed and operational
 - c. Floor finish installation complete
 - d. Wall treatments complete
 - 5. Security
 - a. AV areas secure
 - 1) Equipment, rack and tool storage
 - 2) Staging and work area for final assembly work on racks or in furniture and millwork
 - 3) Equipment installation areas that are not yet turned over to the owner
 - b. Keys provided to AV integrator with limited distribution
 - c. Security badges and clearances obtained for all on-site personnel
 - d. Corporate Privacy or Government Security non-disclosure agreements properly executed
 - 6. AV system infrastructure
 - a. AV field cabling pulls complete
 - b. All AV construction related items completed
 - c. All AV power wiring in place, tested and on
 - d. All millwork and furniture containing AV equipment in place
 - e. System interfaces installed (lighting, screens, motorized drapes, etc.)
 - f. Cabling by others in place (data/telecom, cable TV, fiber)
 - g. Lighting installed and available for use in AV spaces
- B. Before adjusting AV equipment to meet the conditions in Paragraph 3.3, C, the following conditions must be met, in addition to the items listed above, for each space where AV equipment is to be installed.
 - 1. Cable Services live
 - 2. IT Services live

Appendix D

1.1. SYSTEM CHECKOUT NOTIFICATION

- A. The following text shall be used to notify the Owner that the specified rooms or project is ready for checkout.
- B. One letter of notification is required for each of the following:
 - 1. Full Project Verification (Substantial Completion), Paragraphs 1.11, I. and 3.3, D.
 - 2. Final Project Verification, Paragraphs 1.11, K., and 3.3, E.
- C. The Integrator shall copy or retype the text of the following letter onto the Integrator's letterhead and fill in or select the appropriate text.
- D. See sample letter at the end of Appendix D.

This letter serves as notification to Kennesaw State University that (insert Integrator's name) has completed the required setup and is ready for (select one of the following: Full Project or Final Project Check Out).

(Insert Integrator's name) acknowledges that all rooms and systems specified for this staging or verification meet all specified installation and setup requirements.

Printed name of Project Manager

Signature of Project Manager

Date

(Insert Integrator's name) acknowledges that incomplete systems or failure to complete the room setup as specified prior to the Owner arriving for staging or verification will result in additional trips for the Owner.

(Insert Integrator's name) acknowledges that (Insert Integrator's name) will be financially responsible for all additional fees and expenses associated with these trips.

As (Insert Integrator's name) duly authorized representative, I have read and agree to this agreement.

Printed name of signatory

Signature

Date

SAMPLE NOTIFICATION LETTER

AACMEE AV INTEGRATION
123 Avenue Street
Anytown, State

This letter serves as notification to Kennesaw State University that AACMEE AV INTEGRATION has completed the required setup and is ready for Full Verification.

AACMEE AV INTEGRATION acknowledges that all rooms and systems specified for this staging or verification meet all specified installation and setup requirements.

Printed name of Project Manager

Signature of Project Manager

Date

AACMEE AV INTEGRATION acknowledges that incomplete systems or failure to complete the room setup as specified prior to the Owner's arriving for staging or verification will result in additional trips for the Owner.

AACMEE AV INTEGRATION acknowledges that AACMEE AV INTEGRATION will be financially responsible for all additional fees and expenses associated with these trips.

As AACMEE AV INTEGRATION's duly authorized representative, I have read and agree to this agreement.

Printed name of signatory

Signature

Date

Appendix F

1.1. SUBMITTAL DRAWING CHECKLIST

A. FORM (ALL SHEETS)

1. Submittal copy quantity requirements satisfied
2. Submittal content satisfied
3. Adequate sheet size for drawing
4. All notes and other text legible throughout the drawing set
5. Contact info for each responsible party (architect, owner, Integrator, etc...) clearly printed on the drawings
6. Table of contents with necessary fields present (Sheet Title, Sheet Number, Description, etc...)
7. Drawing titles and sheet names match the Table of Contents
8. Sheet titles make sense
9. Drawing order makes sense
10. Spelling checked and corrected

B. FIT (EQUIPMENT LAYOUT PLAN, RCP, ELEVATION, DETAILS)

1. All of the equipment shown on plan view in the correct position
2. All equipment uniquely identified
3. Equipment clearances throw distances, and elevations clearly marked, dimensioned and noted
4. Detail drawings for the hanging/installation/mounting of projectors, screens, cameras, surface mounted loudspeakers, ceiling suspended loud speakers, wall or floor mounted racks, displays, microphones, antennas and sensors, and camera/speaker housings
5. Equipment mounting details for equipment (composite weight including hardware) over 40 lbs. include the stamp of the Approved Licensed Structural Engineer.
6. Details contain manufacturer and model numbers for each part, detail key referenced back to Equipment layout, weight, and clearance requirements
7. Detail reference keys for every piece of equipment permanently installed overhead

C. FIT (CABLE FILL FORM, OR PLAN AND RCP)

1. Conduits uniquely identified
2. Cable types identified by make and model number
3. Cables leaving rooms uniquely identified
4. Cable quantities/types correct
5. Cables segregated by type/signal level when possible

D. FIT (RACK, CONSOLES, FURNITURE RACK LAYOUTS AND ELEVATIONS)

1. Racks and Consoles have a unique ID
2. All equipment uniquely identified within each rack layout
3. Blanks, vents, and fans positioned properly with respect to the actual heat generating equipment
4. Layout functional for daily use
5. Mounting of any external equipment such as monitors, speakers, and desk shelves detailed
6. Detail covering grounding, bonding, and the pass through of conduits to and from the racks

E. FIT (CUSTOM FURNITURE DRAWINGS)

1. Furniture drawings accurately show the form fit and function of the original design intent

2. Cable pass-troughs and equipment access panels appropriate for daily use
 3. Finish samples provided unless finishes are pre-approved by owner/architect
 4. Furniture uniquely identified and keyed to Equipment Layout Plans, Rack elevations, and System Line Diagrams
 5. Furniture drawings contain enough detail for custom fabrication by furniture vendor
- F. FIT (CUSTOM PANELS AND PLATES)
1. Plate drawings include the following manufacturing details: material type and thickness; plate finish; engraving/screening size, color, and font style; bevel and mounting hole details; connectors and switches identified by make and model number; and connector mounting method (pressure fitting, nuts and bolts, etc...)
 2. All plates uniquely identified and keyed to match line diagrams and equipment layouts
- G. FUNCTION (SYSTEM LINE DIAGRAMS)
1. Signal flow from input to output, left to right
 2. Wiring notes make sense
 3. System line diagrams accurately reflect the original system design intent
 4. Equipment shown identified by manufacturer, model number, and a product description
 5. All of the equipment shown has a unique ID matching the plate drawings, rack elevations, and equipment layout plans and RCP's
 6. All field and rack wires uniquely identified by number
 7. All terminal strips identified by locations and numbered
 8. All rack power circuits and power control sequencing circuits identified
 9. All pre-made cables indicated by manufacturer, make, and model number
 10. Calculated measurements for RF level for taps, drops, splitters, and amps
 11. All wires identified by signal type (MIC, Line, RGB, Serial, Etc...)
 12. Details for DIP switch settings, IP Addresses, Baud Rates or equipment modifications
 13. Detailed pin outs for all Integrator manufactured cables
 14. System line diagrams contain detail markers of where to find pin out details
 15. System line diagrams indicate the impedance at amplifier outputs for all speaker lines
- H. MISC (MISC CONSTRUCTION DETAILS)
1. Details and elevations for any custom built equipment, architectural oddities, or any other Integrator work not covered elsewhere
- I. EQUIPMENT LIST
1. Variances from the original basis of design clearly marked
 2. All of the necessary equipment accessories included
 3. Equipment identifiers match those on the drawings
 4. Equipment quantities match those of the drawings

Appendix G

1.1. SUGGESTED EQUIPMENT LIST

- A. Attached is the suggested AV equipment list based on the Owner's AV requirements for the project. The equipment in this list is intended to be an example of the intended equipment functionality and quality to be used in the AV system and is not complete, nor does it establish an equipment specification. This information may be used by the AV Design Builder as a reference when determining the overall system design.
- B. The Integrator is solely responsible for the completeness and accuracy of the system designs and installation.
- C. All information indicated on this equipment list, including but not limited to quantities, manufacturers, model numbers and room allocations are non-binding, and neither the Owner nor the Consultant is obligated to accept the information, in original or altered form, from the Integrator as the final Bill of Materials.
- D. The Integrator shall supply a complete and operable system meeting the requirements of the project.

Sample Equipment List KSU Standard Equipment March 21, 2024				
Number	Reference	Description	Manufacturer	Model Number
1	FF 220	Ceiling speaker	Extron	FF 220T
2	JBL	8" Coaxial Loudspeakers, 60 watt with 70V xfmr	JBL	Control 28-1
3	BRAVIA	BRAVIA BZ40L Series	SONY	55BZ40L- 85BZ40L
4	MTMU	Fusion® Micro-Adj Tilt Wall Mount	CHIEF	MTM1U
5	MLC	MLC PLUS 100 6-button Panel	EXTRON	MLC Plus 100
6	TLP	TLP Pro 525M Mounted Touch Pnl	EXTRON	TLP Pro 525M
7	IPL	IPL Pro S3 3-Port IP Controller	EXTRON	IPL Pro S3
8	HP	Poly Studio Conferencing Bar	HP	PolyStudio

Appendix H- Audio Visual Program Report

AV SYSTEM LEVELS

To create consistent standards for conferencing technology, all presentation spaces in this project should be programmed to have similar basic AV capabilities. A terminology of “Level 1” through “Level 4” has been created to assist the core project team in communicating requirements in a concise manner. This terminology is described in this section; the spaces for this project are identified by level in the drawings. Where indicated, some equipment will be furnished by the owner and will be referred to as owner-furnished equipment (OFE).

LEVEL 0

Level 0 is used to represent a room that will include AV infrastructure (conduit, power, appropriate lighting, etc.); however, Level 0 rooms will not have any installed AV equipment. These spaces are designed to accommodate full AV systems in the future. These spaces may be equipped with a tabletop conference phone for audio conferences.

LEVEL 1

Level 1 systems include flat panel displays with loudspeakers installed for program audio playback. These rooms room have no permanent AV source devices installed; however, they can include the ability to display portable OFE devices (laptop, document camera, etc). AV input plate(s) will be placed at a convenient wall or tabletop location for connecting portable equipment. Audio conference capability can be included utilizing a tabletop conference phone. These rooms can utilize the display's handheld remote or a simple button panel to control the equipment.

LEVEL 2

Level 2 represents the standard AV system capability for typical meeting and presentation spaces. Level 2 rooms add dedicated source equipment to the Level 1 room. These spaces are designed for high-quality local AV presentations and can include installed displays (ceiling-mounted video projectors or flat panel displays as appropriate based on room size and functionality), AV source devices (HDMI connections), and program audio systems. In-room AV sources may include a dedicated in-room PC (OFE), satellite/cable TV tuner and connections for portable computers (OFE), document cameras (OFE) or other video devices (OFE). Audio conference capability can be included utilizing a tabletop conference phone. These rooms would typically utilize a button panel or touch screen panel to control the equipment and environment.

LEVEL 3

Level 3 systems are appropriate for larger rooms that typically seat more than 50 people. Level 3 systems are planned to be identical to Level 2 systems but with the additional capability for speech reinforcement, an ADA-compliant assistive listening system, and/or additional AV inputs for multiple presenters. Audio conference capability can be included utilizing the speech reinforcement microphones and ceiling loudspeakers. These rooms would typically utilize a button panel or touch screen panel to control the equipment and environment.

LEVEL 4

Level 4 systems are planned to be identical to Level 2 systems, with the additional capability of audio conferencing and videoconference systems installed in the room. These rooms have dedicated cameras, microphones and associated videoconferencing hardware. Rooms with Level 4 systems feature enhanced lighting; acoustical and camera-friendly room finishes for improving outgoing audio and video signal quality. A specialized table is often included in Level 4 rooms to provide enhanced camera angles to view participants. These rooms would typically utilize a button panel or touch screen panel to control the equipment and environment.

DIGITAL SIGNAGE DISPLAYS

Flat panel displays for informational signage and TV viewing may be installed in on-campus facilities. Generally, at least one digital sign shall be installed in each facility, and will supply campus-wide emergency notifications.

Digital signage content is delivered via network to signage appliances located behind the displays.

PAGING AND BACKGROUND MUSIC

Public spaces may have a paging and background music system. Operation/control shall be via IP, and only authorized personnel in the operations office should be able to operate the system.

There may be multiple zones for paging and background music. Any such system shall allow users to select any or all of the various zones for announcements or music delivery.

The control center shall be able to override audio mutes in case of emergency.

Customer will supply information regarding separating space into zones.



AV Programming and Configuration Guidelines

University Information Technology Services - AV Engineering

Date	Author	Version	Changes
10/15/19	JD Price	4.0	Major changes/additions to original SOP.
10/23/19	Jason Sims	4.1	Update to Sony display setup
9/8/21	JD Price	4.2	Minor changes: TCP port, Projector
10/15/21	JD Price	4.3	Sony display update
3/3/22	Josh Price	4.4	Sony display update
8/2/23	Josh Price	4.5	Sony display update
4/5/24	Josh Price	4.7	Sony display update

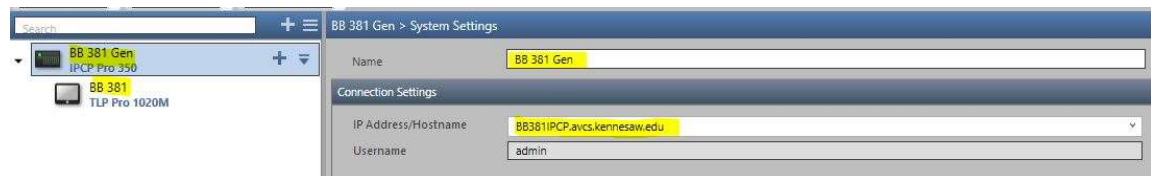
Programming – Pro Systems (GCP)

Pro Controllers:

- 1) Set hostname for all controller/touch panel using the following format:
 - a) **[room number] [device abbreviation]**
 - b) Standard device abbreviations are TLP, IPCP, IPL, MLC, etc.
 - c) The final format should look as follows: **KH2102IPCP**, where KH2102 is the room number for Kennesaw Hall 2102 and IPCP is the controller.
 - d) Enable DHCP
- 2) Set “Time and Date” settings for the controller as follows:
 - a) Select “Automatically set the time and date with a NTP server.”
 - b) Set Time Zone to Eastern Time.
 - c) Enter **pool.ntp.org** for the NTP Server.
 - d) Select “Apply”
- 3) Set administrator password.

GCP:

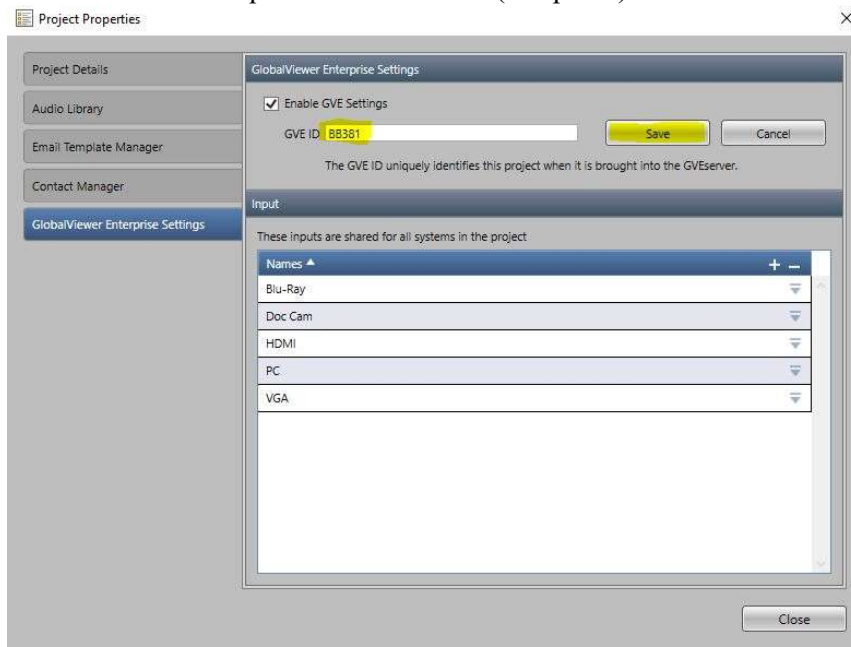
- 1) Ensure the “IP Address/Hostname” matches the device hostname with the fully qualified domain address of **.avcs.kennesaw.edu**.
 - a) Example 1: **KH2102IPCP.avcs.kennesaw.edu**.
 - b) Example 2: **KH2102DTPCP.avcs.kennesaw.edu**



- 2) Ensure Global Viewer Tree room number is accurate:



- 3) Ensure GVE ID is equal to room number (no spaces).



Programming – Legacy Systems (GC3)

Legacy Controllers:

- 1) Set hostname for controller/touch panel using the following format:
 - a) **[room number] [device abbreviation]**
 - b) Standard device abbreviations are MLC, TLP, IPL, etc.
 - c) The final format should look as follows: **KH2102MLC**, where KH2102 is the room number for Kennesaw Hall 2102 and MLC is the controller.
- 2) Assign provided static IP to controller/touch panel.
- 3) Set administrator password.
- 4) Load GUI (if applicable).
- 5) Load program.

Device Configuration

Network-Controlled Devices:

- 1) Set hostname for all network-controlled devices using the following format:
 - a) **[room number] [device abbreviation]**
 - b) Standard device abbreviations are DMP, DTPCP, IN1608, etc.
 - c) The final format should look as follows: **KH2102DTPCP**, where KH2102 is the room number for Kennesaw Hall 2102 and DTPCP is the switcher.
 - d) Pro systems Only:
 - a. Enable DHCP
 - e) Legacy systems only:

- a. Assign provided static IP.
- 2) Set administrator password.
- 3) Load configuration file to device.

Apple TV's:

- 1) Provide serial number to KSU AV Engineering Team prior to installation. Include the location the Apple TV is being installed (TP 2010, KH 2005, etc....).
- 2) Apple TV should get to Ditto Receiver Screen within 5-10 minutes (wireless presentation app).
- 3) Follow on-screen prompts to cast your laptop to the Apple TV for testing the input.

Displays and Projectors:

1) Displays:

a) Samsung:

- i) Set the display ID to 1.
- ii) Turn off all eco settings, including standby control.

b) Sony:

i) Pro Mode:

- (1) Enter Pro Settings Mode: "Pro Mode Tool" > "Pro Settings Mode" > "OK".

ii) Settings:

- (1) Settings > RS232C Control > Via serial port. Display may restart if not already in "Pro Settings Mode".
- (2) Settings > Bluetooth settings > Turn off Bluetooth.
- (3) System > Power and Energy > Energy Saver > Turn Off Display After = Never
- (4) System > Power and Energy > Auto Power Saving Mode = Off
- (5) System > Power and Energy > Power Saving = Off
- (6) System > Power and Energy > No Signal Power Off = Off
- (7) Inputs > External Inputs > Bravia Sync > Bravia Sync Control = Off
- (a) Adjust Pro Settings: "Pro Settings"
 - (i) Deny "WebAppRuntime" access.
 - (ii) Disable "Screen Mirroring".
 - (iii) Select default input source: "External Input" > "HDMI 1"
 - (iv) Initial Volume > Reset Volume On Power On (only needed if no controller).

c) Select "Start Pro Mode." Display will restart.

2) Epson Laser Projectors:

- a) Set brightness light source mode to "custom."
- b) Reduce the level to 70%.
- c) A/V Settings: "Extended" > "A/V Settings" > "Always On"
- d) Standby Communication: "Extended" > "Standby Mode" > "Communication On"
- e) Control Communication: "Extended" > "HDBaseT" > "Control Communication" > "On"
- f) HDBaseT: "Extended" > "HDBaseT" > "Extron XTP" > "On"

Other:

- 1) Ensure all devices have the most recent firmware installed.
- 2) Set all EDID's to 1080p, unless notified otherwise.
- 3) Set all video outputs to 1080P, unless notified otherwise.
- 4) Equalize all audio inputs.
- 5) Adjust mic levels to ensure adequate voice capture.
- 6) Set mic frequencies to the same frequencies as existing in that location. Label both the transmitter and receiver with the set frequency and room number.
 - a) If there was not an existing mic, a new frequency would be provided by AV Engineering.

KSU Requirements

Telecom/Data Infrastructure Specifications

(REVISED 8-10-24)

**For Additional Information
Please Contact:**

**Thornton Bertoli
Director Enterprise Network Engineering
Office Phone: (470) 578-6620
network@kennesaw.edu**

Contents

A.	Project Summary and Administrative Procedures	2
1.	Scope of Work	3
2.	Contractor Qualifications	3
3.	Scheduling	3
4.	General Requirements	3
5.	Ceiling Space Coordination	3
6.	Inspection Requirements	4
7.	Product Requirements	4
a)	Standards for Materials	4
b)	Materials and Components	4
c)	Completeness of Work	4
B.	Fiber Cabling Installation Specifications	5
1.	Single-Mode Fiber	5
2.	Multi-Mode Fiber	5
3.	As-built Testing	5
C.	Specifications for CAT 6A Copper Cabling Installation	6
1.	Facilities Structured Cabling Specifications	6
D.	Structured Cabling - Outside Plant Entrance	7
1.	Buried Entrance Conduit	7
2.	Connecting Conduit	7
3.	Quantity of Conduits/Innerducts	7
4.	True/Prove of Conduits	7
5.	Conduits Entering Building	8
E.	Structured Cabling - Entrance Termination MDF/IDF	9
1.	MDF/IDF Locations:	9
2.	Wall, Floor, Ceiling, and Door Requirements	9
3.	Electrical Power and Lighting	10
4.	Environmental Control (HVAC)	10
5.	Shafts and Raceways	10
6.	Sleeves	11
7.	Horizontal Distribution Pathways	11
8.	Cable Trays	11
9.	Grounding	13
10.	Utilization of MDF/IDF Space	13
F.	Electronic Classroom and Lab Specifications	14
1.	Workstation Communication Outlets	14
2.	Data Outlets	14
3.	Room Layout	14
4.	Power	15
5.	Furniture	15
G.	Elevator Lines, Alarm Circuits, Emergency/Courtesy Phones	16
H.	Grounding and Bonding Labeling	17
I.	Equipment and Racks	17
J.	Wi-Fi Installation	19
K.	Standards	20
L.	Materials and Methods Specifications	21

Legend:

MDF (Main Distribution Frame)

Backbone Riser System IDF (Intermediate Distribution Frame)

A. Project Summary and Administrative Procedures

IMPORTANT NOTICE: These “Telecom/Data Infrastructure Specifications” **MUST** be incorporated into the initial Architect’s Project Manual and the Construction Project Manual under “Division 16000-Electrical” as “Section 16200-Communications & Protection”.

1. Scope of Work

The intention of these specifications and accompanying drawings is for the Contractor to provide all necessary labor, supervision, materials, tools, equipment, and service for a complete and acceptable communication installation located on the Kennesaw and/or Marietta campus of Kennesaw State University (KSU).

2. Contractor Qualifications

The Contractor must be licensed in the State of Georgia as a Low Voltage Telecommunications (LV-T) or Low Voltage Unlimited (LV-U) class certification. The Contractor must identify a staff member who will be on site to oversee and coordinate the data communications installation with UITS.

3. Scheduling

The construction schedule, as approved by the KSU Project Manager, shall be an integral part of the Contract and shall establish interim contract completion dates for the various activities. The schedule must remain adjustable and flexible throughout the length of the project with the completion of the Voice/Data Equipment rooms a top priority.

Certain Fire Marshal inspections may require the fire alarm system to be connected to the outside monitoring service via IP or analog lines. If this is the case, it is critical that the MDF (as a minimum) be clear of dust and properly secured. Connection to outside networks cannot occur without these items. Allow at least 5 working days from a dust free and secured environment for the IT staff to make any outside connections.

4. Project Review

Submit proposed data location drawings to the IT Department for review per the following schedule:

- Design Development
- 50% Construction Documents
- 95% Construction Documents

5. General Requirements

The work could consist of, but shall not be limited to the installation of the following systems:

- Provide and install raceway, conduit, equipment racks, cable tray, network cable, fiber optic cable, connectors, termination panels, wire management, etc... for a complete telecommunications system.
- Demolition of indicated communication devices, cabling, and/or equipment as required for preparation of space for renovation.
- **Related Work:** Coordination of cabling work with other trades.

6. Ceiling Space Coordination

The General Contractor shall coordinate and schedule the installation of work above ceiling with the KSU Telecom cabling technicians and other trades to avoid installation conflicts. The KSU Telecom cabling staff/technicians shall participate in special project meetings (if requested) for the purpose of ceiling space coordination. Such coordination shall include, but is not limited to, the following work:

- a) Ceiling Grid and Ceiling Tile Installation
- b) Ductwork, HVAC Piping, and Conduits
- c) Electrical Wiring
- d) Telephone/Data Wiring

7. Inspection Requirements

The contractor shall be solely responsible for determining, verifying, and complying with inspection requirements relative to the scope of work.

8. Product Requirements

a) Standards for Materials

- 1.1. All materials shall be new and undamaged and shall conform to the applicable standard of standards where such have been established for the material in question. Publications and Standards of the organizations listed below are applicable to materials specified herein.
 - American Society for Testing and Materials (ASTM).
 - Underwriters' Laboratories, Inc. (UL).
 - National Electrical Manufacturers Association (NEMA).
 - Institute of Electrical and Electronic Engineers (IEEE).
 - American National Standards Institute (ANSI).
 - National Fire Protection Association (NFPA).
- 1.2. Where reference is made in the contract documents to trade names or to the names of manufacturers, such references are made solely to designate and identify the quality of materials or equipment to be furnished and are not intended to restrict competitive bidding.

b) Materials and Components

KSU will maintain a standard list of materials and components. Do not deviate from specified manufacturer or part # without prior approval from KSU Telecommunications. If a part number is not indicated, please contact Telecommunications for directions before ordering or installing.

c) Completeness of Work

- 2.1. Furnish all material, labor, transportation, tools, equipment and supervision to install and leave ready for operation a complete communication system in accordance with these specifications or the accompanying drawings.
- 2.2. Furnish all fittings, devices and equipment and the use of such methods of construction as to insure compliance with the before referenced standards.
- 2.3. All offsets, bends, fittings, pull boxes, j-hooks, d-rings, and supports for the complete installation are not indicated on the drawings; however, it shall be the Contractor's responsibility to furnish and install all offsets, bends, devices, raceway supports, and equipment for the complete installation.

END OF SECTION

B. Fiber Cabling Installation Specifications

Fiber must be installed in one continuous run—no splices.

1. Single-Mode Fiber

- 1.1. Connector shall be compliant with industry standard ANSI/TIA/EIA-568-C.3. The connector must meet TIA/EIA Fiber Optic Connector Standards (FOCIS), document TIA/EIA-604-3.
- 1.2. LC type ultra PC polished pigtails with ceramic tip connectors fusion spliced to fiber. LC-UPC fusion splices on connectors are acceptable. Station fibers may be terminated with UPC-LC type connectors with pre-polished fiber stub e.g., Corning Uni-Cam or LC-UPC fusion splice on connectors.
- 1.3. LC (new) or SC (existing) type adapters with ceramic alignment inserts compatible with termination cabinet/shelf.
- 1.4. Connector shall be consistently capable of insertion losses of 0.2 dB (typical) and shall be 0.5 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be measured at the factory to be less than or equal to -40 dB for super physical contact (SPC) and less than or equal to -55 dB for ultra physical contact (UPC). Strain-relief boot color shall be white for SPC and blue for UPC.
- 1.5. The manufacturer shall be ISO 9001 and TL 9000 registered. The manufacturer shall have an in-depth knowledge, and more than 10-year history, of manufacturing and supporting connector technology that does not require epoxy or polishing in the field.

2. Multi-Mode Fiber

- 2.1. All connectors and adapters shall conform to ANSI/TIA-568-C.3 standard. Connector shall be compliant with industry standard ANSI/TIA/EIA 492AAAD. The connector shall comply with the TIA/EIA Fiber Optic Connector Standard (FOCIS) document, TIA/EIA-604-2. The connector shall comply with the ISO/IEC 11801 Standard.
- 2.2. LC type, (OM3/4) ceramic tip connectors field installed or factory pigtails with ceramic tip connectors fusion spliced to fiber.
- 2.3. LC type (OM3/4) adapters with ceramic or metallic alignment inserts compatible with termination cabinet/shelf. Unless otherwise specified the maximum number of adapters per panel shall be six duplex couplings.
- 2.4. The connector shall be consistently capable of insertion losses of 0.3 dB (typical) and shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. The manufacturer shall be ISO 9001 and TL 9000 registered. The manufacturer shall have an in-depth knowledge (and more than 10 years' history) of manufacturing and supporting connector technology that does not require epoxy or polishing in the field.

3. As-built Testing

Testing and results are required for ALL completed installations.

To be performed after the terminations are completed and before leaving the job site. This testing consists of end-to-end attenuation testing, OTDR signature traces and connector loss values on EACH fiber in the cable. It is the baseline to which future tests and troubleshooting shall be compared and critical to the resolution of any future warranty issues. As-built testing also includes end-to-end and OTDR tests after a repair or system change/upgrade. As-built documentation should create a complete history of the original installation and any changes to the cable system.

- All fibers must be tested with an OTDR in both directions.
- All fibers must be tested with an optical power meter in both directions.
- Test results must be provided at completion of the project.

End of Section

C. Specifications for CAT 6A Copper Cabling Installation

KSU will provide an on-site Lead Technician to oversee all aspects of the Telecommunications installation. KSU Lead Technician will be responsible for all decisions to be made concerning voice, data, copper, and fiber installation.

All low voltage data cable work must be completed following KSU Telecommunications-Data Specifications, using parts and materials as specified in the Approved Telco Supplies Sheet (attached), KSU Telecommunications Infrastructure Specifications, as well as BICSI cabling installation standards. **No subcontracting is allowed without prior written approval from KSU UITS-Telecom.**

Cable tests for copper and fiber must be provided to KSU UITS-Telecom.

PROHIBITED: Splitting of copper pairs between jacks

PROHIBITED: Sharing the outlet and conduit pathway without prior approval of KSU UITS-Telecom

KSU Telecom will provide cut sheets and floor plan showing jack locations and labeling schematic.

KSU Telecom will provide information (verbal or written) explaining cable routes, neatness of cable bundles, and equipment room layouts including specific sequence of cable terminations on patch panels and specific locations of patch panels on each rack.

Wire management such as Velcro, D-rings, J-hooks, or other cable support to be used for cable runs to keep cable off ceiling grid and away from lighting and electrical devices to prevent EMI.

Vendors shall not accept instructions from anyone except for authorized UITS personnel. A list of authorized personnel and their contact numbers will be provided to the vendor at the start of the project. Any changes to the original scope of the project needs written approval by UITS personnel on the approved list. Questions or clarifications about who is on the approved list can be directed to either the Director of Enterprise Network Engineering or the Chief Technology Officer. While customers and other personnel in the field may ask for changes, the vendor should NOT accept changes from anyone except from the authorized list.

Special purpose outlets such as courtesy/emergency phones should be single-gang. These outlets must be located at ADA height. If there is no conduit, use an Arlington Industries LV1 Low Voltage Mounting Bracket.

Outlets in rooms are to be labeled left to right with the 1st wall to the left of the door being the A-wall, then B-wall, then C-wall, then D-wall, etc. The outlets are to be labeled A1, B1, C1, D1, etc. If multiple outlets are on the same wall, they will be labeled as A1, A2, A3, A4, etc.

All faceplates are to be labeled to correspond with the Room Number & outlet location and the MDF/IDF room number.

- Example: 382 A1 IDF 314

Whether a faceplate is single-gang or double-gang, it should be mounted vertically and start with Data 1(D1) on the upper left and go left to right/top to bottom continuing with D2, D3, etc.

- 4-port example:

D1	D2
D3	D4

1. Facilities Structured Cabling Specifications

Direct attach cables between devices (not pulled to an IDF/MDF) are to adhere to the following color coding:

- HVAC is to be color coded Light Green.
- Salto is to be color coded Yellow.
- Fire Safety is to be color coded Red.

All devices pulled back to an IDF/MDF patch panel are to follow ALL campus standards.

End of Section

D. Building Structured Cabling - Outside Plant Entrance

Adequate conduit must be provided for all new Building Projects to allow for the installation of Copper and Fiber into the building.

Must coordinate design with UITS Telecommunications & Networking.

1. General

- All new buildings on campus require a fiber connection to the campus loop. Coordinate exact locations with KSU IT during the Design Development phase.
- See Appendix for more details on site related fiber requirements.

2. Buried Entrance Conduit

- Buried building entrance conduit shall extend into undisturbed earth to prevent shearing (24-inch [60 cm.] minimum depth) and will be run in a conduit trench back filled with appropriate material.
- An Orange detectable plastic warning tape shall also be placed in the trench a minimum of eighteen (18) inches above the conduit to provide additional detection measures.
- The conduit shall further be encased with 2500 psi minimum strength concrete where:
 - The recommended minimum depth cannot be attained.
 - The conduit(s) pass under roads or driveways.
 - Conduit bend points are subject to movement.
- When boring under roadways or railways, corrosion-resistant steel pipe can be used as a substitute for concrete encasement.

3. Connecting Conduit

- The connecting conduit run shall be limited to a maximum of two (2) 90- degree bends (or an equivalent number of sweeps and/or radiused bends). Conduit runs installed by the Contractor should not exceed 300 feet or contain more than two (2) 90-degree bends without utilizing appropriately sized pull boxes. Pull box sizes will be determined by KSU Telecom personnel during the construction project.
- The radius of a conduit bend must be multiple times the diameter of the conduit, depending on its size. If the conduit has an internal diameter of 2 inch or less, the bend radius must be at least 6 times the internal conduit diameter. If the conduit has an internal diameter of more than 2 inches, the bend radius must be at least 10 times the internal conduit diameter.

4. Quantity of Conduits/Innerducts

- **There shall be a minimum of four, four-inch (4x 4-inch) data cable conduits used to provide cable ingress into the Main Equipment Room (MDF).**
- Contractor shall verify exact termination point of service with the utility prior to roughing.
- All cable conduits shall extend four (4) inches beyond the surface from which they emanate.
- The ends of all metallic data/voice conduits should be reamed, bushed, and grounded according to the National Electrical Code.
- All conduits and/or innerduct shall contain Kevlar pull strings with a minimum test rating of 200 lb. pulling tension.
- Two conduits are to be void of innerduct. One of these conduits shall contain a continuous true tape from end to end.
- Two conduits to be utilized for data (fiber optic), shall contain innerducts. Each data conduit shall contain four (4) - 3/4 inch innerducts.

5. True/Prove of Conduits

- All conduits must be true to ensure that the interior of the conduit does not change to less than 3-1/2" from end to end. KSU Personnel must be present to ensure verification.

6. Conduits Entering Building

- Outside plant (nonfire-rated) entrance cable must be terminated within fifty (50) feet upon exiting the conduit inside the building.
- If the termination point is greater than fifty (50) feet from the entrance point, the cable must be run in rigid metallic conduit to within fifty (50) feet of the termination point and the conduit shall be grounded.
- The inside-the-building end of the voice/data cable conduit(s) shall be sealed to prevent vermin and environmental elements from entering the building.

END OF SECTION

E. Building Structured Cabling - Entrance Termination MDF/IDF

(MAIN DISTRIBUTION FRAME AND BACKBONE RISER SYSTEM IDF (INTERMEDIATE DISTRIBUTION FRAME))

MDF must be completed in early stages of the building project using both KSU and AT&T specifications. This will allow KSU and AT&T to install entrance copper and fiber cables necessary to provide dial tone/data required for certifications, i.e. elevator, fire alarm, HVAC, etc.

The building entrance cable shall be terminated at the Voice/Data Main Distribution Frame (MDF).

1. MDF/IDF Locations:

The Voice/Data shall be co-located in a single room, with a minimum of one room per floor. Telecom rooms should be directly accessible from the hallway or other common area. Telecom rooms should have only one door and not be used as a passageway to other rooms.

The MDF/IDF rooms shall be stacked vertically wherever possible so that the backbone riser is accessible in each Telecommunications room.

The MDF/IDF rooms shall be centrally located so that network access can be provided with IEEE 802.3 1000BaseT horizontal cabling distribution specifications, thus retaining the 295 ft, (excluding the patch cable length) maximum cable distance requirement, from MDF to each telecommunications workstation outlet box.

2. Wall, Floor, Ceiling, and Door Requirements

The room sizes should be determined by KSU Telecom personnel during the Space Allocation meetings.

The MDF/IDF room shall be sized appropriately based on occupancy/use and distance. Minimum room sizes should be 10'x15' for MDF's, as other KSU UITS approved providers may also be utilizing the MDF space, and 8'x12' minimum for IDF's. A larger room MDF/IDF may be required if voice/data connectivity exceeds 575 cables per Telecom Room. An example of this would be providing network connectivity in classrooms and labs.

The MDF/IDF rooms shall be painted with campus standard China Doll White paint. **All four walls to be lined with ¾" fire-retardant plywood** painted with minimum of **two coats WHITE** on all sides. If not using fire-retardant plywood, it should be painted on all sides with **two coats WHITE** Intumescent Fire Retardant Paint.

Placement of the plywood shall begin within twelve (12) inches of the entrance door and shall be placed continuously around the room. All ¾" plywood backboards will be 4 feet wide x 8 feet high and will be installed vertically beginning 20" A.F.F., or above electrical outlets. **Plywood must be attached in all four corners to a stud using toggle bolts.** This is to prevent warping or buckling of plywood.

The MDF/IDF room floor shall not have a floor covering other than being sealed or a vinyl covering with base coving. No carpet is to be installed in the MDF/IDF rooms.

The MDF/IDF room shall not have a finished ceiling such as sheetrock or drop construction. Room to be no less than 9' in height to the building structure.

The door to the MDF/IDF room shall be a B18 GA-22 Gauge Stiffners- Honeycomb core steel door, with a (3) hour fire rating. The steel door shall be not less than three (3) feet wide by six (6) feet eight (8) inches high (3'x6'8") and shall open outward unless building codes prohibit. Doors swinging in eliminate three feet of usable wall space. In the advent that the door must swing in, the design professional shall add the lost wall space in the design and increase room size to compensate. Do not

center door on wall. Entrance door to be located to one side to allow as much wall space as possible.

Card lock must be provided for each MDF/IDF throughout building.

3. Electrical Power and Lighting

All electrical outlet locations in MDF/IDF to be determined by KSU Telecom personnel at time of installation. Standard outlet locations will fall in line with the center of data 2-post rack (see reference of standard data closet requirements drawing). Additional electrical outlets will be required for data racks upon build-out of data room.

All Network data racks to have minimum two (2) dedicated twenty (20) ampere, 120-volt independently breakered and grounded quad outlets for the first rack and one (1) additional dedicated twenty (20) ampere 120-volt independently breakered and grounded quad outlet per additional rack. This should work out to 1+n, with n be the total number of data racks in an IDF and 2+n in an MDF.

The MDF room shall be properly powered with a minimum of three (3) dedicated twenty (20) ampere, 120-volt independently breakered and grounded quad outlets. IDF rooms shall be properly powered with a minimum of two (2) dedicated twenty (20) ampere, 120-volt independently breakered and grounded quad outlets.

Installation of these outlets to be coordinated with KSU Networking personnel upon installation of data racks in each MDF/IDF.

REQUIREMENT TO BE DETERMINED BY NETWORKING PER EACH PROJECT:

Two (2) dedicated thirty (30) ampere, 208-volt independently breakered and grounded (NEMA L6/30 Twist Lock) outlet in MDF only.

Electrical outlets shall be flush with the plywood backboards or located below installed backboards. No surface mounted electrical to be installed on backboards. All electrical outlets in the MDF/IDF shall also be connected to the emergency power circuits or facility generator in case of utility power outages.

Lighting of the MDF/IDF shall be provided with illumination to approximately 50 foot-candles (540 lux). Power for the lighting should not feed from the same circuits as the wall outlets. The lighting circuits shall not be on the building master switch.

4. Environmental Control/HVAC (heating/ventilation/air conditioning)

The MDF/IDF room shall have either dedicated HVAC equipment or access to the main HVAC delivery system. The HVAC system must always be capable of functioning properly (24/7/365). Utilizing the building AC will **not** be adequate if the air handlers reduce or turn off to save energy on evenings, weekends, holidays and campus closings. **No heat is to be supplied to these rooms. Either system must be fitted with manual controls located in the MDF room.**

If the HVAC system is a dedicated unit it **shall be connected to the emergency power circuits or facility generator in case of utility power outages.** Location of the AC unit and relief duct must be coordinated with KSU ITS-Telecom to **avoid locating above data racks**, which could cause possible water damage from malfunctioning units or drainage. If possible, **locate above or near door** and away from data racks.

The AC control systems for the MDF/IDF shall meet or exceed the standards shown below:

Environmental Factor

- Temperature
- Relative Humidity
- Heat Dissipation

Requirement

64 to 75 Degrees Fahrenheit
30 to 55 Percent
MDF to accommodate ~25,000 BTUs/hr
IDF's to accommodate ~10,000 BTUs/hr

5. Shafts and Raceways

Riser shafts and raceways shall be located and designed to provide adequate space for the amount of

cable to be installed, meet structural loading requirements, and enable cable to be routed within distance limitations (copper 295 foot maximum to allow for patch cable additions).

6. Sleeves

Sleeves shall be used on all floors for cable riser distribution within the building. All sleeves from floor to floor shall be four (4) inches in diameter. There shall be a minimum of four (4) – four (4) inch sleeves between all MDF/IDF rooms.

In locations where the MDF/IDF rooms are not constructed in a stacked fashion, all sleeves will be connected with rigid metallic conduit. Conduit runs from the MDF to each IDF to be installed by the contractor shall not exceed 100 feet or contain more than two (2) 90-degree bends without utilizing appropriately sized pull boxes.

In addition, all MDF/IDF rigid conduit specified for data usage shall be filled with innerduct (3 - 1.00") – this to be coordinated with KSU ITS-Telecom.

Sleeves shall be located adjacent to a wall on which the backbone cables can be supported without obstructing the wall termination space. Sleeves shall be designed to conform to the National Electrical Code (NEC) and local fire codes and must be fire stopped as part of the installation procedure following the pulling of the cable.

Sleeves shall extend four (4) inches above/below the entrance into the MDF/IDF room. The ends of all metallic data/voice conduits should be reamed, bushed, and grounded according to the NEC.

7. Horizontal Distribution Pathways

The layout and capacity of the horizontal data cable pathways shall have the following characteristics:

Meet ANSI/EIA/TIA-569 and ANSI/NFPA 70 (Clearance from EMI sources) requirements. For special or heavy EMI/RFI environment installation situations, the home run conduit method shall be considered.

Conduit runs installed by the contractor should not exceed 100 feet or contain more than two (2) 90-degree bends without utilizing appropriately sized pull boxes. To avoid electromagnetic interference (EMI), all pathways shall provide clearance of at least:

- Four (4) feet from motors or transformers.
- One (1) foot from conduit and cables used for electrical power distribution.
- Five (5) inches from fluorescent lighting.

Provide for maintenance of the horizontal cabling with minimal disruption of occupant activities through easy access.

The pathway design shall allow for a minimum of four (4) Cat 6A cable runs per individual work area.

All horizontal pathways from classrooms must go back to the same Telco room. This includes all wall and floor box locations within the room.

All horizontal pathways that penetrate fire-rated barriers must be fire-stopped in accordance with applicable codes.

8. Cable Trays

Cable tray systems shall be made of straight sections, fittings, and accessories as defined in the NEMA standards publication VE-1. Cable trays shall be UL classified as equipment grounding conductors.

Cable trays shall be used in all horizontal distribution installations. J-Hook distribution shall not be used unless cable tray installation is not feasible due to structure or space accommodation with other trades. J-Hooks must be 2" and installed from ceiling structure with stringers. Avoid wall mounted J-hooks whenever possible.

Cable trays shall be located in hallways or corridors whenever possible to minimize disruption of occupant activities. Cable trays located in hallways shall be placed off-center to avoid fluorescent lights.

The distance from the cable termination point in the MDF/IDF room to the telecommunications workstation outlet boxes through the cable tray configuration shall not exceed 295 feet (excluding the patch cable length). Additional IDF MUST be provided if there is any possibility of the cable tray route causing the data cable to exceed the 295' maximum length. This is crucial to cable testing and providing the proper functionality to any given room.

The general area for the feeder cable tray to exit the IDF room shall be located to avoid sources of EMI. The cable tray shall not extend into the IDF more than six (6) inches.

The total weight of the cable tray when loaded with cable shall be considered when designing supports to secure the cable tray to the building structure. The working load capacity of a cable tray system shall be determined by both the length of the support span and the static load capacity of the tray.

Materials and Finishes: Straight section and fitting side rails and rungs shall be extruded from aluminum.

Tray Types: If exposed tray should be aluminum with bottom plate in tray unless submitted approval. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced nine (9) inches on center. Rung spacing in radiused fittings shall be measured at the center of the tray's width. Rungs shall have a minimum cable-bearing surface of 7/8 inches with radiused edges. No portion of the rungs shall protrude below the bottom plane of the side rails.

- **Tray Size:** Trays shall have an overall nominal depth of six (6) inches with a minimum usable loading depth of four (4) inches.
- Straight section side rails shall be I-beam, C rail or Z rails. All straight sections shall be supplied in standard lengths of twelve (12) feet.
- Minimum tray widths shall be twelve (12) inches or as shown on the drawings, whichever is larger.

Sweeping or radius bends shall be used. 90-degree corners in the cable tray are not allowed. Fitting radius shall be thirty-six (36) inches. Side rails of straight sections and fittings shall be compatible so that standard splice plates can be used to join straight sections and fittings. Fittings shall have three (3) inch tangents beyond the curved section to accommodate the standard splice plates. Provide standard radius fittings for turns. Provide standard fittings with required radii for elevation transitions. Provide standard 90-degree down radius at cable tray termination locations.

Splice Plates: Splice plates shall be the bolted type, using either square neck or ribbed-neck carriage bolts and serrated flange lock nuts. The resistance of fixed splice connections between an adjacent section of tray shall not exceed .00033 ohm. The cable tray shall be designed so that a splice plate located anywhere along the span shall not decrease the strength of the cable tray system. Splice plates shall be furnished with straight sections and fittings and shall be included in unit prices.

Accessories: Covers and other special accessories shall be furnished as required to protect, support, and install a cable tray system.

Cable tray shall meet NEMA class 12A. Cable tray shall be made to manufacturing tolerances as specified by NEMA VE1-2.03 and VE1-2.04.

Support: Provide trapeze-type support system consisting of horizontal channel and hanger rod of

sizes recommended by NEMA (publication VE-1, latest edition) for ten (10) foot simple spans. Rod shall be threaded at each end or as required for connections. Connection shall be made with fittings and hardware specifically welded. Hanger rods shall not extend more than one (1) inch below bottom of trapeze channel. Support horizontal spans on ten (10) foot intervals. Provide a support within two (2) feet of any termination (endpoint of run). Refer to detail on plans for location of supports at elbows and terminations.

Sway-brace shall be one piece channel attached between outside midpoint of elbow radius (or end-point of termination) and nearest building structural component. Make attachments to structure only; do not attach to piping, ductwork, or non-structural walls, floors, etc. Attachments to the structure shall be by one of the following means:

1. Toggle bolts on hollow masonry units
2. Expansion anchors on solid masonry
3. Concrete machine screws on steel work
4. Beam clamps on structural steel
5. Wood screws on wood members

Penetration of Fire/Smoke Rated Partitions: Provide an eighteen (18) gauge galvanized steel sleeve solidly set in the fire smoke barrier to allow passage of the cable tray through the partition. The sleeve dimensions shall be one (1) inch larger than the cross-sectional dimensions of the cable tray. Fill the entire space within the sleeve with Dow Corning TRV foam or #M Barrier compounds (leaving no voids around the cable tray or cables) to maintain the integrity of the partition fire or smoke rating.

9. Grounding

- Provide a #6 AWG copper ground bonded to the cable tray, spanning the entire length of cable tray. Bond points shall occur at every section.

In MDF: Provide a four (4) lug #6 ground buss bar (3M 4140 copper ground buss bar or equivalent) with AWG #6 insulated wire terminated on a ground bar 20" A.F.F. for copper lines. Must be located near the building entrance conduits. Ground bar shall be connected to the approved building ground. Leave a minimum of 8 ft. slack of ground wire.

In each IDF: Provide a four (4) lug #6 ground buss bar (3M 4140 copper ground buss bar or equivalent) with AWG #6 insulated wire terminated on a ground bar 20" A.F.F. – exact location to be determined by KSU Telecom personnel at time of installation. Ground bar shall be connected to the approved building ground. Leave a minimum of 8 ft. slack of ground wire.

10. Utilization of MDF/IDF Space

ALL wall space in MDF's and IDF's is to be utilized by KSU Telecom approved equipment only. There shall be no other equipment installed either on the walls or within the room without the prior approval of KSU Telecom personnel. These are secured rooms and access is limited to IT personnel.

PROHIBITED: Locating other non-UITs resources in Telecommunications rooms.

PROHIBITED: Using Telecommunications rooms as a route for other facilities to pass through or utilize, including but not limited to air handler units, fire or security alarm systems, A/V infrastructure.

PROHIBITED: Using boiler rooms, air exchange rooms, janitorial closets, Electrical distribution closets or areas with water, and/or sinks for Communications is prohibited. It is essential that these spaces be dedicated to Telecommunications.

END OF SECTION

F. Electronic Classroom and Lab Specifications

NO FLEX CONDUIT WITHOUT PRIOR CONSENT OF UITS TELECOM FOR ALL INSTALLS

1. Workstation Communication Outlets

- When the individual work area is 100 square feet or less, a single 2-square box with a single-gang mud ring is required.
- An individual work area larger than 100 square feet shall have at least two (2) 2- square boxes, each with a single-gang mud ring, and are to be located on opposite sides of the work environment.
- Each back box shall have an individual 1" conduit terminated as close as possible, using the shortest most direct route, to the nearest cable tray on that floor. If cable tray is not provided, each conduit to stub up a **minimum of 6 inches above wall cap and piped out into common area**. 2" J-hooks must be provided every 5-6 feet, to manage cable to be taken back to nearest cable tray. J-Hooks must be 2" and installed from ceiling structure with stringers. Avoid wall mounted J-hooks whenever possible.
- All conduits shall be fitted with a minimum 200 TS polyline pull string to run the length of each conduit.
- All workstation communication outlet boxes shall be placed in close proximity to standard electrical outlets. Outlet boxes shall be mounted at either standard electrical outlet height or above counters.
- All data outlets and floor boxes must go back to the appropriate telco room **keeping within the 295' maximum copper cable distance requirement for network connectivity**.

2. Data Outlets

- All horizontal pathways from classrooms must go back to the same Telco room. This includes all wall and floor box locations within the room.
- Provide at minimal, (1) 2 square single gang outlet in each classroom & lab with a single-gang mud ring. One outlet to be centrally located on wall at the front of each room, to accommodate data cable.
- Provide one 2 square single gang back box with a single-gang mud ring for every four workstations. Outlet to be located approximately mid-way between the four workstations. Each back box shall have an individual 1" conduit terminated as close as possible, using the shortest most direct route, to the nearest cable tray on that floor. If cable tray is not provided, each conduit to stub up a minimum of 6 inches above wall cap and out of room with an appropriately sized J-hook provided every 5-6 feet, to manage cable to be taken back to nearest cable tray.
- When tables are set up in rows, adequate power must be provided on the walls to allow for an electrical whip from the wall to powered tabletop.
- All computer labs must have a location designated during design to allow for a print release station and PC. Provide one 4 square double gang outlet with 2-gang mud ring at each printer location.
- Provide one dedicated electrical quad outlet at each printer station location
- 1-1" Conduit to be provided for data cable to floor box at Instructor's Station in each classroom & lab. This conduit to be stubbed up and out to nearest cable tray. Data cable will co-exist with AV cable in floor box.

3. Room Layout

Computer Labs: Tables to be arranged in rows, unless otherwise specified by the Dean or Department Chair.

- The room layout in computer labs should allow for a minimum of 4 feet between each row of tables. This allows sufficient room for walking and for moving chairs in and out of position.

- The room layout should allow for a 4-5 foot center aisle, if tables are to be arranged in rows.
- The room should allow for tables to be a minimum of 72" long and 24" deep allowing a minimum of 36" of spacing between workstations.
- A minimum of 2% of classroom seating for wheelchairs is required by ADA specifications.

Electronic Classrooms: Tables to be arranged in horseshoe shape, unless otherwise specified by the Dean or Department Chair.

- The room layout in electronic labs should be arranged in horseshoe shape around the room perimeter.
- The room should allow for tables to be a minimum of 72" long and 24" deep allowing a minimum of 36" of spacing between workstations.
- All electronic classrooms must provide wall space for a printer table. Allow space for a table to be a minimum of 48" long x 30" wide and ADA height requirements must be met. The placement of this table must be in an accessible area for all students to access, without interrupting instructor. Table must also be placed in a location that will not interfere with a pull down screen.
- A minimum of 2% of classroom seating for wheelchairs is required by ADA specifications.

4. Power

- Electronic classrooms must be provided with surge protection at the electrical panel.
- Power must be adequate at electrical panel to accommodate the scheduled number of seats per row.
- When tables are arranged around perimeter of room in a horseshoe shape, adequate power must be provided on the walls to accommodate a PC & monitor for each seat.

5. Furniture

The room should allow for tables to be a minimum of 72" long and 24" deep allowing a minimum of 36" of spacing between workstations for all electronic classrooms and computer labs.

For Computer Labs:

- Tables should be arranged in rows, unless otherwise specified by the Dean or Department Chair. These tables must be wired for electrical and powered to accommodate an electrical whip from wall to tabletop. A separate wire management system must be provided for power and data. These cannot be combined.

For Electronic Classrooms:

- Tables should be arranged around the perimeter of the room, unless otherwise specified by the Dean or Department Chair.
- Tables need to provide a separate wire management system for power and data. These cannot be combined.

ADA seating must be provided with tables which are either 31" in height or adjustable. A minimum of 2% must be furnished for wheelchair bound students.

One printer table must be provided to accommodate a printer and a PC Work Release Station. The printer table must be a minimum of 48" long x 30" wide and must be ADA compliant.

Movable seating with tablet arm should have an oversized arm for note taking. Approximately 10% of tablet armchairs should be for left-handed students.

END OF SECTION

G. Elevator Lines, Alarm Circuits, Emergency/Courtesy Phones

A written request must be sent to KSU Telecom, requesting appropriate number of data cable(s) that will be required, as well as giving locations where cable is to be pulled and terminated. Data cable **will not** be terminated, patched in, and active until MDF and IDF Telco closets have been completed by KSU personnel.

Conduit must be provided for all elevator lines and alarm circuits, from appropriate mechanical room to nearest cable tray on that floor, using the shortest most direct route, or to nearest Telco closet.

Telco rooms are to house only building entrance conduits and pathways to multiple floors. All other conduit should be taken back to nearest cable tray or have prior approval by UITS to be located in an MDF/IDF.

Conduit or appropriate pathway must be provided for emergency and courtesy phones, from outlet to nearest cable tray or Telecommunications room. These outlets must comply with ADA requirements.

END OF SECTION

H. Grounding and Bonding Labeling

- **Telecommunications Main Grounding Busbar (TMGB)**
 - The telecom main grounding busbar must be labeled "TMGB" to comply with standard requirements.
- **Telecommunications Grounding Busbar (TGB)**
 - Telecom grounding busbars located in each equipment room must bear the prefix "TGB". The room numbers in which the TGBs are installed must be labeled accordingly.

(**Example:** TGB-1-A is the Telecommunications Grounding Busbar on the first floor, cable A)

- **Telecommunications Backbone Bonding Conductor (TBBC).**
 - The telecom backbone-bonding conductor shall be labeled with the prefix "TBBC".
- **Grounding Electrode Conductor (GEC).**
 - The grounding electrode conductor shall carry the prefix of "GEC" followed by the type of electrode to which it is grounded.
- **Telecommunications Equipment Bonding Conductor (TEBC).**
 - The telecommunications equipment-bonding conductor shall have a prefix of "TEBC". In installations with more than one (1) equipment rack, the suffix shall indicate the rack in which the TEBC terminates. The TEBC shall also be labeled at both ends.

(**Example:** TEBC-1 would be bonding conductor #1)

END OF SECTION

I. Equipment and Racks

Equipment racks shall be 7-ft. high floor mounted standard racks with a minimum load rating of 600 pounds. Racks shall be black powder coat finish and shall comply with EIA310-D. Racks shall be UL listed, self-supporting, with horizontal and vertical wire management systems to facilitate the proper termination of cabling, and allow neat and orderly cross-connect administration, labeling, and move/add/change (MAC) management. Horizontal cable channels shall intersect seamlessly with vertical cable channels. Provide covers for all cable management channels.

Because every location is unique, final placement of:

1. Rack and Ladder
2. Cable Management
3. UPS equipment
4. Network switches
5. Other equipment

This will need to be coordinated with KSU UITs Cabling, Infrastructure, and Networking.

In general, spacing should be 3' in the front of the rack, and 5' in back.

The Ladder should connect to both walls and directly connected to the top of the racks using the top plate and "J" bolts.

END OF SECTION

J. Wi-Fi Installation

Mounting and installing the Wireless Access Points (WAPs) must follow the guidelines provided by the manufacturer. Standard cabling for WAPs is 2 Cat6A cables per WAP.

AP location information:

A Wireless site survey should be performed to determine AP locations or a simulation tool such as Ekahau or Hamina. WAP models and locations must be confirmed with KSU UITS Network.

Transmit Power levels for the predictive should be set to 6mW for 2.4GHz and 12mW for 5GHz unless otherwise noted. The locations identified by the survey should be additional APs to the KSU UITS Network specified locations which will be provided.

Survey Grade as defined by the following Specifications:

Minimum Cell Boundary (2.4 GHz / 5 GHz)	-73dBm
Minimum Data Rate	12 Mbps
Minimum SNR	25 dB
Cell Overlap (2.4 GHz / 5 GHz)	15%
Adjacent Channel Separation	-86 dBm
2.4 GHz Channels	1, 6, 11
5 GHz Channels	UNII-1 & UNII-3
AP power Levels	Set to match Client or 6/12mW

END OF SECTION

K. Standards

- ANSI/EIA/TIA-568.1-D Commercial Building Telecommunications Cabling Standard.
- ANSI/EIA/TIA-568-C.2 Telecommunications Copper Cabling Systems Standard.
- ANSI/EIA/TIA-568-D.3 Telecommunications Optical Fiber Cabling Systems Standard.
- ANSI/EIA/TIA-569-D Commercial Building Telecommunications Pathways and Spaces Standard.
- ANSI/EIA/TIA J-STD-607-C Commercial Building Grounding and Bonding Requirements for Telecommunications.
- ANSI/EIA/TIA-606-B Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- National Electric Code.

END OF SECTION

L. Materials and Methods Specifications

Please find materials and methods specifications in the following pages.

Please continue to next page

MANHOLE#

GPS COORDINATES : _____

CONDUIT COUNTS ARE LISTED AS:
TOTAL NUMBER/ NUMBER USED

WALL CONTAINS {
1" INNERDUCT (IN 4" CONDUIT)
2" CONDUITS
4" CONDUITS } TO _____
(HANDHOLE **f** / MANHOLE **f** / BLDG. **f** & NAME)
DISTANCE IS _____ FEET.

WALL CONTAINS { 1" INNERDUCT (IN 4" CONDUIT)
2" CONDUITS
4" CONDUITS } TO _____
(HANDHOLE **f** / MANHOLE **f** / BLDG. **f** & NAME)
DISTANCE IS _____ FEET.

WALL CONTAINS { 1" INNERDUCT (IN 4" CONDUIT)
2" CONDUITS
4" CONDUITS } TO _____
(HANDHOLE **f** / MANHOLE **f** / BLDG. **f** & NAME)
DISTANCE IS _____ FEET.

WALL	CONTAINS	{	<u> / </u> 1" INNERDUCT (IN 4" CONDUIT) <u> / </u> 2" CONDUITS <u> / </u> 4" CONDUITS	}	TO _____
					(HANDHOLE f / MANHOLE f / BLDG. f & NAME)
					DISTANCE IS _____ FEET.

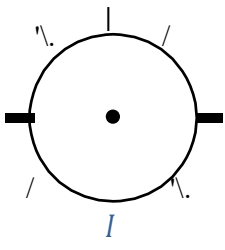
WALL CONTAINS { 1" INNERDUCT (IN 4" CONDUIT)
2" CONDUITS
4" CONDUITS } TO _____
(HANDHOLE **f** / MANHOLE **f** / BLDG. **f** & NAME)
DISTANCE IS _____ FEET.

WALL CONTAINS {
 /-
 /-
 /-
 }
 1" INNERDUCT {IN 4" CONDUIT)
 2" CONDUITS
 4" CONDUITS }

TO _____
(HANDHOLE **f** / MANHOLE **f** / BLDG. **f** & NAME)

DISTANCE IS _____ FEET.

WALL CONTAINS {
1" INNERDUCT (IN 4" CONDUIT)
2" CONDUITS
4" CONDUITS } TO _____
(HANDHOLE **f** / MANHOLE **f** / BLDG. **f** & NAME)
DISTANCE IS _____ FEET.



eo 4" CONDUIT

•0 2" CONDUIT

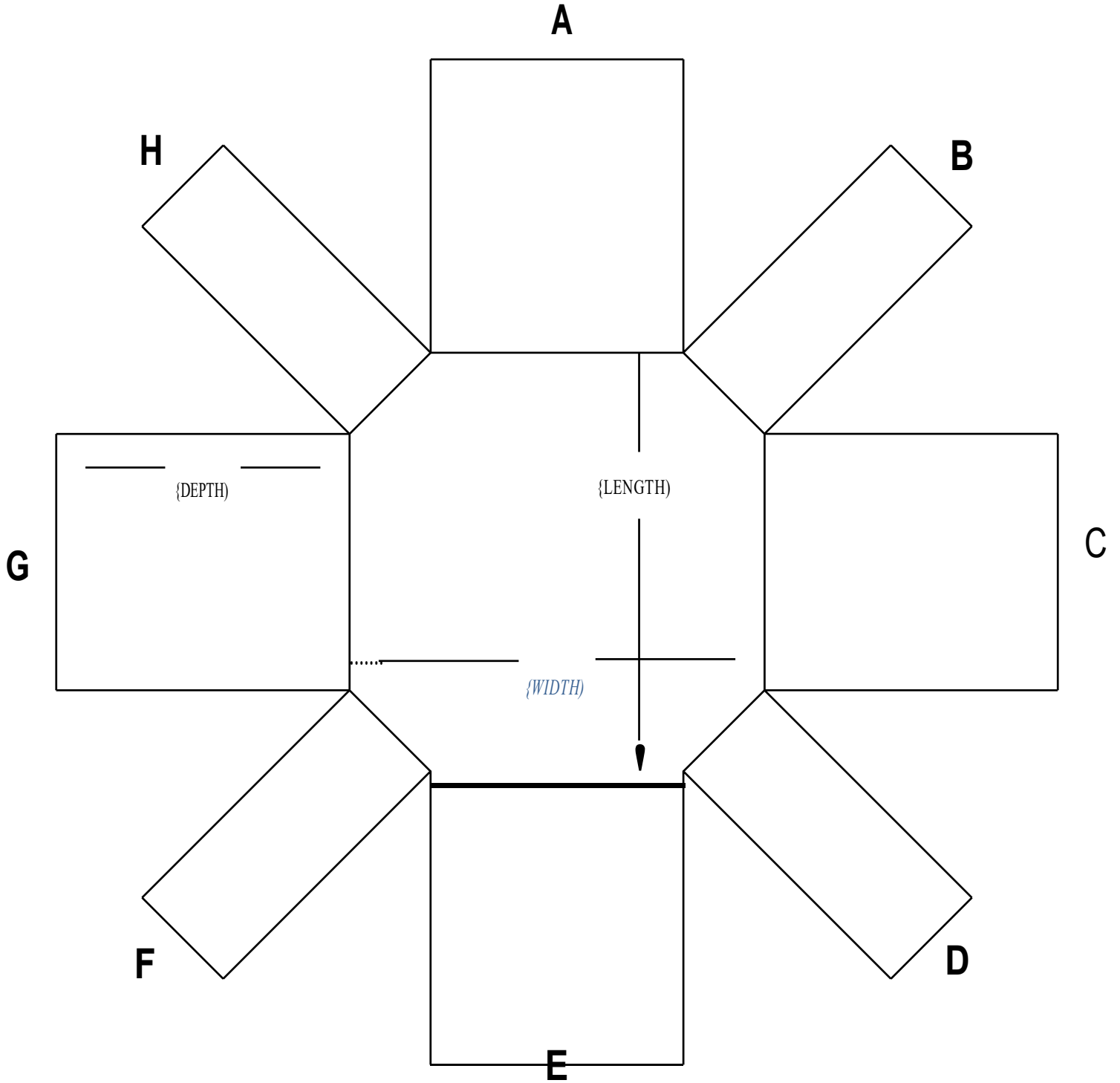
0 INNERDUCTS IN 4" CONDUIT

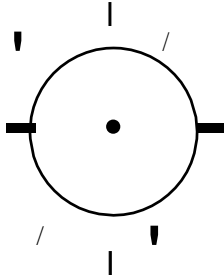
SHADING INDICATES USED CONDUIT

MANHOLE# _____

LOCATED NEAR: _____

DATE: _____





eo 4" CONDUIT

eo 2" CONDUIT

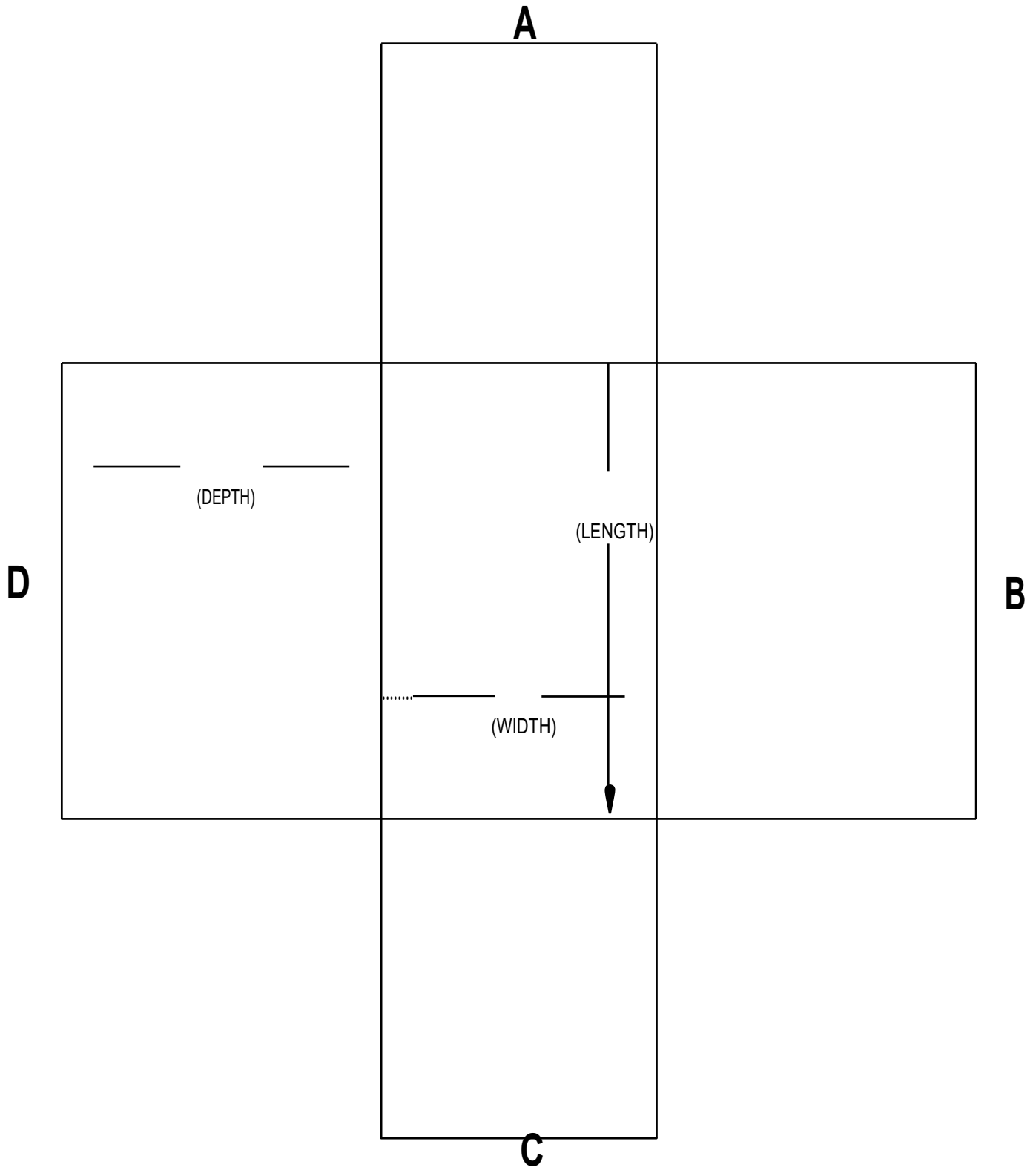
0 INNERDUCTS IN 4" CONDUIT

SHADING INDICATES USED CONDUIT

MANHOLE# _____

LOCATED NEAR: _____

DATE: _____



HANDHOLE # _____

CONDITION OF COVER : _____

TO (HOLE NUMBER, NUMBER USED)

WALL CONTAINS {
 / 1ff INNERDUCT {IN 4ff CONDUIT)
 / 2ff CONDUITS
 / 4ff CONDUITS
}

TO _____
(HANDHOLE # / MANHOLE # / BLDG. # & NAME)

DISTANCE IS _____ FEET.

WALL CONTAINS { 1f INNERDUCT {IN 4f CONDUIT)
2f CONDUITS
4f CONDUITS } TO _____
(HANDHOLE # / MANHOLE # / BLDG. # & NAME)
DISTANCE IS _____ FEET.

WALL CONTAINS {
 - / - 1ff INNERDUCT {IN 4ff CONDUIT}
 - / - 2ff CONDUITS
 - / - 4ff CONDUITS } TO _____
 (HANDHOLE # / MANHOLE # / BLDG. # & NAME)
 DISTANCE IS _____ FEET.

WALL CONTAINS { 1f INNERDUCT {IN 4f CONDUIT)
2f CONDUITS
4f CONDUITS } TO (HANDHOLE # / MANHOLE # / BLDG. # & NAME)
DISTANCE IS _____ FEET.

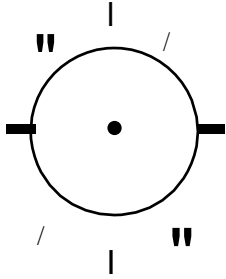
WALL CONTAINS

{	/	1ff INNERDUCT {IN 4ff CONDUIT)
	/	2ff CONDUITS
	/	4ff CONDUITS

} TO _____
(HANDHOLE # / MANHOLE # / BLDG. # & NAME)
DISTANCE IS _____ FEET.

WALL CONTAINS {  1ff INNERDUCT {IN 4ff CONDUIT}
2ff CONDUITS
4ff CONDUITS } TO _____
(HANDHOLE # / MANHOLE # / BLDG. # & NAME)
DISTANCE IS _____ FEET.

WALL CONTAINS { 1f INNERDUCT {IN 4f CONDUIT)
2f CONDUITS
4f CONDUITS } TO (HANDHOLE # / MANHOLE # / BLDG. # & NAME)
DISTANCE IS FEET.



eo 4" CONDUIT

•0 2" CONDUIT

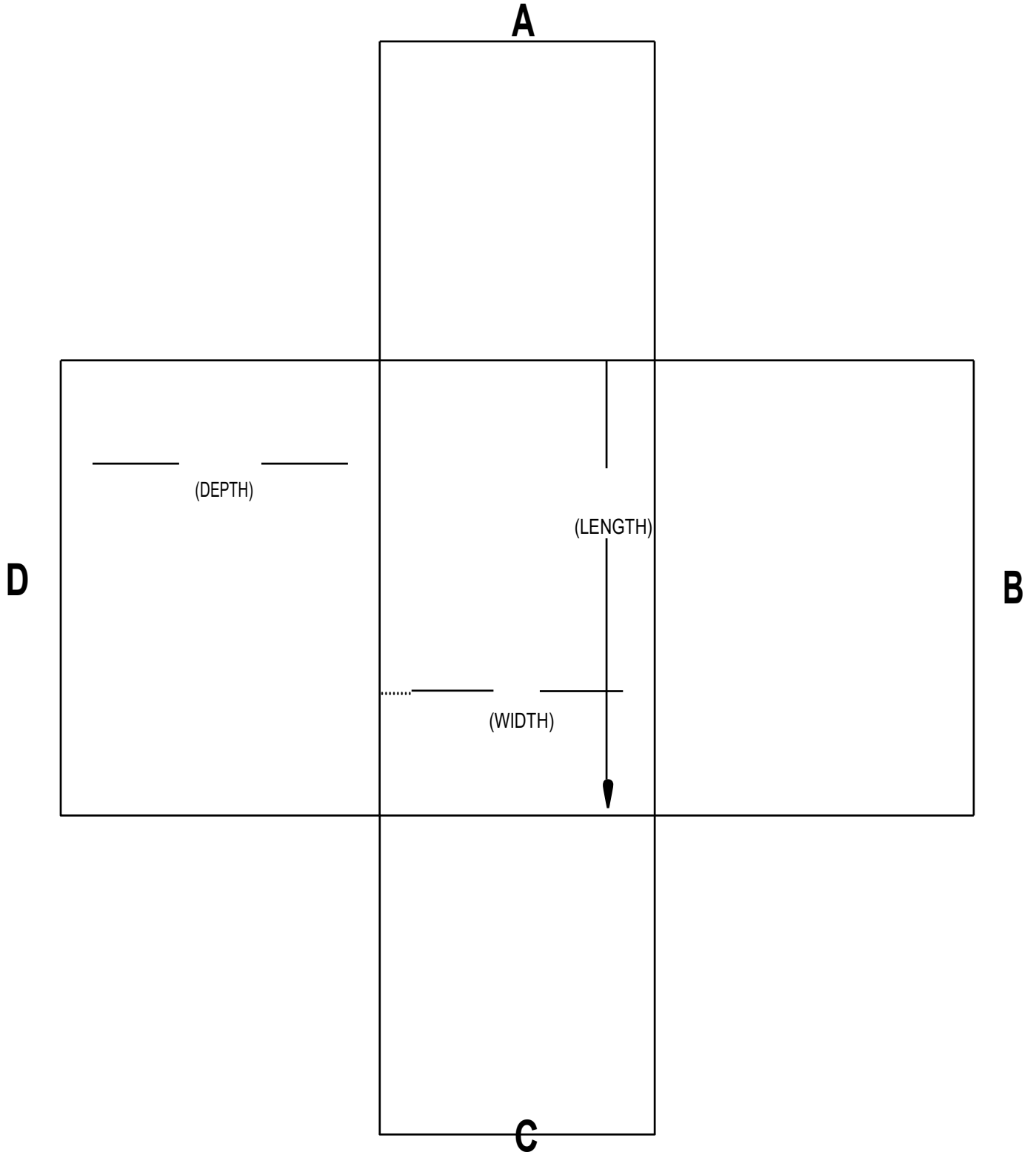
0 INNERDUCTS IN 4" CONDUIT

SHADING INDICATES USED CONDUIT

HANDHOLE # _____

LOCATED NEAR: _____

DATE: _____



Construction and Demolition Waste Diversion Program

Program Summary

Kennesaw State University (KSU) is committed to conserving natural resources and serving as a model for sustainability throughout the region. As part of that commitment, Planning, Design, and Construction along with the Office of Sustainability requires that all construction projects involving construction and demolition produce the minimum amount of waste the scope allows. Construction related waste includes materials from construction and associated packaging, construction office waste and demolished materials. Contractors shall:

1. Develop and submit a construction waste management plan to be submitted to KSU project manager prior to the beginning of construction. The plan shall:
 - a. Identify materials to be diverted from the landfill
 - b. Specify if materials will be sorted on site or describe a tracking methodology to ensure that materials identified for recycling reach the intended recycling center
 - c. Ensure 100% of recyclable paper, corrugated cardboard, plastic sheet and film, aluminum and plastic beverage containers are recycled.
 - d. Ensure 100% Recycling, salvaging or reuse of:
 - Wood pallets
 - Clean, untreated dimensional lumber
 - Landscape waste
 - Concrete, CMU, and brick (to be salvaged for reuse or crushed and used for aggregate, sub-base material, landscape cover etc. as appropriate)
 - Asphalt paving
 - Metals
 - Glass
 - Windows, doors, and door hardware
 - Fluorescent lamps and light bulbs
2. Submit a mandatory tonnage report documenting project waste generated and the method of disposal at substantial completion and revised at project close-out.

[Mandatory C&D waste reporting template](#)

Recycling Facilities –Partial List

KSU has compiled a partial list of local C&D recycling facilities, below, as a resource for contractors. However, contractors and their haulers can select any C&D recycling facilities, even those not appearing on the list below.

1. Metro Green – accepts concrete, metals, roofing shingles, shot rock, sheet rock, carpet, plastics, wood, cardboard, brick, drywall/acoustic ceiling tile, other C&D
2. Downey Trees – accepts green waste (unwanted plants, and pruning and leaf material; no stumps and no dirt)
3. Cowart – accepts whole trees, logs, limbs, stumps (additional fee), brush, pallets, other wood debris or yard waste, and clean wood chips

4. Lifecycle Building Center – accepts salvaged building components (lumber, cabinetry, doors, wire, select lighting fixtures, intact windows); provides free pickup eligible material; provides deconstruction services at competitive rates.

Haulers –Partial List

KSU has compiled a partial list of local haulers with expertise in C&D waste diversion. However, contractors can select any haulers, even those not appearing on the list below.

1. Raintree Waste
2. Patterson Services, Inc.
3. Alternative Waste Solutions
4. Lifecycle Building Center* (will provide free pick-up for eligible material)

If you have questions, contact Angelo Teachout, Sustainability Program Manager, at ateachou@kennesaw.edu.

Building Services Restroom Standards Table

Description	Project Funded	Building Services Provided	Contractor Installed	Brand	Brand Choices
Hand Dryer	X		X	Excel	Xlerator XL-SB
				Excel	Xlerator XL-GR
				Dyson	Airblade V HU02 Nickel
				Dyson	AB14-dB
Paper Towel Dispenser	X		X	Bobrick	B29744
	X		X	Bobrick	B2860
		X	X	San Jamar	T8300TBK
Tissue Dispenser	X		X	Bobrick	B-2892
	X		X	American Specialties	ASI 0040
			X	Lavex	7122JTDDISP
	X	X	X	VanDrehle	3253
Soap Dispenser		X	X	GOJO	FMX-20
Seat Cover Dispenser	X		X	Bobrick	B-221
Sanitary Receptacle	X		X	Rubbermaid	FG11SS
	X		X	Global Industries	WGB794099
Baby Changing station	X		X	Koala Kare	KB200-00 Horizontal

BLDG Services Restroom Amenity and Custodial Closet List

RESTROOM AMENITIES

Materials	Preferred Order	Brand & Model	Description	Click Link for Specs
Hand Dryer	1	Xlerator XL-SB	Stainless Steel Hand Dryer	Hand Dryer - XL-SB
	2	Xlerator XL-GR	Graphite Textured Hand Dryer	Hand Dryer - XL-GR
	3	Dyson Airblade V HU02 Nickel	Sprayed Nickel Hand Dryer	Hand Dryer - HU02
	4	Dyson AB14 dB	Polycarbonate Hand Dryer	Hand Dryer - AB14-dB
Paper Towel Dispenser	1	Bobrick B-29744	SS Automatic, Universal Roll Towel Dispenser	Paper Towel Dispenser - B29744
	2	Bobrick B-2860	SS Automatic, Universal Roll Towel Dispenser	Paper Towel Dispenser - B2860
	3	San Jamar T8300TBK	Universal Hybrid Electronic Roll Towel Dispenser	Paper Towel Dispenser - T8300TBK
Tissue Dispenser	1	Bobrick B-2892	Twin 10" Jumbo-Roll Tissue Dispenser - SS	Tissue Dispenser - B2892
	2	American Specialties ASI0040	Twin 9" Jumbo-Roll Tissue Dispenser - SS	Tissue Dispenser - ASI0040
	3	Lavex 7122JTDISP	Twin 9" High Capacity Dispenser - smoke	Tissue Dispenser - 7122JTDISP
	4	Vondrehle 3253	Twin 9" High Capacity Dispenser - smoke	Tissue Dispenser - 3253
Soap Dispenser	1	Gojo FMX-20	Touch Free Foam Soap Dispenser	Soap Dispenser - FMX20
Seat Cover Dispenser	1	Bobrick B-221	Stainless Steel, Surface Mounted	Seat Cover Dispenser - B221
Sanitary Receptacle	1	Rubbermaid FG11SS	Stainless Steel, Wall Mount w/Drop Bottom	Sanitary Receptacle - FG11SS
	2	Global Industrial WGB794099	Impact Safe-Use, Plastic Sanitary Receptacle	Sanitary Receptacle - WGB794099
Baby Changing Station	1	Koala Kare KB200-00	Horizontal Changing Station	Changing Station - KB200

CUSTODIAL CLOSET FIXTURES

Materials	Preferred Order	Brand & Model	Description	Click Link for Specs
Shelving	1	Bobrick B-239 Shelf	Shelf w/Mop and Broom Holders and Hooks	Utility Shelving - B-239

BLDG Services Waste Receptical List and Exterior Fixtures List

TRASHCANS FOR CLASSROOMS, HALLWAYS, and OFFICES

Preferred Order	Brand & Model	Description	Click Link for Specs
1	Rubbermaid Slim Jim RCP354000BLA	23-gal. rectangular blk, slim	Trashcan - FG354000BLA
2	Rubbermaid Slim Jim RCP354060BK	23-gal. rectangular blk, slim, vented	Trashcan - RCP354060BK
3	Lavex Economy Slim 475WH23BKA	23-gal. rectangular blk, slim, vented	Trashcan - 475WH23BKA
1	Rubbermaid Ranger FG917388BLA	45-gal. black, no doors, square, canopy top	Trashcan - Ranger FG917388BLA
1	Rubbermaid Silhouettes FGSC22ERBDP	50-gal. square, perforated, square, open top	Trashcan - FGSC22ERBDP
1	Rubbermaid 295600BK	7-gal. rectangular blk, desktide wastebasket	Trashcan - RCP295600BK
1	Rubbermaid FG295673BLUE	7-gal. rectangular blue, desktide recycle can	Trashcan - FG295673BLUE
2	Rubbermaid FG295573BLUE	4-gal. rectangular blue, desktide recycle can	Trashcan - FG295573BLUE

TRASHCANS FOR Building Exteriors

Preferred Order	Brand & Model	Description	Click Link for Specs
1	Victor Stanley SD-42	36-Gallon Side-Door Opening Litter Receptacle	Trashcan - SD-42
1	Victor Stanley SDC-45	45-Gallon Side-Door Opening Litter Receptacle	Trashcan - SDC-45
1	Victor Stanley SDC-45 Recycle	45-Gallon Side-Door Opening Litter Receptacle	Trashcan - SDC-45 Recycle
1	Big Belly (Single and Double)	150-Gallon Compacting Litter Receptacle	Big Belly

SELF CONTAINED COMPACTOR CONTAINERS

Preferred Order	Brand & Model	Description	Click Link for Specs
1	Marathon RJ-250SC - 34 cubic yard	3-phase, 230 V, 10 hp, 7.5 kW, 120 VAC. Clearance: 24" sides, 42" front, 6'6" overhead.	Compactor - RJ250SC

XLERATOR® Hand Dryer



Model XL-SB Brushed Stainless Steel Cover

XLERATOR XL-SB

Product Features

- > Activation: Automatic Sensor Operated
- > Mounting: Surface Mounted
- > Dimensions: 11 3/4" W x 12 11/16" H x 6 11/16" D
- > Weight: 15-17 lbs.
- > ADA-Compliant: Available with Recess Kit
- > Warranty: 7-Year Limited
- > Cover Finish: White Epoxy, Textured Graphite, Special Paint, Special Image, Chrome Plated, Brushed Stainless Steel
- > Electric Hand Dryer Specifications: 110-120V – 11.3-12.2 Amps, 1240-1450 Watts, 50/60 Hz, 208-277V – 5.6 -6.2 Amps, 1160-1490 Watts, 50/60 Hz, 230V – 6.1 Amps, 1410 Watts, 50 Hz

XLERATOR® Hand Dryer

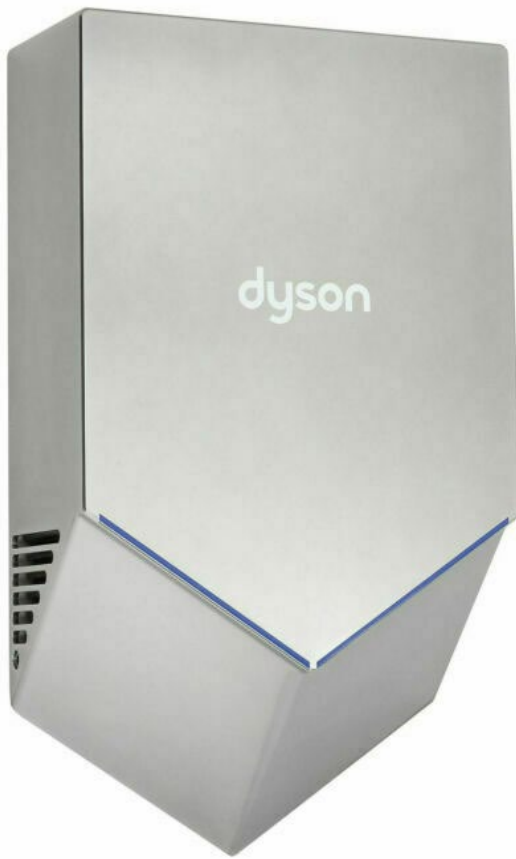


Model XL-GR Graphite Textured Painted Cover

Xlerator XL-GR

Product Features

- > Activation: Automatic Sensor Operated
- > Mounting: Surface Mounted
- > Dimensions: 11 3/4" W x 12 11/16" H x 6 11/16" D
- > Weight: 15-17 lbs.
- > ADA-Compliant: Available with Recess Kit
- > Warranty: 7-Year Limited
- > Cover Finish: White Epoxy, Textured Graphite, Special Paint, Special Image, Chrome Plated, Brushed Stainless Steel
- > Electric Hand Dryer Specifications: 110-120V – 11.3-12.2 Amps, 1240-1450 Watts, 50/60 Hz, 208-277V – 5.6 -6.2 Amps, 1160-1490 Watts, 50/60 Hz, 230V – 6.1 Amps, 1410 Watts, 50 Hz



Specifications

Weight

6.17 lbs

Dry time

12 seconds¹

Operating airflow

5.3 gal/s

Airspeed at open

420 mph

Rated power

1,000w

HEPA filter

Yes

Height

15.51 in (394 mm)

Width

9.21 in (234 mm)

Depth

4 in (100 mm)

Dyson Airblade V HU02 Nickel

atures

Motor speed

Up to 83,000 rpm

Decibel level

79db

Bacteria removal

99.97% of particles,³
including bacteria and viruses

Input voltage

100-120v (LV) 200-240v (HV)

1)



LOW VOLTAGE AND HIGH VOLTAGE TECHNICAL SPECIFICATION

Electrical

Input voltage: Low Voltage = 110-127 V, High Voltage = 208-240 V
Frequency: Low Voltage = 50 or 60 Hz, subject to voltage (85-115 V at 50 Hz; 85-130 V at 60 Hz); High Voltage = 50 & 60 Hz
Rated power: 1400 W
Motor type: Dyson digital motor V4 – brushless DC Motor
Motor switching rate: 6,100 per second
Motor speed: 92,000 rpm
Amp: Recommended dedicated 15 amp circuit, Low voltage = 11.7 amps at 120V, High voltage = 7.3 amps
Operating temperature range: 32°– 104°F
Heater type: None
Standby power consumption: Less than 0.5 W

Construction

Casing construction: Polycarbonate-ABS casing
Antimicrobial coating type: Antimicrobial molded additive in facia and blades
Color finish: Gray or White
Light reflective value: 28.3 (gray) 77.4 (white)
Galvanized steel back plate/mounting bracket
Exterior screw type: Anti-tamper M6 machine screw
Water ingress protection to IP25

Filter

Double-life HEPA filter (glass fiber and fleece prelayer)
Bacteria removal 99.97% at 0.3 microns

Operation

Touch-free infra-red activation
Hand dry time measurement: 12 seconds*
Operation lock-out period: 30 seconds
Airspeed at apertures: 420 mph
Maximum Altitude: 2,000m/6,561 ft.
Operating airflow: Up to 9.25 gallons/s and up to 74.2 CFM
Rated operating noise power: 81 db(A)

Logistics

Serial number prefix: Gray FT6; White FT7
Net weight: 18.1 lbs.
Packaged weight: 24.3 lbs.
Packaged dimensions: (H) 28^{15/16}" × (W) 14^{1/8}" × (D) 12"
UPC barcodes:
Gray – Low Voltage: 885609001050, High Voltage: 885609004440;
White – Low Voltage: 885609001067, High Voltage: 885609004433

Standard warranty

5 year parts and 1 year limited labor warranty

Accreditations

Carbon Trust
HACCP International
NSF International P335
ADA compliant
Contributes to LEED certification



Product range (Select one)

AB14 Gray

Part number/SKU

☐ Low Voltage: 301853-
☐ High Voltage: 300677



The Carbon Reduction Label is the registered trade mark of the Carbon Trust. HACCP International non-food certification mark is the registered trademark of HACCP International. HACCP International have certified Dyson products based on their recommended installation and operating conditions. The NSF logo is the registered trademark of NSF International.

*Dry time measured using Dyson test method 769 based on NSF P335 using a measurement of 0.1g residual moisture.

For more information, please contact Dyson: 1-888-397-6622,
www.dysonairblade.com, airbladeinfo@dyson.com



B-29744

Automatic, Universal Semi-Recessed Roll Towel Dispenser Equipped with LED Light

Intuitive, patron-friendly light directs users to towel activation zone. Satin-finish stainless steel. Door has tumbler lock and piano-hinge. Seamless satin-finish stainless steel beveled flange designed for semi-recessed installation in wall opening 16" W, 18 3/8" H, 4" D (405 x 480 x 100mm). Extends 5 1/4" (130mm) from wall. Battery requirements: 4 Alkaline "D" Cells (not included).

B29744 - BOBRICK



BOBRICK B-2860

B-2860

Surface-Mounted Roll Towel Dispenser

Satin-finish stainless steel. "touch-free" pull-to-dispense. Dispenses 12" (305mm) length per pull [1.8 lb. roll]. Accommodates 8" (205mm) diameter rolls, 800 ft (244m) long, per roll with automatic transfer. Includes tumbler lock and piano-hinge. Unit 11 3/4" W (300 x 380 x 230mm).

Wall Paper

owel mechanism

s (8.0 N)] of

wide, up to 8"

plus 3 1/2"

Door has

, 15" H, 9" D



Hybrid Electronic Roll Towel Dispenser

Enjoy Electronic Towel Dispensing with Guaranteed Access to Paper

The Hybrid Roll Towel electronic dispenser has a unique manual back up when batteries are low. It has the same great features of the Smart System.

FEATURES / BENEFITS

- Smart System with IQ sensor
- Adjustable paper length (8", 12", 16")
- Adjustable paper delay (0, 1 1/2, 3 seconds)
- Manual "Push" bar operation when batteries are low
- Choose from Classic or Summit™ Design
- Uses 4 D-Cell alkaline batteries



SPECIFICATIONS:

Item	Colors	Capacity	Core Diam.	H x W x D Dimensions
CLASSIC STYLE				
T8300TBK	TBK	(1) 8" wide roll (200 mm)	1½" (38mm)	16-1/2" x 13" x 9-1/4 " (419 x 330 x 235 mm)
SUMMIT™ STYLE				
T8370*	BKSS, SS, WHCL	(1) 8" wide roll (200 mm)	1½" (38mm)	16-1/2" x 13" x 9-1/4 " (419 x 330 x 235 mm)

* Specify desired color after item number Example: T8370BKSS
– Requires 4 D-cell alkaline batteries

SAN JAMAR T8300TBK



B2892 - BOBRICK

B-2892 ClassicSeries®

Surface-Mounted Twin Jumbo-Roll Toilet Tissue Dispenser

Satin-finish stainless steel. Equipped with tumbler lock. Spindles hold two 10" (255mm) diameter rolls with 2 1/4" (55mm) diameter core rolls; convertible for 3" (75mm) diameter core rolls. Sliding access panel exposes one roll at a time, allows easy roll change-over. Wide viewing slot in door. Quick reloading. Unit 20 13/16" W, 11 3/8" H, 5 5/16" D (530 x 290 x 135mm).



ASI 0040 - AMERICAN SPECIALTIES, INC.

0040
TWIN 9" JUMBO ROLL TOILETTISSUE DISPENSER –
SURFACE MOUNTED

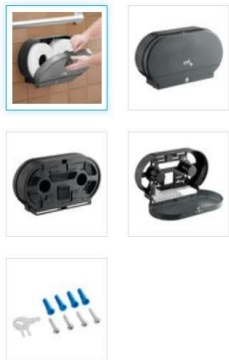
Holds two 9" (229 mm) diameter rolls of 2-1/4" or 3" (57 or 76 mm) diameter core. When one roll is depleted, slide panel to expose other roll. Door cabinet and mounting plate fabricated of 18 gauge type 304 stainless steel with a satin finish. Two viewing slots reveal toilet tissue rolls inside. Equipped with tumbler lock.

Model Options: 0040	▼

Lavex Janitorial 9" Double Roll Jumbo Toilet Tissue Dispenser

★★★★★ Read 6 reviews Item #: 7122JTDISP





Overall Dimensions:

Width: 20 1/2 Inches

Depth: 4 13/16 Inches

Height: 11 1/2 Inches

Roll Diameter: 9 Inches

- ✓ Holds two 9" rolls
- ✓ Integrated locking feature
- ✓ Effortless dispensing system
- ✓ Tiny teeth allow for easy tearing of tissue
- ✓ Sleek, translucent black finish
- ✓ Includes two molded keys

UPC Code:

755576020852



Quick Shipping

Usually ships in 1 business day



[View all Lavex Janitorial Commercial Toilet Paper Dispensers and Holders](#)



3253

Twin Jumbo Roll Tissue Dispenser

The high capacity, cost-effective, sanitary tissue solution.
Reduce waste. Reduce costs. Reduce labor.

von Drehle's Jumbo Roll Tissue Systems provide a cost-effective, sanitary solution for high-traffic locations, and the high capacity rolls reduce maintenance demands as well as the possibility of run-outs.

- No Perforations – Keeps the restroom environment cleaner
- Fully Enclosed/Locking Feature – Reduces waste by protecting tissue from damage and eliminates pilferage

Specifications

Item #: 3253

Description: Twin Jumbo
Roll Tissue Dispenser

Items Per Case: 4

Cases Per Pallet: 28

Depth: 4.825"

Brand Name: von Drehle

Color: Smoke

Base: Black Polystyrene

Cover: Smoke

Polycarbonate

Case Cube: 2.83

Height: 11.5"

Shipping Weight: 17.3

For Use With: 1208-8,
1209, 120VT, 2109, PQ800,
9021, 3109, JRT002

Sanitary Napkin Receptacles

Space-saving and easy to service.

- Tight-fitting lids help contain odors
- Removable rigid liner is easy to clean and maintain
- Durable plastic and metal receptacles



FG11SS

No.	Color	Description	U.S. Dimensions	U.S. Ship Wt/Ctn	Metric Dimensions	Metric Ship Wt/Ctn	Material Type	Pack
FG614000	WHT	Sanitary Napkin Receptacle with Rigid Liner	10.75" l x 5.25" w x 12.5" h	2.6 lb	27.3 cm x 13.3 cm x 31.8 cm	1.2 kg	Plastic	1
FG614100	0000	Waxed Bags for Sanitary Napkin Receptacle 50 bags/bundle; 250 per carton	8.75" l x 8.5" h	6.2 lb	22.2 cm x 21.6 cm	2.8 kg		1/250
FG10	WHT	Sanitary Napkin Wall Mount with Drop Bottom	8.75" l x 4.5" w x 11" h	4.0 lb	22.2 cm x 11.4 cm x 27.9 cm	1.8 kg	Powder Coated	1
FG11	SSSTL	Sanitary Napkin Wall Mount w/Drop Bottom includes (3) 6141 Waxed Bags	5.75" dia x 9.25" l x 11" h	3 lb	14.6 cm dia x 23.5 cm x 27.9 cm	1.4 kg	Stainless Steel	1

FG11SS - RUBBERMAID



GLOBAL INDUSTRIAL - WGB794099

Impact® Safe-Use® Plastic Sanitary Napkin Receptacle - Black, 1103

Item #: WGB794099

★★★★★ (5)

Ships in One Business Day ?

Enter [zip code](#) for delivery date estimate



Product Information

[Photo/Video Gallery](#)

[Customer Review](#)

[Product Q&A](#)

[Accessories](#)

Safe-Use® Plastic Sanitary Napkin Receptacle - Black

Safe-Use® Plastic Sanitary Napkin Receptacle. Unit empties from the bottom so hands never touch the contents. Prevents the spread of disease or cross-contamination. Unit operates by pulling bottom forward; liner automatically drops into waste receptacle. Can be used on floor as single or double unit; wall mountable. Each unit contains complimentary waxed bag.

Weights & Dimensions

Width	9 in
Length	10-5/8 in
Height	4-5/8 in
Weight	6.6069 lbs

Product Details

Mounting Location	Wall
Description	Receptacle Napkin Sanitary Safe Use Plastic Black
Type	Sanitary Receptacle
Brand	Impact Products
Package Quantity	1
Material	Plastic
Style	Single Sided
Manufacturers Part Number	1103
Color Family	Black



B-221 ClassicSeries®

Surface Mounted Seat-Cover Dispenser



Satin-finish stainless steel*. Dispenses 250 single- or half-fold toilet seat covers or one box. Fills from bottom. Unit 15 3/4" W, 11" H, 2" D (400 x 280 x 50mm). Allow 5" (125mm) minimum clearance from bottom of dispenser to top of any horizontal projection for filling dispenser from below unit.

Available in **matte black finish.*

B-221 - BOBRICK



FMX-20 - GOJO

GOJO® FMX-20™ Dispenser

Push-Style Dispenser for GOJO® Foam Soap

High-capacity foam soap dispenser.

- High-capacity design
- ADA compliant, one-handed push operation
- Converts to a locking dispenser - key sold separately
- Compatible with GOJO® FMX-20™ 2000 mL refills

Features	Specifications	Sustainability	Related Programs
SKU	5271-06		
Size	2000 mL		
Case Pack	6		
Case Weight	12.0 lbs		
Overall Case Dimensions	14.25 h x 12.12 w x 13.38 d		
Overall Unit Dimensions	4.68 h x 6.5 w x 11.66 l		
Case Cu. Ft.	1.34 ft ³		
Cases Per Layer	9		
Cases Per Pallet	27		
Layers Per Pallet	3		
Dispensing System	FMX		
Product Type Packaging	Wall Mount Dispensing		
Refill Material	Lightweight PET plastic bottle, polypropylene collar, mixed material plastic pump.		
Refill Recyclability	Remove pump on refill for easy recycling.		
Refill Features	SANITARY SEALED™ refills are hygienic locking out germs.		
Dispenser Material	Durable ABS Plastic with rugged polycarbonate view windows (both recycling code number 7).		
Mounting Options	Mounts to wall with adhesive tape (included) or optional mounting screws (not included). Multiple hole pattern allows use of existing wall holes.		
Mounting Clearance	10" (25.4 cm) clearance from bottom of dispenser to surface		
Country of Manufacture	United States		
UPC (Each)	073852056273		
Case UPC (GTIN)	10073852056270		

Koala Kare KB200 Horizontal Baby Changing Station Wall Surface M



KB200 KOALA KARE

Description	Features	Specifications	Data Sheets
Koala Kare KB200 the gold standard for baby changing stations. White popular color option for 2022. Koala Kare KB200 horizontal baby changing station is the category leader popular plastic baby changing station. This Koala Kare baby changer is constructed of polypropylene and a unit this baby changing station is for changing infants, age up to 3.5 years, weight up to 50 lbs. The model has been strength tested to 200 lbs with minimal deflection hinge has greater resistance to wear and improved durability and the gas spring ensures smooth open and close of the unit. Its sleek design and color palette fits a modern restroom design and décor. The dual liner cavity with lock minimizes and discourages potential vandalism. The product includes child protective hooks. ASTM and EN compliant. Meets ADA requirements when mounted on a wall. The surface exclusively contains Microban® antimicrobial, reducing odor caused by bacteria. The dispenser features two liner cavities. Each cavity holds 25 liners, for a total of 50 liners per unit. Constructed with 16% recycled materials; contributes to LEED building requirements.			
Description	Features	Specifications	
Unit Dimensions: 35 3/16" W x 22 1/4" H (890 mm x 569 mm)			
Depth (closed): 4" (102 mm)			
Extension (open): 23 3/16"(589 mm)			
Shipping Weight: 28 lbs			
Age Limit: Up to 3.5 Years			
Weight Limit: 50 lbs			

Granite is our most

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n. The steel-on-steel
s spring mechanism
alette matches
izes operator refills
ion straps and bag
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ombined total of 50
.EED certified

Data Sheets

93 mm x 565 mm)

Slim Jim Rubbermaid Container - Standard Bar Capacity - Black - Black



Color	Black
Brand	Slim Jim
Capacity	23 Gallons
Material	Plastic
Item Dimensions LxWxH	22 x 22 x 30 inches
Shape	Rectangular
Item Weight	6.9 Pounds
Special Feature	Pull Out/Under Counter

About this item

- Efficient size and shape for tight places, such as behind restaurant bars and all
- Easy to clean, long life.
- Crack-resistant, even under tough indoor/outdoor conditions.

Product Specifications

Color	Black
Ean	0086876164855 , 0640206814768 , 0640206814768
Item Shape	Rectangular
Item Weight	6.90 pounds
Model Number	3540BLA - EA
Part Number	FG354000BLA
Size	Rectangular
Special Features	Pull Out/Under Counter
UNSPSC Code	47121700
UPC	640206814768 , 086876164855 , 640206814768

RUBBERMAID FG354000BLA

se - 23-Gallon

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RUBBERMAID RCP354060BLA / FG354060BLA

SPECIFICATIONS

Product Length
Product Width
Product Height
Product Weight
Case Pack Quar
Color
UPC

STANDARD SLIM JIM® 23 GAL BLACK

3354060BLA

Seabrook Commercial Slim Jim® containers with venting channels offer the promised performance in constrained spaces.

Venting channels make removing liners from the container up to 80% easier, improving productivity and reducing the risk of worker injury.

Draw bag cinches secure liners around the rim of the container and create quick, no-tie liner changes.

Robust handles at the base and rim of the container resist tearing and improve control while lifting and emptying.

Reinforced rim resists crushing while the step design prevents jamming when nested.

Crafted of the highest quality commercial-grade materials for superior durability.

	U.S.	Metric
	22.00 in	55.88 cm
	11.00 in	27.94 cm
	30.00 in	76.20 cm
	7.80 lb	3.54 kg
Quantity	4	
	Black	
	00086876186352	

Lavex Janitorial Economy 23 Gallon Black Slim Rectangular Trash Can

[Leave a review](#) Item #: 475WH23BKA



LAVEX 475WH23BKA

Details



Providing an excellent, compact solution for waste management, this Lavex Janitorial Economy slim trash can is the perfect addition to restaurants, healthcare facilities, schools, offices, and home space is at a premium! The base and rim are both reinforced so you can confidently transport anywhere area to another without fear of it breaking or bending, even while transporting heavy loads. Plus, the clean, heavy-duty plastic surface cuts down on cleanup time and effort.

The convenient container features venting channels that create ample airflow to reduce the vacuum effect that occurs when lifting out trash liners. The added air circulation makes removing liners significantly easier than traditional containers, helping to save valuable time, reduce excess labor, and minimize the risk of injuries. With its slender design that ensures a superior fit in tight spaces, this trash can is sure to keep your facility clean and organized!

Overall Dimensions:

Width: 20"

Depth: 11"

Height: 31"

Capacity: 23 gallons

SPECS	
Quantity	1/Each
Width	20 Inches
Depth	11 Inches
Height	31 Inches
Capacity	23 Gallons
Color	Black
Color Badge	Colors
Features	Stackable
Installation Type	Freestanding
Lid Type	No Lid
Material	Heavy Duty Plastic
Shape	Rectangle
Stackable	Yes
Style	Slim
Type	Trash Cans

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RUBBERMAID COMMERCIAL PRODUCTS

Trash Can: Ranger(R), Square, Canopy Top, 45 gal Cap

Item # **2FTF1**

UNSPSC # **47121702**

Catalog Page # **1553**

Mfr. Model # **FG917388BLA**

Catalog Group # **D0237**

Country of Origin USA. Country of Origin is subject to change.

Ranger Series outdoor trash cans from Rubbermaid are weather-resistant, making them ideal for collecting waste in areas exposed to rain, snow, and extreme temperatures. The can features a hinged lid that provides access to the liner bag and hinged doors that hide contents from view, helping to control odors and preventing pests and rodents from entering the can. Use them in parks, outdoor food courts, stadiums, and office parks.

Decorative outdoor trash cans are used to collect trash while providing a professional appearance. They are used in parking garages, parks, and at building entrances to provide people a place to dispose of trash or waste.

Technical Specs

Container Product Grouping	Trash Can
Container Shape	Square
Top Type	Canopy
Trash Container Capacity	45 gal
Color	Black
Height	41 1/2 in
Width/Diameter	24 3/4 in
Depth	24 3/4 in
Material Grouping	Plastic
Specific Container Material	Plastic
Finish	UV Protectant
Location	Indoor/Outdoor

Mobility	Stationary
Lid Options	Lid Included
Lid Connection	Hinged
Lid Opening Mechanism	None
Container Mounting Style	Free-Standing
Series	Ranger(R)
Features	Designed For Shopping Mall Traffic Areas. Hinged Lid For Easy Emptying
Includes	Permanently Mounted / Easy Emptying
Standards	ADA Compliant Approved

RUBBERMAID RANGER FG917388BLA

capacity, Black

aking them suitable for
They have a hinged lid
m sight while containing
in high-traffic areas such

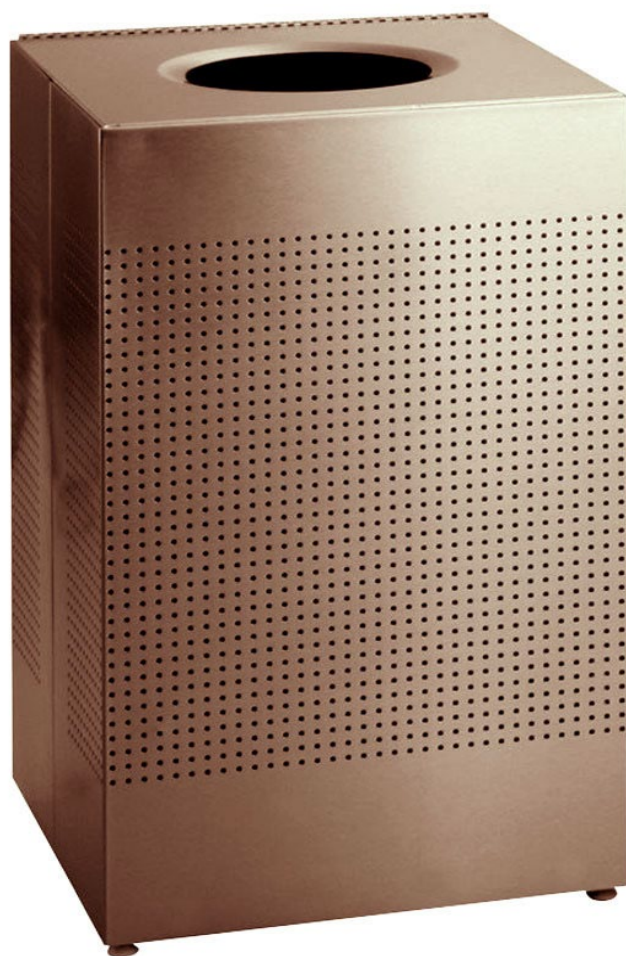
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a convenient means for

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Stadiums, Parks,
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or Easy Emptying.

Attached Hinged Lid For
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RUBBERMAID SILHOUETTE FGSC22ERBDP

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Product

SKU:

Weight (lb:

Manufactur

Manufactur

GTIN:

Product

Manufact

Manufact

GTIN

Rubbermaid FGSC22ERBDP LHOUETTE SQ OPEN TOP 39L/50G DP

Technical details

	kpi009-FGSC22ERBDP
Weight (kg):	51.000000
Manufacturer Part Number:	FGSC22ERBDP
Manufacturer:	Rubbermaid
	97591123409

Product description

Manufacturer	Rubbermaid
Manufacturer Part Number	FGSC22ERBDP
	97591123409



Rubbermaid 2956 Wastebasket, Rect

Color	Black
Brand	Rubbermaid
Capacity	7 Gallons
Material	Plastic
Item Dimensions LxWxH	10.25 x 15
Shape	Rectangular
Opening Mechanism	Swing-Lid
Item Weight	2.5 Pounds
Recommended Uses For Product	Commercial

About this item

- Sold as 1 Each.
- Fits in well in many home and commercial settings.
- Rims add durability, are easy to clean.
- All-plastic construction won't rust.
- Dimensions: 15"H x 10.25"W

RUBBERMAID 295600BK

00BK Deskside Plastic :angular, 7 gal, Black

d Commercial

inches

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nd work environments.

/ to clean.

't chip, rust or dent.

/ x 14.4"D. Fits under standard-height desk.



RUBBERMAID COMMERCIAL PRODUCTS

Recycling Wastebasket: Rectangular, Open Top

Item # 5M785

Mfr. Model # FG295673BI

UNSPSC # 47121702

Country of Origin USA. Country of Origin is subject to change.

Rectangular plastic recycling wastebaskets fit under standard-height recyclables such as paper and plastic. They are typically placed near rooms, or other locations where recyclable materials are encountered.

Technical Specs

Container Product Grouping	Recycling Wastebasket
For Recyclable Material	Bottle, Can, Paper, Plastic
Trash Container Capacity	7 gal
Top Type	Open
Number of Openings	1
Container Markings	Recycle Symbol
Total Capacity	7 gal
Color	Blue
Container Shape	Rectangular

Height	15 in
Width/Diameter	10 1/2 in
Depth	14 1/2 in
Material Grouping	Plastic
Specific Container Material	Plastic
Mobility	Static
Series	BRU
Standards	PCR
Green Environmental Attribute	Proc Posi

RUBBERMAID FG295673BLUE

), Blue, 7 gal Capacity

LUE

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ar workstations, in conference
red or where floor sp. [View More](#) ✓

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t-Consumer Recycled Content



RUBBERMAID COMMERCIAL PRODUCTS

Recycling Wastebasket: Rectangular, Open Top

Item # **5M781**

Mfr. Model # **FG295573**

UNSPSC # **47121702**

Country of Origin USA. Country of Origin is subject to change.

Rectangular plastic recycling wastebaskets fit under standard-height recycling bins. They are typically placed in offices, classrooms, or other locations where recyclable materials are encountered.

Technical Specs

Container Product Grouping	Recycling Wastebasket
For Recyclable Material	Bottle, Can, Paper, Plastic
Trash Container Capacity	3 1/4 gal
Top Type	Open
Number of Openings	1
Container Markings	Recycle Symbol
Total Capacity	4 gal
Color	Blue
Container Shape	Rectangular

Height	11 1/2 in
Width/Diameter	11 1/2 in
Depth	11 1/2 in
Material Grouping	Plastic
Specific Container Material	Plastic
Mobility	Stationary
Series	Blue
Standards	Plastic
Green Environmental Attribute	Plastic

RUBBERMAID FG295573BLUE

op

3BLUE

eight desks and are used to collect
near workstations, in conference
tered or where floor sp. [View More](#) ✓

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B-239 x 34

Shelf with Mop and Broom Holders and Hooks

34" L x 13" H, three anti-slip mop holders, four hooks, satin-finish stainless steel



BOBRICK B-239

MATERIALS:

Mounting Base and Shelf — 18-8, type 304 stainless steel, 8" (205mm) deep.

Shelf Support Brackets — 18-8, type 304 stainless steel.

Mop/Broom Holders — 18-8, type 304 stainless steel.

Hooks — 18-8, type 304 stainless steel, 1/2" x 1/2" x 1/2" rivets.

OPERATION:

Utility shelf with hooks to accommodate hanging stored materials.

INSTALLATION:

Secure unit to wall construction, provide wall surfaces, provide expansion bolts.

SPECIFICATION:

Utility shelf with mop and broom holders and hooks. Surfaces shall have front edge height.

STANDARD STOCK SIZES

Model No.	Length	Dim. Y	Shelf Brackets	No. of Hooks	No. of Mtg. Holes	No. of Mop Holders
B-239 x 34	34" (865mm)	NA	2	4	6	3

nd Shelf — 18-8, type-304, 18-gauge (1.2mm) stainless steel with satin finish. All-welded construction. Shelf p with 3/4" (19mm) return edge on all three sides. Front edge is hemmed for safety.

ackets — 18-8, type-304, 16-gauge (1.6mm) stainless steel with satin finish. Welded to mounting base and

ders — Spring-loaded rubber cams with anti-slip coating. Plated steel retainers.

ie-304, 12-gauge (2.8mm) stainless steel with satin finish. Each hook attached to mounting strip with two

olders is designed to keep mops and brooms away from wall. Spring-loaded rubber cam holders dles from 7/8" to 1-1/4" (22 to 30mm) diameter. Utility shelf above handle area provides clear access to

with Phillips-head screws, furnished by manufacturer, at points indicated by an S. For plaster or dry wall ide concealed backing to comply with local building codes, then secure unit with screws furnished. For other ide fiber plugs or expansion shields for use with screws furnished, or provide 1/8" (3mm) toggle bolts or

rop/broom holders and rag hooks shall be type-304 stainless steel with all-welded construction; exposed e satin finish. Shelf shall be 18 gauge (1.2mm), 8" (205mm) deep with 3/4" (19mm) return edges, and shall mmed for safety.



GRAINGER APPROVED

Wire Shelving Unit: 48 in x 24 in x 80 in, Dry

Item # **16A694**

Mfr. Model # **SS-2**

UNSPSC # **24101501**

Catalog Page # **N**

Country of Origin China. Country of Origin is subject to change.

This Mobile Wire Shelving Unit is equipped with casters to help environments. The open design allows 4-way access to shelv provide easy mobility.

Technical Specs

Item	Wire Shelving Unit
Material	Steel
Finish	Zinc-Plated
Color	Silver
Overall Depth	24 in
Overall Height	80 in
Overall Width	48 in
Caster Wheel/Configuration	(4) Swivel
Caster Wheel/Tread Material	Polyurethane
Caster Wheel Diameter	5 in

GRAINGER SHELVING 16A694

, Split Sleeve, 4 Shelves, Silver

2448-74LZF

I/A

p store and transport equipment in a variety of
es on the cart, and the swivel casters help to

Load Capacity per Shelf	250 lb
Whole Unit Load Capacity	1,000 lb
Number of Shelves	4
Shelf Adjustment Type	Split Sleeve
Shelf Adjustment Increments	1 in
Shelving Configuration	Standalone
Adjustability	Adjustable
Includes	(16) Plastic Split Sleeves, (4) Posts with Levelers
Post Shape	Round
Recommended Environments	Dry



CRESCENT

CRS-2200



Product Details

CRESCENT

CRS-2200 -

The CRESCENT CRS-2200 was designed around the two features of today's style and function conscious specifications.

SPACE EFFICIENT - radial designed corner model that occupies

MAXIMUM UTILITY - front drop with stainless steel cap that facilitates equipment and reduces lifting of conventional equipment.

NOTE: All dimensions subject to manufacturing variance of plus or minus radial type.

Dimensions

CRESCENT - 6" front drop with Stainless Steel Cap

CRS-2200 - 28x28x12"

STERN-WILLIAMS CRS-2200

res most sought after by

is minimum floor space.

ilitates dumping of power

or minus 1/4" (6 mm). 12"

SELF-CONTAINED COMPACTOR



STANDARD SPECIFICATIONS

6" x 2" x 1/4" Longsills
1- 1/4" Solid Bullnose Inserted 4" and Fully Welded
1/2" Pull Plate with 1-1/4" Pull Hook (Double-End Pick-Up)
4" x 6" Solid Steel Nosecone Rollers with 1/2" Plate Brackets
3" Structural Channel Crossmembers on 16" Centers
8" Diameter x 6" Long Front and Rear Ground Rollers
7 Ga Floor
7 Ga Roof
7 Ga Front Sheet
7 Ga Side Sheets with (1) Fire Dept. Fitting and Plug Per Side
7 Ga Rear Door Sheet
Clear Top Opening: 37.2" x 57.5"
Cycle Time: 42.3 Seconds
Total Normal Force: 39,650 lbs
Total Maximum Force: 44,055 lbs
Normal Ram Face Pressure: 23.5 psi
Maximum Ram Face Pressure: 26.2 psi
Ram Penetration: 11 inches
Motor: 10 hp
Pump: 10.5 gpm
Normal Hydraulic Pressure: 1,800 psi
Maximum Hydraulic Pressure: 2,000 psi
Cylinder Stroke (Dual Cylinders): 37 inches
Cylinder Bore (Dual Cylinders): 4 inches
Cylinder Rod Diameter (Dual Cylinders): 2 inches
Hydraulic Reservoir Capacity: 20 gallons
Primed and Painted Any Standard Color

RJ-250SC Features

- Exclusive 41" x 58" (1041mm x 1473mm) top opening for bulky items.
- Continuous feeding capability — even while operating.
- Adaptable to special loading systems: security chutes, or total enclosures.
- Odor and pest control via marathons®.
- Easy loading from either ground or container.
- More than 24 tons (21,772 kg) of crushing force, less than 1/3 of its former size, saving valuable space.
- Fire hose connection provided on each side.
- Factory testing to ensure leak-proof operation.
- UL® and CUL® Listed.
- Also available as Green Built®, featuring power units and other environmental features.
- Great for high liquid waste.
- Large 41" x 58" (1041mm x 1473mm) top opening.
- Full Door Seal with P-Seal.
- Bubble Gate with Auto Relatch and Lock.
- Qwik Clean® Tank.
- CYCON's Life-Xtender® Cyclic Control System.
- Signature Series Warranty.



Commercial (FEL) & Roll Off (RO): Container & Truck info

mm) feed opening to handle large,

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s such as large- capacity hoppers,

's ozone odor Control option.

lock level.

shing force to reduce refuse to a
uable space.

ch unit.

construction.

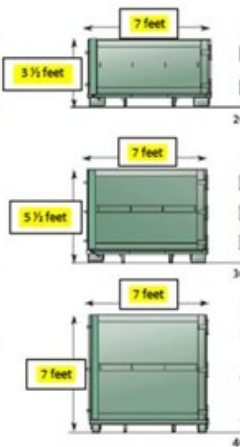
iring Solar or 5 hp high-efficiency
ally friendly components.

) Feed Opening

Double-Hinge Door

ol System

Roll Off Container Information Sheet			
Container Type	Capacity	Dimensions	Access
20 yard RO	2.5, 8 yard containers	22'L x 7'W x 3.5'H	Top or side door for easy loading
30 Yard RO	3.75, 8 yard containers	22'L x 7'W x 5.5'H	Top or side door for easy loading
40 Yard RO	5, 8 yard containers	22'L x 7'W x 8'H	Top or side door for easy loading



- Roll Off Trucks:**
- 36' long / 10' wide (w/mirrors) / 14' high with receiver box
 - Required overhead service clearance = 21'
 - Required turning radius = 57'



- Roll off trucks are 36 feet long & need 21 feet of height clearance to deliver/pick up conta
- Roll off trucks need roughly 60 linear feet to deliver & pick up container (combined length
- Roll off trucks require a turning radius of 57 feet.





10-Yard Open-Top Container



10-Yard Open-Top Container



10-Yard Open-Top Container



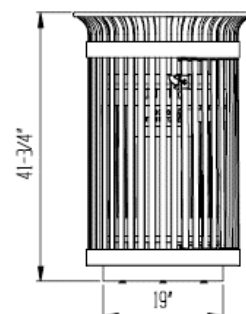
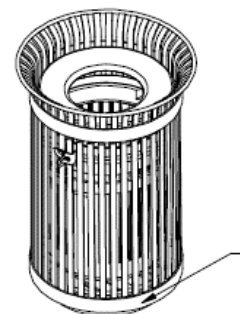
Roll-Off Truck

liner (because of tilt).

of truck & container).



VS VICTOR STANLEY
-Manufacturers of Quality Site Furniture-

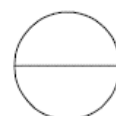


AVAILABLE OPTIONS:

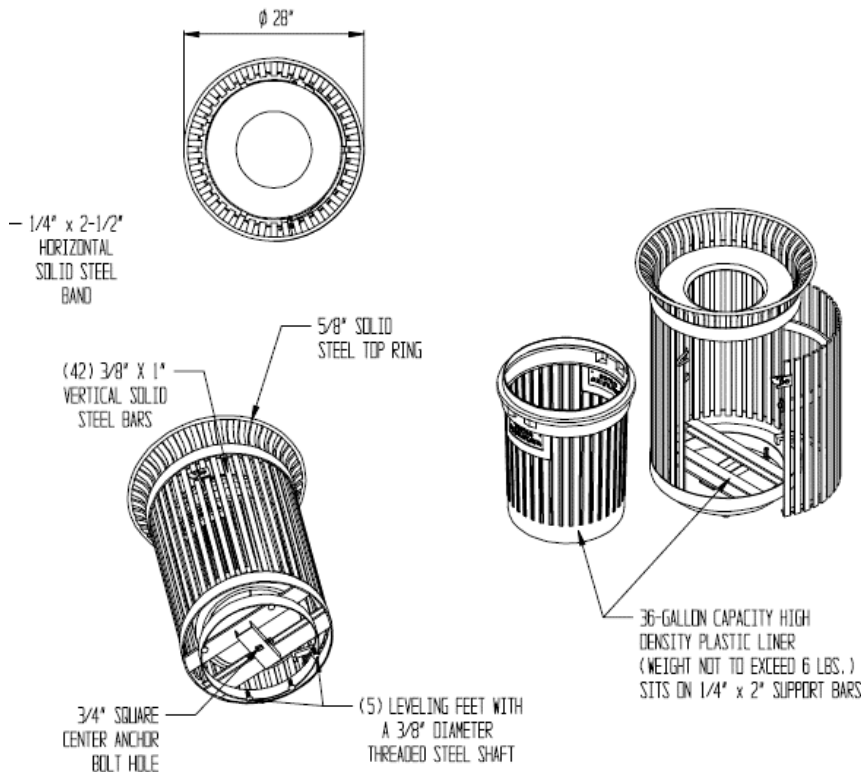
POWDER COATING
TO STANDARD COLORS, CUSTOM COLORS (INCL)
CUSTOM PLAQUES & DECALS
AVAILABLE WITH STEEL PLAQUES IN VARIOUS
VINYL OUTDOOR DECALS.

NOTES:

1. DRAWINGS NOT TO SCALE. DO NOT SCALE DRAWING.
2. ALL FABRICATED METAL COMPONENTS ARE STEEL POWDER COATINGS. PRODUCTS ARE FULLY CLEAN ARE THEN FULLY CURED TO COATING MANUFACTURER'S SPECIFICATIONS.
3. OIL IMPREGNATED BRONZE BUSHINGS AND STAIN PATENTED STAINLESS STEEL KEYED LOCK ASSEMBLY.
4. VICTOR STANLEY, INC., PLASTIC INNER LINER MAXIMUM CAPACITY AND STRENGTH WITH LIGHTWEIGHT MATERIALS. THIS MINIMIZES HANDLING DIFFICULTY.
5. THIS VICTOR STANLEY, INC. PRODUCT MUST BE ANCHORED TO CONCRETE OR ASPHALT.
6. ANCHOR BOLT NOT PROVIDED BY VICTOR STANLEY.
7. FOR HIGH SALT ABUSIVE CLIMATES, HOT DIP GALVANNEAL.
8. ALL SPECIFICATIONS ARE SUBJECT TO CHANGE.
9. THIS PRODUCT IS SHIPPED FULLY ASSEMBLED.

 **SD-42**
IRONSITES® SERIES

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REV. 7/16/07 DRAWN M.C.W. 2007-262



LIDS
LOADING THE RAL RANGE).
SIZES AND PRESSURE SENSITIVE
STANDARD TAPERED FORMED LID (AS SHOWN). AVAILABLE WITH OPTIONAL
S-2ASD FORMED DOME, S-2ASD FORMED DOME WITH STAINLESS STEEL ASHTRAY,
AND DS-32 FORMED DOME WITH SELF-CLOSING DOOR.
SECURITY
SHOWN WITH STANDARD LOCKABLE LATCH AVAILABLE WITH OPTIONAL KEYED
LOCK BOX. LID RIVETED IN PLACE. AVAILABLE WITH OPTIONAL MOUNT WITH
3 IN-LINE ANCHOR HOLES AND OPTIONAL BOTTOM PLATE COVER.

FINISHES
SHOTBLASTED, ETCHED, PHOSPHATIZED, PREHEATED, AND ELECTROSTATICALLY POWDER-COATED WITH T.G.I.C. POLYESTER
VED AND PRETREATED, PREHEATED AND COATED WHILE HOT TO FILL CREVICES AND BUILD FILM COATING. COATED PARTS
RER'S SPECIFICATIONS. THE THICKNESS OF THE RESULTING FINISH AVERAGES 8-10 MILS (200-250 MICRONS).
LESS STEEL PIVOT PINS FOR DOOR MOVEMENT, STANDARD 3/16" SOLID STEEL LATCH ASSEMBLY OR OPTIONAL
BLY.
S ARE MOLDED ON TOOLING DESIGNED FOR AND OWNED BY VICTOR STANLEY, INC. THEY OFFER
EIGHT CONSTRUCTION USING CRITICAL MOLDED RIBS, INTEGRAL HANDHOLES, AND HIGH-STRENGTH
ULTY AND FACILITATES EASY EMPTYING AND STORAGE WHILE AFFORDING LONG SERVICE LIFE.
E PERMANENTLY AFFIXED TO THE GROUND. CONSULT YOUR LOCAL CODES FOR REGULATIONS.
Y, INC.
GALVANIZING BEFORE POWDER COATING IS AVAILABLE. SEE WRITTEN SPECIFICATIONS FOR DETAILS.
CONTACT MANUFACTURER FOR DETAILS.

3 36-GALLON SIDE-DOOR-OPENING LITTER RECEPTACLE
SHOWN: STANDARD TAPERED FORMED LID

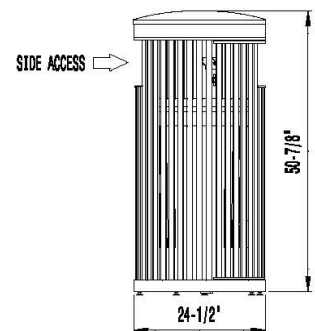
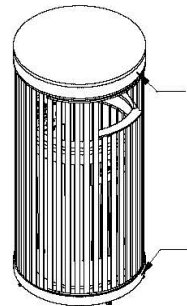
RESERVED



SDC-45

VICTOR  ST

Create a timeless moment.



AVAILABLE OPTIONS:

POWDER COATING

10 STANDARD COLORS, 2 OPTIONAL METALLIC COLO

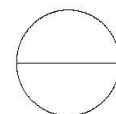
CUSTOM COLORS (INCLUDING THE RAL RANGE)

CUSTOM PLAQUES & DECALS

AVAILABLE WITH STEEL PLAQUES IN VARIOUS SIZE
AND PRESSURE SENSITIVE VINYL OUTDOOR DECALS.

NOTES:

1. DRAWINGS NOT TO SCALE. DO NOT S
2. ALL FABRICATED METAL COMPONENTS
COATINGS. PRODUCTS ARE FULLY CL
TO COATING MANUFACTURER'S SPECI
3. OIL IMPREGNATED BRONZE BUSHINGS
PATENTED STAINLESS STEEL KEYED
4. THIS VICTOR STANLEY, INC. PRODU
5. VICTOR STANLEY, INC., PLASTIC I
LIGHTWEIGHT CONSTRUCTION USING
6. EMPTYING AND STORAGE WHILE AFFO
7. ANCHOR BOLT NOT PROVIDED BY VIC
FOR HIGH SALT ABUSIVE CLIMATES,
EXPERIENCED QUALIFIED FIRM TO W
OF CHARGED LIQUID ZINC AT OR AR
TO THE STEEL SURFACE. AS A RESU
AS SMOOTH AS THE STANDARD FINIS
8. ALL SPECIFICATIONS ARE SUBJECT
9. THIS PRODUCT IS SHIPPED FULLY A



SDC-45
STEELSITES™

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REV. 2/19/19 DRAWN V.F.T. 2019-183

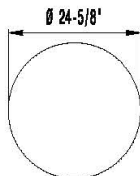
ANLEY®

P.O. DRAWER 330 - DUNKIRK, MD 20754 USA
TOLL FREE: (800) 388-2573 (USA & CANADA)
TEL (301) 855-8300 - FAX (410) 257-7579
WEB SITE: HTTP://WWW.VICTORSTANLEY.COM

* ALL DIMENSIONS ARE IN INCHES *

DERIVED FROM NSDC-36 RECEPTACLE. NSDC-36
COVERED BY ONE OR MORE OF THE FOLLOWING
PATENTS: U.S. 6,339,944 B1

1/4" x 2-1/2" HORIZONTAL
SOLID STEEL BAND



1/4" x 2" HORIZONTAL
SOLID STEEL BAND

3/8" x 1" VERTICAL
SOLID STEEL BARS

LEVELING FEET WITH
A 3/8" DIAMETER
THREADED STEEL SHAFT

3/4" SQUARE
CENTER ANCHOR
BOLT HOLE

45-GALLON CAPACITY HIGH
DENSITY PLASTIC LINER
(WEIGHT NOT TO EXCEED 7 LBS.)
SITS ON 3/8" x 3" SUPPORT BARS

LIDS

STANDARD WITH SOLID CONVEX LID, AVAILABLE WITH OPTIONAL SOLID CONVEX
LID WITH RAISED BAND (AS SHOWN), AVAILABLE WITH OPTIONAL STAINLESS
STEEL ASHTRAY. ASHTRAYS AVAILABLE WITH OPTIONAL ASHTRAY COVER.

SECURITY

STANDARD INTERIOR LATCH (AS SHOWN), AVAILABLE WITH OPTIONAL TRI-KEYED
LOCK BOX. LID BOLTED IN PLACE. AVAILABLE WITH OPTIONAL SIDE-ACCESS
PLATE WITH RECYCLE HOLES, OPTIONAL MOUNT WITH 3 IN-LINE ANCHOR HOLES
AND OPTIONAL ABS BOTTOM PLATE COVER.

SCALE DRAWINGS.

ARE STEEL SHOTBLASTED, ETCHED, PHOSPHATIZED, PREHEATED, AND ELECTROSTATICALLY POWDER-COATED WITH T.G.I.C. POLYESTER POWDER
LEARNED AND PRETREATED, PREHEATED AND COATED WHILE HOT TO FILL CREVICES AND BUILD FILM COATING. COATED PARTS ARE THEN FULLY CURED
IFICATIONS. THE THICKNESS OF THE RESULTING FINISH AVERAGES 8-10 MILS (200-250 MICRONS).

AND STAINLESS STEEL PIVOT PINS FOR DOOR MOVEMENT, STANDARD 3/16" SOLID STEEL LATCH ASSEMBLY OR OPTIONAL
LOCK ASSEMBLY.

MUST BE PERMANENTLY AFFIXED TO THE GROUND. CONSULT YOUR LOCAL CODES FOR REGULATIONS.

INNER LINERS ARE MOLDED ON TOOLING DESIGNED FOR AND OWNED BY VICTOR STANLEY, INC. THEY OFFER MAXIMUM CAPACITY AND STRENGTH WITH
CRITICAL MOLDED RIBS, INTEGRAL HANDHOLDS, AND HIGH-STRENGTH MATERIALS. THIS MINIMIZES HANDLING DIFFICULTY AND FACILITATES EASY
LOADING LONG SERVICE LIFE.

VICTOR STANLEY, INC.

HOT-DIP GALVANIZING BEFORE POWDER COATING IS AVAILABLE. HOT-DIP GALVANIZING IS PERFORMED FOR VICTOR STANLEY, INC. BY AN
WHICH PRODUCTS ARE SHIPPED FOR GALVANIZING. HOT-DIP GALVANIZING INCLUDES AN AGGRESSIVE PRE-TREATMENT AND IMMERSION IN A TANK
ROUND 860°F (460°C). THE RESULTING SURFACE IS RESISTANT TO RUST BUT HAS SOME UNEVENNESS RESULTING FROM THE BONDING OF THE ZINC
ILT, THE POWDER-COATING SURFACE FINISH OVER THAT GALVANIZED SURFACE MAY EXHIBIT BUMPS, UNEVENNESS, AND MAY NOT BE
H; THIS UNEVEN AND INCONSISTENT FINISH IS NORMAL FOR GALVANIZING. CONTACT MANUFACTURER FOR DETAILS.

TO CHANGE. CONTACT MANUFACTURER FOR DETAILS.

ASSEMBLED.

45-GALLON SIDE-DOOR-OPENING LITTER RECEPTACLE WITH SIDE DOOR ACCESS
SHOWN: OPTIONAL CONVEX LID WITH RAISED BAND
STANDARD INTERNAL LATCH

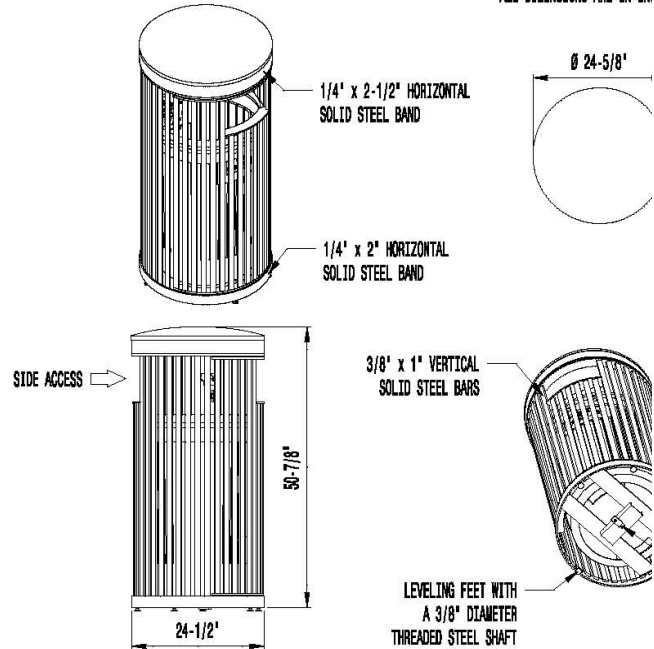
IVED



VICTOR STANLEY®

Create a timeless moment.®

* ALL DIMENSIONS ARE IN IN



AVAILABLE OPTIONS:

POWDER COATING

10 STANDARD COLORS, 2 OPTIONAL METALLIC COLORS, CUSTOM COLORS (INCLUDING THE RAL RANGE)

CUSTOM PLAQUES & DECALS

AVAILABLE WITH STEEL PLAQUES IN VARIOUS SIZES AND PRESSURE SENSITIVE VINYL OUTDOOR DECALS.

LID

SEC

NOTES:

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2. ALL FABRICATED METAL COMPONENTS ARE STEEL SHOTBLASTED, ETCHED, PHOSPHATIZED, PREHEAT COATINGS. PRODUCTS ARE FULLY CLEANED AND PRETREATED, PREHEATED AND COATED WHILE HOT TO COATING MANUFACTURER'S SPECIFICATIONS. THE THICKNESS OF THE RESULTING FINISH AVER OIL IMPREGNATED BRONZE BUSHINGS AND STAINLESS STEEL PIVOT PINS FOR DOOR MOVEMENT, ST PATENTED STAINLESS STEEL KEYED LOCK ASSEMBLY.
3. THIS VICTOR STANLEY, INC. PRODUCT MUST BE PERMANENTLY AFFIXED TO THE GROUND. CONSULT
4. VICTOR STANLEY, INC., PLASTIC INNER LINERS ARE MOLDED ON TOOLING DESIGNED FOR AND ON LIGHTWEIGHT CONSTRUCTION USING CRITICAL MOLDED RIBS, INTEGRAL HANDHOLDS, AND HIGH-ST EMPTYING AND STORAGE WHILE AFFORDING LONG SERVICE LIFE.
5. ANCHOR BOLT NOT PROVIDED BY VICTOR STANLEY, INC.
6. FOR HIGH SALT ABUSIVE CLIMATES, HOT-DIP GALVANIZING BEFORE POWDER COATING IS AVAILAB EXPERIENCED QUALIFIED FIRM TO WHICH PRODUCTS ARE SHIPPED FOR GALVANIZING. HOT-DIP G OF CHARGED LIQUID ZINC AT OR AROUND 860°F (460°C). THE RESULTING SURFACE IS RESISTAN TO THE STEEL SURFACE. AS A RESULT, THE POWDER-COATING SURFACE FINISH OVER THAT GALVA AS SMOOTH AS THE STANDARD FINISH; THIS UNEVEN AND INCONSISTENT FINISH IS NORMAL FOR
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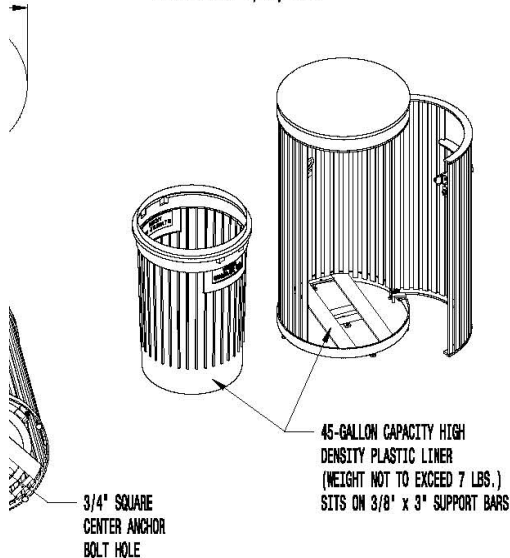


45-GALLON SIDE-DOOR-OPENING LITTER RECEPTACLE
SHOWN: OPTIONAL CONVEX LID WITH RAISED BAND
STANDARD INTERNAL LATCH

P.O. DRAWER 330 - DUNKIRK, MD 20754 USA
TOLL FREE: (800) 388-2573 (USA & CANADA)
TEL (301) 855-8300 - FAX (410) 257-7579
WEB SITE: [HTTP://WWW.VICTORSTANLEY.COM](http://www.victorstanley.com)

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DERIVED FROM NSDC-36 RECEPTACLE. NSDC-36
COVERED BY ONE OR MORE OF THE FOLLOWING
PATENTS: U.S. 6,338,944 B1



DS
STANDARD WITH SOLID CONVEX LID, AVAILABLE WITH OPTIONAL SOLID CONVEX
LID WITH RAISED BAND (AS SHOWN), AVAILABLE WITH OPTIONAL STAINLESS
STEEL ASHTRAY. ASHTRAYS AVAILABLE WITH OPTIONAL ASHTRAY COVER.

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STANDARD INTERIOR LATCH (AS SHOWN), AVAILABLE WITH OPTIONAL TRI-KEYED
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PLATE WITH RECYCLE HOLES, OPTIONAL MOUNT WITH 3 IN-LINE ANCHOR HOLES
AND OPTIONAL ABS BOTTOM PLATE COVER.

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AGES 8-10 MILS (200-250 MICRONS).
TANDARD 3/16" SOLID STEEL LATCH ASSEMBLY OR OPTIONAL

YOUR LOCAL CODES FOR REGULATIONS.
IGNED BY VICTOR STANLEY, INC. THEY OFFER MAXIMUM CAPACITY AND STRENGTH WITH
TRENGTH MATERIALS. THIS MINIMIZES HANDLING DIFFICULTY AND FACILITATES EASY

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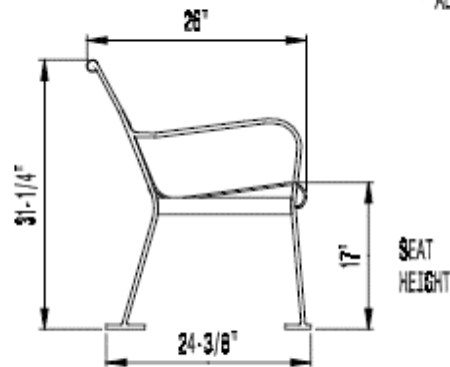


VICTOR STANLEY, INC.®

-Manufacturers of Quality Site Furnishings since 1962-

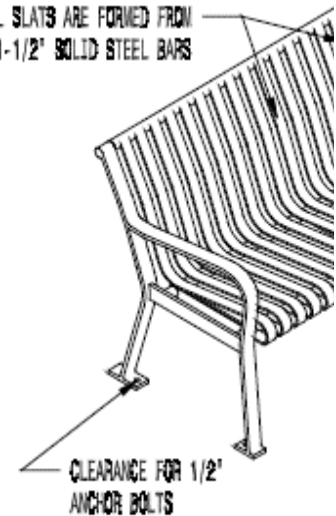
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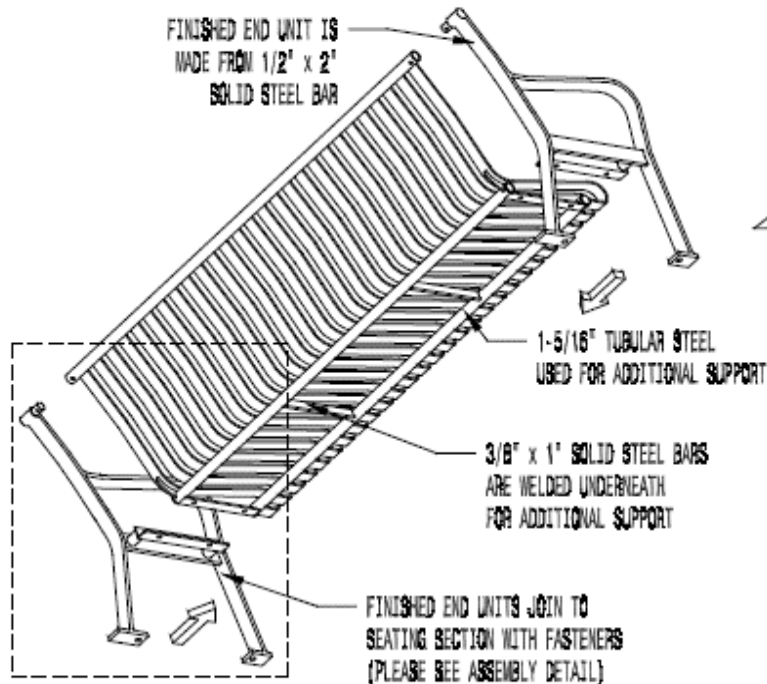


FRONT WELDS ARE POLISHED UNTIL
THEY DISAPPEAR, FORMING A
CONTINUOUS SURFACE

STEEL SLATS ARE FORMED FROM
1/4" x 1-1/2" SOLID STEEL BARS



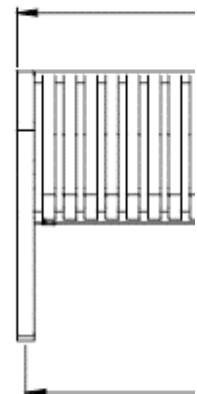
FINISHED END UNIT IS
MADE FROM 1/2" x 2"
SOLID STEEL BAR



1-5/16" TUBULAR STEEL
USED FOR ADDITIONAL SUPPORT

3/8" x 1" SOLID STEEL BARS
ARE WELDED UNDERNEATH
FOR ADDITIONAL SUPPORT

FINISHED END UNITS JOIN TO
SEATING SECTION WITH FASTENERS
(PLEASE SEE ASSEMBLY DETAIL)



AVAILABLE OPTIONS

POWDER COATING

10 STANDARD COLORS, 2 OPTIONAL METALLIC COLORS,
CUSTOM COLORS (INCLUDING THE RAL RANGE)

INTERMEDIATE & CENTER ARMRESTS

4', 6', & 8' AVAILABLE WITH OPTIONAL SOLID STEEL ARMRESTS

LENGTHS

STANDARD 4'

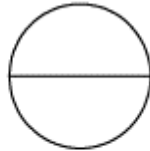
STANDARD 6' LENGTH SHOWN

STANDARD 8'

NOTES:

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- MANUFACTURER'S SPECIFICATIONS, THE THICKNESS OF THE RESULTING FINISH AVERAGES 8-10 MILS (200-250 MICRONS).
3. IT IS NOT RECOMMENDED TO LOCATE ANCHOR BOLTS UNTIL BENCH IS IN PLACE. THIS VICTOR STANLEY, INC. PRODUCT MUST BE PERMANENTLY AFFIXED TO THE GROUND. CONSULT YOUR LOCAL CODES FOR REGULATIONS.
 4. ANCHOR BOLTS NOT PROVIDED BY VICTOR STANLEY, INC.
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 7. THIS PRODUCT IS SHIPPED PARTIALLY UNASSEMBLED.

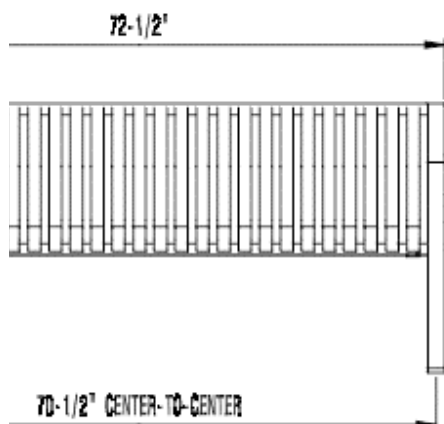
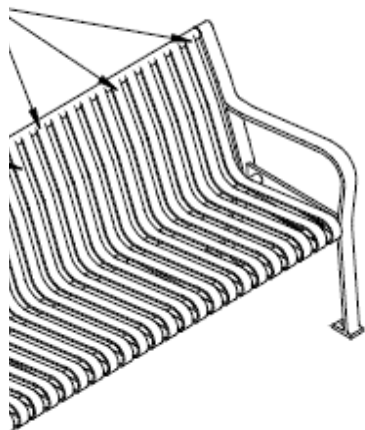


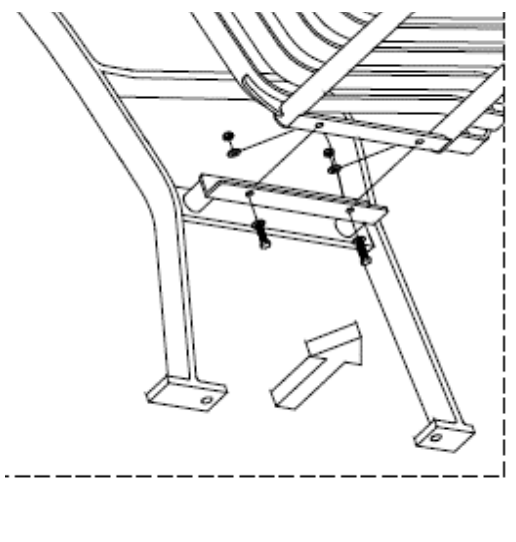
RB-28

STEELSPACES™ RB SERIES

ALL STEEL CONTOURED BENCH
SHOWN: STANDARD 6-FOOT LENGTH

MODEL 330 - DUNKIRK, MD 20754 USA
TEL: (800) 368-2573 (USA & CANADA)
TEL: 855-8300 - FAX (410) 257-7579
WWW.VICTORSTANLEY.COM







LEFT



FRONT



RIGHT



LEFT

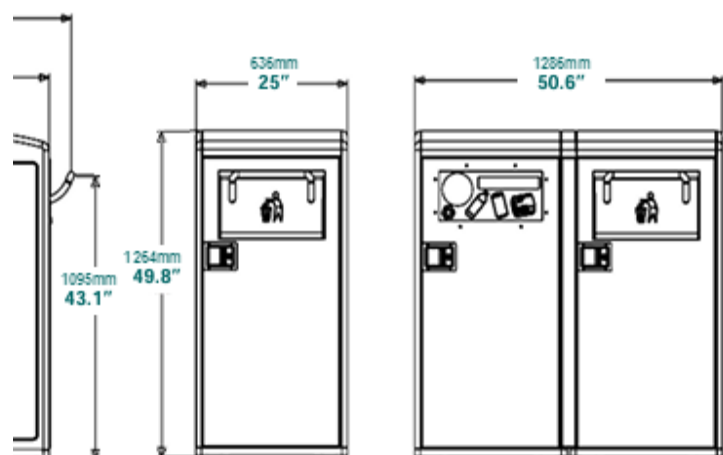


REAR

High Capacity Single unit



High Capacity Double unit



Bigbelly single station
Approximately 270 lbs (123kg)

Bigbelly & Smartbelly double station
Approximately 445 lbs (202kg)

Technical Specifications

Overall Machine Dimensions

Height: 49.8" (1264mm)
Width: 25" (635mm)
Depth: 26.8" (681mm)
Handle Height (ADA Compliant): 43.1" (1095mm)
Weight: 270 lbs (122 kg); Shipping weight: 300 lbs (136 kg)
Hopper Opening: 6" x 17" (152mm x 432mm)
Bin Volume: 33 gallons (125L) compacted trash; approx 150 gallons (568L) uncompacted trash

Compactor Features

Compaction: Up to 5-to-1 compaction ratio
Fully automated, microprocessor controlled system set and machine status
3-color LED status lamps indicate compacted trash level status and error codes
GPRS or CDMA wireless data link for remote monitoring and management
GPS assisted location service

Safety Features

CE approved
Fully interlocked access doors protect users and service
Locked front trash removal door. (Locked rear door optional)
Separately keyed service access
Fault-tolerant design for hopper insertion door prevents compaction area

Durability

Weather resistant, UV stabilized polyester powder-coated exterior parts
Electronic components temperature range of -40°F to +140°F (-40°C to +85°C)
Fully weatherized, but in the event of a flood, Bigbelly can withstand: - Up to 20" (508mm) of water without harming the electronics - Up to 36" (915mm) of water with only minor damage

	Bigbelly® High Capacity	Smartbelly® Standard Capacity
ght	49.8" (1264mm)	49.8" (1264mm)
dth	25" (635mm)	25" (635mm)
pth	26.8" (681mm)	26.8" (681mm)
ght	43.1" (1095mm)	-
ght	270 lb (122kg)	175 lb (80kg)
ght	300 lb (136kg)	205 lb (93kg)
age	12V	12V
ing low)	6" x 17" (15.2cm x 43.2cm)	Can be configured for multiple recycling or waste streams.
ime	33 gallons (125L) compacted; 150 gallons uncompacted	50 gallons (189L)
ags	Custom Bigbelly Liner Bags (#BBS-CB4647 or #BBS-RCB4647) are available for purchase. Contact WasteZero at 800.866.3954 or www.WasteZero.com/Bigbelly . The black or clear bags are 47"H x 46"W (120cm x 117cm) and 2.5mil (64µ) thick.	Custom Smartbelly Liner Bags (#BBS-RB4255) are available for purchase. Contact WasteZero at 800.866.3954 or www.WasteZero.com/Bigbelly . The clear bags are 55"H x 42.5"W (140cm x 108cm) and 1.25mil (32µ) thick.

(BB5)

6.08kg)

approximately 150

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+185°F

can withstand:
tronics
to electronics

KSU Utility Metering Standard

KSU's Metering Standard outlines the framework for real-time and ongoing measurement of energy and water consumption. The goal is to evaluate building performance, identify operational issues, and support strategies to reduce utility use. This standard ensures consistent and accurate monitoring across all campus buildings.

- All meters shall include installation and O&M documentation.
- Meters must be approved by Energy Management prior to procurement.
- All meters must be installed in accessible locations for service and maintenance.
- All meter signals shall be integrated into KSU's Energy Dashboard for real-time monitoring and analysis. BACnet/IP meters shall connect directly to the building network switch, while MSTP or Modbus meters shall connect to a networked building controller.
- The contractor shall ensure all meter data is visible on the Energy Dashboard prior to final approval.

Section 1: Electric Metering Standard

a. General/Communications:

The power meter shall measure, at a minimum, electrical energy consumption (kWh) and peak real power demand (kW).

The power meter shall communicate via native BACnet/IP, transmitting data directly to the building network switch for integration with the Energy Dashboard.

The power meter shall capture total building electrical consumption (kWh). Sub-metering is strongly recommended to separate building lighting, HVAC, and plug loads. For a new construction this can be achieved in the main electrical room by dividing loads based on panel configuration, eliminating the need to monitor every circuit in the building. By addressing this during the design phase, panels can be arranged to ensure these loads are monitored separately.

b. Location and Installation Requirements:

The meter shall be located in a readable location, five feet off the finished floor.

The meter shall be installed according to the manufacturer's guidelines, accounting for the size, amperage, and voltage of the measured line.

c. Basis of Design (or approved equal):

Building Level Meter:

1. Accuenergy Acuvim IIBN (Preferred)
2. Schneider PM5560
3. Honeywell E-Mon D-Mon Class 3400 (Preferred for submetering down past the switchgear)

Multi-Circuit Options (Only needed if branch circuit monitoring):

4. Schneider HDPM6000

d. Measurements and Accuracy:

The power meter shall perform, at a minimum, the electrical measurements defined in Appendix A.

For verification, commissioning, and setup purposes, the meter's default web UI page must display all units outlined in Appendix B.

The meter must be able to change the polarity of the current transformers (CTs) either locally using the LCD screen or remotely through the meter's default web UI page.

The power meter shall perform to the accuracy standards provided by the original equipment manufacturer.

As the meter is utilizing BACnet IP (Ethernet) communications, the power meter shall have data logging capability to protect the data in the event of a communications or power failure. The meter shall have a real-time clock that allows for time-stamping of all data collected when log events are created.

The meter must include a foreign device registration with a BACnet Broadcast Management Device (BBMD), allowing the device to participate in broadcasts across different subnets.

e. Reference Voltage/Fuse Protection:

Power supply to the meter shall not exceed 120 volts.

Use appropriately sized, NEMA-rated instrument transformers to step down voltage to 120 volts if necessary.

Protect the reference voltage with a fuse on the secondary side for safe power down of meter equipment.

The meter shall have a fuse kit or dedicated breaker for easy and safe power cycling of the device.

f. Current Transformers (CTs):

The CTs shall be standard 0.333mA (preferred) or 5A and conform to the ANSI Standard accuracy class for metering service of 0.3 or better (revenue metering) with burden B-0.1 to B-2.0 (with burden equal to or greater than that of the installed meter and any other connected equipment).

The extension of CTs is strongly discouraged and should only be done if necessary. If a CT extension is needed, the contractor/engineer shall read the manufacturer's instructions on the proper extension wire size and maximum length or calculate the additional burden of CT wiring and ensure that the total burden of the meter and associated wiring is within the rating of the CTs at the intended accuracy class of 0.3 or better.

Split Core and Rogowski CTs are strongly encouraged. Solid core may be used if deemed necessary after consulting plant operations personnel.

Verify that the CTs are compatible with the purchased meter and include an integrator component if the meter does not have this feature built in.

Section 2: Gas Metering Standard

a. Basis of Design:

ONICON F-5400 Series Thermal Mass Flow Meter (insertion or inline) (or approved)

ONICON F-5400 Series Inline Thermal Mass Flow Meters for pipe sizes < 1.5" (or approved equal)

Fox Thermal FT-1 Series (or approved equal)

b. Examination:

Examine the existing natural-gas piping system to verify actual locations of piping connections before equipment installation. Confirm that unsatisfactory conditions have been corrected.

c. Metering Technology:

The flow meter shall provide SFPM (Standard Feet Per Minute) flow readings from a pair of encapsulated platinum sensors and shall not require additional temperature or pressure compensation.

In addition, the meter shall allow for field validation testing of the current calibration and provide for a printed validation test report.

d. Installation Requirements:

Provide a flow conditioner if required to meet the manufacturer's minimum upstream straight pipe run requirement.

Installation hardware necessary to enable insertion and removal of the meter without system shutdown.

Hand-insertable up to 60 psi

e. Output Signals and Communication:

F-5400, one analog 4-20mA output and one totalizing pulse.

FT-1, one analog 4-20mA output (MSTP) or one totalizing pulse.

The F-5400 analog output shall be connected to an ONICON D-100 network display (or equivalent) to provide local or remote indication of flow rate and total. The D-100 output signal shall be BACnet UDP/IP/MSTP to ensure connection to KSU's Energy Dashboard.

If FT-1 provides a pulse output, it shall connect to an ONICON D-100 network display (or approved equal), which will then interface with a building controller.

If FT-1 provides an analog signal, it shall connect directly to a building controller.

All meter signals must make a home run connection to a building network controller to ensure integration with KSU's Energy Dashboard for real-time monitoring, totalization, data analysis, and energy conservation efforts.

f. Accuracy:

± 1% of rate from 500-7000 SFPM

± 2% of rate from 100-500 SFPM

Overall turndown > 1000:1

Each flow meter shall be individually wet-calibrated against a standard that is directly traceable to NIST (National Institute of Standards and Technology). A certificate of calibration shall be provided with each flow meter.

- g. Materials:** Materials of construction for wetted metal components shall be 316 SS.
 - h. Warranty:** 3-year manufacturing warranty and 1-year no-fault warranty
-

Section 3: Water Metering Standard

Domestic, Irrigation, Make-up, and Blowdown

The contractor shall be responsible for selecting the flowmeter options submitted based on the application. Flowmeter shall be selected for the intended application in terms of pipe size, pipe material, installation requirements, expected flow rate, ambient conditions and fluid characteristics which include but are not limited to pressure, temperature, and viscosity.

1. Basis of Design - Pipe Sizes 2.5" and Smaller:

ONICON Model F-4600 or FT-4600 Series Inline Ultrasonic Flowmeter (or approved equal).

F-4600, when MS/TP is acceptable

FT-4600, when IP is required, Paired with - Flow Display D-100 Series Display Module (or approved equal): For local and remote indication of flow rate and total.

Description:

Provide an inline flowmeter complete with direct beam wetted ultrasonic transducers, temperature sensor, mounting hardware and calibration certificate.

Design – Sensing Technology:

Ultrasonic flow sensing element shall utilize matched direct path, wetted ultrasonic transducers and 1000 OHM Platinum RTD.

Output Signal and Communications:

F-4600 Transmitter with Integral Display: Display shall visually indicate total fluid volume, instantaneous flow rate and fluid temperature.

Output signals shall be:

- One analog output via 4-20mA or RS485 serial network protocol either BACnet MS/TP or MODBUS RTU
- Pulse output (Gallons typical) for totalization of flow and BACnet meters shall be BTL certified.

Information provided via the serial communication network shall be able to communicate and integrate into KSU's Energy Dashboard. It shall also provide up to three additional auxiliary pulses configured as inputs or outputs and include:

- Flow rate
- Flow total
- Fluid temperature
- Trend including peak values

FT-4600 Transmitter:

- One analog output via 4-20mA
- Pulse output for totalization of flow (Gallons typical)
The analog output shall connect to an ONICON D-100 network display (or approved equal) to provide a BACnet UDP/IP to the BAS/BMS/Energy Dashboard. BACnet meters shall be BTL certified.

Information provided via the serial communication network shall include:

- Flow rate
- Flow total

Construction:

Flowmeter shall consist of a drop forged corrosion resistant metal flow body with process connections, integral transducers and a processor / transmitter.

All wetted materials shall be ANSI/NSF 61 & 372 compliant.

Maximum Pressure Rating: 400 psi or flange rating

Maximum Temperature Rating: 250°F

Mounting Connections:

For NPS ½" – 2": piping connections shall be male NPT threads

- For NPS 2 ½": provide ANSI class flange, rated for maximum system temperature and pressure'

Flow Range: Flow-measuring element and transmitter shall cover operating range of equipment or system served.

Accuracy: Flowmeter shall provide calibrated outputs directly from the transmitter, throughout the operating range with the accuracy stated as follows:

- Plus or minus 1.0% of flow rate over a 25:1 turndown
- Plus or minus 2.0% of flow rate over a 100:1 turndown
- Overall turndown of 500:1

2. Basis of Design - Pipe Sizes 3" and Larger (Preferred):

ONICON Model FT-3200 Inline Electromagnetic Flow Meter (or approved equal).
Paired with - Flow Display D-100 Series Display Module (or approved equal): For local and remote indication of flow rate and total.

Description:

Provide an inline electromagnetic flowmeter complete with NIST traceable, wet calibrated flow-measuring element, transmitter, visual display, ANSI Class 150 or 300 mounting flanges, and calibration certificate.

- Sensing Technology: Electromagnetic velocity-measuring element.
- Design: Electromagnetic sensing element shall utilize a minimum of two 316L stainless steel electrodes to measure the average flow rate velocity.

Transmitter with Integral Display: Display shall visually indicate total fluid volume and instantaneous flow rate.

Output Signal and Communications: When paired with D-100 network display, output signals shall be BACnet UDP/IP/MSTP via open collector pulse signal from FT-3200 meter, pulse output and one 4-20mA analog output. Pulse output for totalization of flow, Gallons typical. Information provided via the serial communication network shall include: Flow rate and flow total. All to ensure remote connection to KSU's Energy Dashboard.

Construction:

Flowmeter shall consist of epoxy painted carbon steel outer body, 304 stainless steel flow tube and integral liner to be selected based on operating temperature and fluid. Individual calibration tag shall be attached indicating calibration and programming information.

Maximum Pressure Rating: 580 psig.

Maximum Temperature Rating: 266°F.

End Connections for NPS 1.0" and Larger: ANSI Class 150 Flange typical.

Flow Range: Flow-measuring element and transmitter shall cover operating range of equipment or system served.

Accuracy: Flowmeter shall provide calibrated outputs directly from the transmitter, throughout the operating range with the accuracy stated as follows:

- Plus or minus 0.2% of rate from 1.6 to 33.0 ft/sec velocity.
- Plus or minus 0.0033 ft/s at flow rates < 1.6 ft/s

Calibration:

Each flowmeter shall receive a wet calibration, within the expected operating range, against a primary volumetric standard directly traceable to international standards in accordance with ISO 9104:1991 and ISO 17025:2005.

Transmitter Enclosure: Transmitter enclosure shall be cast aluminum, IP67 rated.

3. Basis of Design - Pipe Sizes 3" and Larger (Alternate):

ONICON Model FT-3500 Series Insertion Electromagnetic Flowmeter (or approved equal)

An alternate style meter may be used when appropriate based on application or installation conditions, such as meeting manufacturer's recommended straight pipe length, achieving specific accuracy requirements, or when hot tapping a live system is necessary.

Description:

Provide an insertion electromagnetic flowmeter complete with NIST traceable, wet calibrated flow-measuring element, remote transmitter, installation valves, adjustable installation depth gage and calibration certificate. The flowmeter shall be hot tappable, allowing insertion and removal from the flow stream without system shutdown.

- Sensing Technology: Electromagnetic velocity-measuring element
- Design: The electromagnetic sensing element shall utilize two sets of diametrically opposed electrodes to measure the average flow rate velocity.

Transmitter with Integral Display: Display shall visually indicate total fluid volume and instantaneous flow rate.

Output Signal and Communication: Output signals shall be BACnet UDP/IP/MSTP. Pulse output for totalization of flow, Gallons typical. Information provided via the serial communication network shall include: Flow rate, flow total. All to ensure remote connection to KSU's Energy Dashboard.

Construction:

Wetted components shall be constructed of 316L stainless steel with an attached tag

indicating calibration information. Sensor technology shall have a NEMA6 enclosure and NEMA4 local display.

Performance Ratings:

- Maximum Pressure Rating: 400 psig
- Fluid Temperature Rating: 15°F to 250°F
- Ambient Conditions Transmitter: -20°F to 150°F
- Flow Range: 0.1 ft/s to 20 ft/s (200:1 turndown)
- Accuracy: $\pm 1.0\%$ of reading from 2 - 20 ft/s | ± 0.02 ft/s below 2 ft/s
- Minimum Conductivity: 25 $\mu\text{S/cm}$

Pipe Size Range Available Options:

1 1/4" – 72" nominal diameter

End Connections for NPS 1.25" and Larger:

1" Male NPT Hot Tap Adapter fitting. Installation through 1" full port isolation valve, minimum.

Calibration:

Each flowmeter shall receive a wet calibration, within the expected operating range, against a primary volumetric standard that is traceable to NIST.

Local Display:

Local display shall provide instantaneous flow rate information and totalized flow information and shall be factory configured to a specific configuration given by the contractor.

Input Power:

- 22-26VDC with maximum power draw at 25 Watts
- 20-28VAC with maximum power draw at 30VA, 60 Hz

I/O Signals (Transmitter Shall Provide):

- Two (2) Analog Output: Active 4-20mA, 0-10V, or 0-5V
 - Two (2) Analog Inputs: Passive 4-20mA
 - Three (3) Digital Inputs/Outputs: Field selectable
 - One (1) Frequency Output: 0-15V peak pulse, 0-1000hz
-

Water Meter Execution

- a. **Installation:** Install flowmeters in accessible locations in piping systems based on manufacturer's recommendations regarding orientation and straight run requirements.

Install flowmeter elements with at least the minimum straight lengths of pipe, upstream and downstream from meter, required to produce the published flowmeter accuracy according to manufacturer's written instructions.

Installation and operating instructions shall be provided for each flowmeter.

- b. **Connections:** This contractor shall be responsible for connecting flowmeter transmitters to flow metering elements as required.
- c. **Commissioning:** After installation, commission all meters according to manufacturer's written instructions.

Adjust faces of meters and gages to proper angle for best visibility. Refer to manufacturers written instructions.

- d. **Flowmeter Schedule by Application:** Flowmeter selection, including flow sensing technology and materials of construction shall be based on accuracy requirements, installation requirements, fluid characteristics and ambient conditions. Flowmeters shall be selected and installed in accordance with the manufacturer's recommendations. Refer to drawings for additional information regarding flow metering applications.
- e. **Warranty:** 3-year manufacturing warranty and 1-year no-fault warranty
- f. **Electrical Connections:** Shall be removable terminal blocks.

Chilled Water (CHW) and Heating Hot Water (HHW) Metering

Basis of Design:

ONICON System-10 BTU Meter paired with ONICON electromagnetic flow meter (F-3100, F-3200, or F-3500, depending on pipe size) or approved equal.

BTU metering is required for CHW and HHW systems serving multiple buildings to measure building-level energy consumption. The metering system shall consist of a BTU energy

meter, a compatible flow meter, and paired supply and return temperature sensors. All components shall be from the same manufacturer to ensure accuracy and reliable performance.

Metering System Description:

Provide a complete BTU metering package that includes:

- A flow meter appropriate to the application (insertion or inline, based on pipe size)
- Dual temperature sensors (supply and return)
- A BTU processor with BACnet MSTP or Modbus RTU communication for integration with the BAS controller or other building controller
- NIST traceable calibration and factory configuration to site-specific settings

Design and Installation Requirements:

- Flow meters shall be flanged and valved to allow calibration and replacement.
- Installation shall follow all manufacturer recommendations, including required straight pipe lengths for accurate measurement.
- Metering components shall operate on 24 VDC and include an identification tag indicating pipe size and location.

Measurement Requirements:

The BTU meter shall calculate and report the metrics in alignment with what is listed in Appendix A:

Flow meters shall be sized for the system's midpoint operating load (not peak) to improve reading stability and accuracy. Minimum 2-year warranty required for all metering equipment installed.

Application Notes:

Alternate meter styles may be used based on installation constraints or application-specific needs (e.g., straight pipe limitations, hot tap installation, or specialized accuracy requirements), pending approval.

APPENDIX A: Building-Level Measured Utility Metrics

Live Point and Historical Trend Increment

Category	Description	Unit	Increment
Electrical	Demand	kW	15 min
	Consumption	kWh	15 min
	Power Factor	pF	15 min
	Apparent Power	kVA	15 min
	Reactive Power	kVAR	15 min
	Current	A	15 min
	Line-to-Neutral Voltage	V	15 min
	Line-to-Line Voltage	V	15 min
	Voltage Phase Angles	Degrees θ V	15 min
	Current Phase Angles	Degrees θ A	15 min
Natural Gas	Flow	cfm or cfh	15 min
	Consumption	cf	15 min
Domestic Water	Flow	gpm	15 min
	Consumption	gallons	15 min
Makeup Water	Flow	gpm	15 min
	Consumption	gallons	15 min
Chilled Water (CHW)	Energy Rate	kBTU/hr	15 min
	Energy Consumption	kBTU	15 min
	Tons of Refrigeration	Tons	15 min
	Ton-Hours	Ton-hours	15 min
	Supply Temperature	$^{\circ}$ F	15 min
	Return Temperature	$^{\circ}$ F	15 min
	Delta T	$^{\circ}$ F	15 min
	Flow	gpm	15 min
Heating Hot Water (HHW)	Energy Rate	kBTU/hr	15 min
	Energy Consumption	kBTU	15 min
	Supply Temperature	$^{\circ}$ F	15 min
	Return Temperature	$^{\circ}$ F	15 min
	Delta T	$^{\circ}$ F	15 min
	Flow	gpm	15 min
Solar PV	Solar Power	kW	15 min
	Solar Energy Produced	kWh	15 min
	Solar Irradiance	W/m ²	15 min
Environmental	Local Outside Air Temperature	$^{\circ}$ F	15 min

APPENDIX B: Set-Up & Commissioning Electrical Live Utility Metrics

Live utility metrics shall be viewable on both the meter's default web UI and the local LCD screen. The meter must, at a minimum, display all metrics outlined below on the local LCD screen and web UI page. A phasor diagram of phase angles on the web UI page is preferred.

Metrics	UNIT
Current (All Phases & Average)	A
Line-to-Neutral Voltage (All Phases & Average)	V
Line-to-Line Voltage (All Phases & Average)	V
Power Factor (All Phases)	pF
Voltage Phase Angles (All Phases)	°V
Current Phase Angles (All Phases)	°A



1. Introduction

Construction and renovation projects can have a significant negative impact on indoor environmental quality (IEQ) through the introduction of pollutants such as particulates, offensive odors, toxic chemical vapors, microbial, and combustion products. These contaminants may be entrained into the building heating ventilation and air conditioning (HVAC) systems and be transported to contiguous areas, subsequently affect populations beyond the immediate project area.

Pre-planning efforts that anticipate potential impacts on IEQ and specify adequate control strategies prior to a project should be viewed as an essential step to completing a project on time and within budget. As part of these efforts, the Project Managers should indicate appropriate project specification for maintaining adequate IEQ during and after construction, ensure review and selection of appropriate materials, adapt a proactive communication strategy to allay concerns and implement commissioning procedures that specifies re-occupancy criteria at project completion.

A. Purpose

The purpose of the document is to provide project managers with guidance on how to minimize the negative impact of construction projects on IEQ during construction and renovation projects.

B. Scope

These guidelines apply to all construction, demolition, and renovation projects at KSU campus buildings.

C. Acronyms and Definitions

EHS – Environmental Health and Safety

HVAC – Heating Ventilation and Air Conditioning

IEQ – Indoor Environmental Quality

PPE – Personal protective equipment

Project personnel – Persons engaged in construction activities either as employees of KSU or as contractors/third parties acting on behalf of KSU.

SDS – Safety data sheet

VOCs – Volatile organic compounds

2. Responsibilities

A. Project Manager

Project managers have the following responsibilities under these guidelines:

- Conduct a pre-construction review to identify the potential impact of the construction project on IEQ and develop control strategies.

- Incorporate IEQ goals and control strategies into the bid and project documents.
- Brief affected parties before and during construction and renovation activities of potential impacts they may have on IEQ and steps to be taken to reduce these impacts.
- Notify building occupants of any scheduled HVAC outages and non-scheduled outages when they are discovered.

B. Environmental Health and Safety Department

The Environmental Health and Safety (EHS) Department has the following responsibilities under these guidelines:

- Work with project manager to conduct pre-construction review and design feasible strategies to control potential IEQ impacts.
- Conduct IEQ monitoring during the project work, as necessary.
- Issue a “Stop Work” order if the IEQ of the project space or contiguous spaces is adversely affected by the construction project.

C. Project Personnel

Project personnel have the following responsibilities under these guidelines:

- Comply with the applicable KSU’s health and safety requirements as well as applicable federal, state, and local regulations.
- Implement control strategies, including engineering controls, to eliminate or minimize the impact of contraction activities on IEQ in the building subject to construction work or nearby buildings.
- Maintain acceptable IEQ within the space or contiguous spaces where the construction project is occurring.
- Provide all safety and personal protective equipment (PPE) required to complete the contracted scope of work – PPE must meet or exceed the requirements of the appropriate governmental regulatory agency.

3. Guidelines

A. Pre-Planning

Planning by project managers can lead to successful control of potential pollutants, allay concerns, and maintain occupant comfort during and after construction activities. During pre-planning, some key factors to assess include:

- Types of dusts or odors produced from:
 - Material being demolished
 - Products used in construction
 - Equipment used in construction
- Presence of pollutants that are a recognized hazard, as evidenced by the safety data sheet (SDS).
- Times and locations where occupants are most likely to encounter airborne pollutants.
- The expected amount and duration of exposure occupants may have to the pollutants.
- General safety and hygiene (i.e., keeping hallways and exits unobstructed).

As specific details of the project become clear, pollutant control methods can be tailored to the project. Specific control measures may involve:

- Protection of the HVAC system
- Control of the pollutant source
- Interruption of the pollutant pathway (plastic sheeting barriers, etc.)
- Housekeeping
- Scheduling considerations

B. Occupant Notification

Notifying area occupants of the proposed work, work schedule, and a description of the type of inconvenience it may cause is critical to the success of most projects. Specifically, occupants should be advised of potential odors, noise, dust generation, etc., well in advance of work so that individuals with pre-existing medical conditions can make alternate arrangements or go on a modified work schedule.

C. Pollution Control

Prior to commencement of work, project personnel should be made familiar with KSU's emergency procedures, and other safety regulations. Project personnel should wear appropriate PPE.

1. HVAC Protection

Where feasible, the HVAC system should be shut down for the duration of the demolition project. All return air openings within the designated work area should be sealed with 6-mil polyethylene sheeting and secured with duct tape.

When total HVAC isolation is not feasible, filter media with MERV of 8 should be used at each return grill. The filters should be frequently inspected during the project and replaced as needed.

The mechanical room must not be used to store construction or waste materials.

2. Source Control

All surfaces to be disturbed should be misted with water to minimize airborne dust. When possible, products emitting lower amounts of odor or volatile organic compounds (VOC's) should be used. If feasible, electric-powered equipment should be used in lieu of gasoline-powered equipment.

3. Pollutant Pathway Interruption

All return air openings within the designated work area should be sealed with 6-mil fire resistant polyethylene sheeting and duct tape to ensure contaminants do not enter the HVAC system.

Establish a complete physical isolation of the construction zone polyethylene sheeting of appropriate thinness.

The floor within the enclosure should be covered with one layer of 6-mil polyethylene sheeting. Each layer should be taped at all edges. All carpeting must be protected from contamination during construction unless new carpeting will be installed.

Adequate exhaust ventilation should be established to maintain a negative pressure differential between the work area and adjacent areas of the building (0.02 to 0.04 w.g). The established negative pressure should be monitored to ensure the containment remains under negative pressure. EHS may be contacted to provide this service.

As far as practicable, negative pressure ventilation units should be exhausted to the outside of the building. Careful installation and daily inspections should be performed to ensure exhausted contaminants do not re-enter the building through open windows or the air intake of the HVAC system and the ducts do not release construction debris into uncontaminated areas of the building.

The negative pressure systems should continuously operate while work is in progress. Damage and defects in the enclosure system are to be repaired immediately upon discovery.

Maintain the occupied spaces under positive pressure relative to the outside.

4. Housekeeping

After completion of the work, the entire work area (including walls, ceilings, floors, and other work surfaces) should be cleaned and vacuumed. All surfaces should be free from visible construction debris and dust.

5. Scheduling

Depending on the expected impact, some projects should be scheduled off-hours. If this is not feasible, a buffer zone should be established around the work area where no building occupants are permitted. Building occupants should not be allowed to remain in the area where construction activities are in progress.

6. Re-Occupancy Criteria/Commissioning

Prior to reoccupation of the project area, the worksite should be cleaned until there is no visible haze in the air and no settled dust is found on surfaces – there should be low to no detectable odors upon re-occupancy.

The HVAC system should be restored to good operating conditions when odors and visible emissions have dissipated or otherwise been eliminated.

Appendix

Pre-Planning Assessment Checklist

	What specific construction activities are likely to be source of chemical (vapor, odor, gases) or physical (dust, noise) pollutants?
	What occupied areas can potentially be affected by pollutants from the project activities?
	Are there especially susceptible occupants (elderly, asthmatic, pre-existing condition <i>etc.</i>) in affected areas?
	Have control options been identified and available control measures assessed?



1. Purpose

This safety program is intended to evaluate and identify the specific hazards where hot work is performed, communicating information concerning these hazards, and establishing appropriate procedures and protective measures for our employees and contractors.

This procedure establishes Kennesaw State University's (KSU's) process for managing hot work activities, including conducting risk assessments, providing authorization, and creating awareness in order to prevent injuries or loss from fire or explosion due to hot work activities.

Scope

This program applies to any hot work activities capable of initiating a fire or explosion and covers all KSU employees, students, contractors, and other personnel at workplaces under the management or control of KSU.

The following operations are not covered within this standard: electric or furnace-heated soldering irons and flameless heat guns. These operations should be covered by specific local procedures where these operations take place in areas specifically constructed, protected, and arranged to accommodate safe hot work process, e.g., welding shops, and that have been adequately assessed for risks and these risks have been controlled. This may include specific operations in laboratories, workshops, and commercial kitchens.

2. Definitions

Hot work – Work involving operations capable of initiating fires or explosions. This includes, but is not limited to, welding, burning, grinding, flame cutting, flame heating, brazing, soldering, and plasma cutting.

Hot work permit ("permit") – A document issued by KSU for the purpose of authorizing performance of a specified hot work activity.

Permit Authorizing Individual (PAI) – The individual designated by KSU to authorize hot work.

Project Manager – An employee who is responsible for planning, procurement, and execution of a project.

3. Roles and Responsibilities

A. Environmental, Health, and Safety Department

The Environmental, Health, and Safety (EHS) Department's roles and responsibilities are as follows:

- Develop, manage, review, and revise the Hot Work Safety Program.
- Communicate requirement of the program to affected member of the campus community.
- Issue hot work permit and conduct inspection to ensure compliance.
- Take responsibility for the overall management of the Hot Work Program.
- Establish permissible areas for hot work activities.
- Serve as the Permit Authorizing Individual (PAI).
- Ensure individuals involved in hot work operations, including contractors, are familiar with the provisions of this program.

B. Project Managers

Project managers have the following roles and responsibilities:

- Communicate KSU hot work requirements to all contractors under their purview.
- Make available and distribute hot work permits to KSU personnel and contractors upon request.
- Coordinate all hot work requests with contractors

C. Permit Authorizing Individual

The permit authorizing individual (PAI) must be aware of the hazards posed by the hot work process and be familiar with applicable regulations. Additional roles and responsibilities include the following:

- Take responsibility for the safe operation of hot work activities.
- Determine the type of hot work operation to be conducted.
- Determine the identity of the hot work operator.
- Conduct pre-operational fire safe precautions.
- Assess the work area where the hot work is to be conducted for site-specific flammable materials, hazardous processes, or other potential fire hazards.
- Issue the hot work permit prior to work commencing.
- Determine if a fire watch is required; if a fire watch is not required, the PAI will conduct a final check after the completion of hot work operations to detect and extinguish smoldering fires.

D. Employee and Contractor Conducting Hot Work

Employees and contractors conducting hot work activities have the following roles and responsibilities:

- Ensure all hot work equipment is in safe operating condition; defective equipment should be repaired by a qualified person prior to use or be withdrawn from service.
- Ensure adequate fire watch is maintained during and after hot work activities as necessary.
- Cease hot work operations if unsafe conditions.
- Notify the PAI upon completion of hot work activities.

E. Fire Watch

Fire Watches must be used when any of the following take place or any of the following conditions exist:

- Work activities that involve torching, welding, cutting, brazing, and soldering.
- Work activities that could create an ignition source.
- Situations where larger than minor fires may develop.
- Areas where appreciable combustible materials in building construction or contents are closer than 35 feet to the point of operation.
- Areas where appreciable combustible materials are more than 35-feet away but could be easily ignited by sparks.
- Instances where wall or floor openings within a 35-foot radius are exposed to combustible material, including concealed spaces in walls, floors, and ceilings.
- When combustible materials are adjacent to the opposite side of partitions, walls, ceilings, or roofs and are likely to be ignited by conduction or radiation.
- Any time or situation as deemed necessary by the Fire and Life Safety Team.

Fire Watch responsibilities include the following:

- Be familiar with facilities for sounding an alarm in the event of a fire.
- Watch for fires in all exposed areas and try to extinguish them only when obviously within the capacity of the equipment available, or otherwise sound the alarm.
- Stay onsite for at least a half-hour after the completion of hot work to assess hot-spots, smoldering material, and fires.
- Attend fire extinguisher use training, or training in equivalent fire protection methods.
- Have fire extinguishing equipment readily available at the location where hot work is being done and on opposite sides of adjacent bulkheads and floors when the potential of conductive heat transfer exists.
- Guard against a fire starting in their assigned area.
- Not engaging in activities or tasks other than that of the Fire Watch.
- Make a complete inspection of the exposed areas for possible hot spots or fire.
- Make an initial inspection of all exposed areas immediately following the completion of hot work operations.

4. Procedures

A. Fire Prevention and Protection

Welders, cutters, their supervisors, and owners of the property where hot work is being performed should refer to the National Fire Protection Association (NFPA) Standard 51B – Standard for Fire Prevention in Use of Cutting and Welding Processes.

Cutting or welding must be permitted only in areas that are or have been made fire safe. Before cutting or welding is permitted, the area must be inspected by a member of the Fire and Life Safety Department for authorizing cutting and welding operations. This individual must

designate precautions to be followed in granting authorization to proceed preferably in the form of a written permit.

The basic precautions for fire prevention during hot work are as follows:

- If the object to be welded or cut cannot readily be moved, the area must be made safe by removing combustibles or protecting combustibles from ignition sources.
 - All combustibles must be relocated at least 35 feet (10.7 m) from the worksite. Where relocation is impracticable, combustibles must be protected with flameproof covers or otherwise shielded with metal or welding curtains.
- If the object to be welded or cut cannot be moved and if all the fire hazards cannot be removed, then guards must be used to confine the heat, sparks, and slag, and to protect the immovable fire hazards, or equivalent precautions taken.
 - Wherever there are floor openings or cracks in the flooring that cannot be closed, precautions must be taken so that no readily combustible materials on the floor below will be exposed to sparks that may drop through the floor. The same precautions must be observed with regard to cracks or holes in walls, open doorways and open or broken windows. If the above requirements cannot be followed, then welding and cutting will not be performed.
 - Where cutting or welding is done near walls, partitions, ceiling or roof of combustible construction, fire-resistant shields or guards must be provided to prevent ignition.
 - If welding is to be done on a metal wall, partition, ceiling or roof, precautions must be taken to prevent ignition of combustibles on the other side, due to conduction or radiation, preferably by relocating combustibles. Where combustibles are not relocated, a fire watch on the opposite side from the work must be provided.
 - Welding must not be attempted on a metal partition, wall, ceiling, or roof having a combustible covering or on walls or partitions of combustible sandwich-type panel construction.
 - Cutting or welding on pipes or other metal in contact with combustible walls, partitions, ceilings, or roofs must not be undertaken if the work is close enough to cause ignition by conduction.
- Where combustible materials such as paper clippings, wood shavings, or textile fibers are on the floor, the floor must be swept clean for a radius of 35 feet (10.7 m).
 - Combustible floors must be kept wet, covered with damp sand, or protected by fire-resistant shields. Where floors have been wet down, personnel operating arc welding or cutting equipment must be protected from possible shock.
- Ducts and conveyor systems that might carry sparks to distant combustibles must be suitably protected or shut down.

- Suitable fire extinguishing equipment must be maintained in a state of readiness for instant use. Such equipment may consist of pails of water, buckets of sand, hoses or portable extinguishers depending upon the nature and quantity of the combustible material exposed.

Cutting or welding must not be permitted in the following situations:

- In areas not authorized by management.
- In sprinkler-protected buildings while such protection is impaired.
- In the presence of explosive atmospheres (mixtures of flammable gases, vapors, liquids, or dusts with air), or explosive atmospheres that may develop inside unclean or improperly prepared tanks or equipment which have previously contained such materials, or that may develop in areas with an accumulation of combustible dusts.
- In areas near the storage of large quantities of exposed, readily ignitable materials such as bulk sulfur, baled paper, or cotton.

B. Welding and Cutting Containers

No welding, cutting, or other hot work may be performed on used drums, barrels, tanks, or other containers until they have been cleaned so thoroughly as to make certain that there are no flammable materials present or any substances such as greases, tars, acids, or other materials which when subjected to heat, might produce flammable or toxic vapors.

Any pipelines or connections to the drum or vessel must be disconnected or blanked.

All hollow spaces, cavities or containers must be vented to permit the escape of air or gases before preheating, cutting, or welding.

Purging with inert gas is recommended.

C. Confined Spaces

Ventilation is a prerequisite to work in confined spaces.

When welding or cutting is being performed in any confined spaces the gas cylinders and welding machines must be left on the outside.

Before operations are started, heavy portable equipment mounted on wheels must be securely blocked to prevent accidental movement.

Where a welder must enter a confined space through a manhole or other small opening, means must be provided for quickly removing the welder in case of emergency.

- When safety belts and lifelines are used for this purpose, they must be so attached to the welder's body that his body cannot be jammed in a small exit opening.
- An attendant with a preplanned rescue procedure must be stationed outside to observe the welder at all times and be capable of putting rescue operations into effect.

When arc welding is to be suspended for any substantial time, such as during lunch or overnight, all electrodes must be removed from the holders and the holders carefully located so that accidental contact cannot occur, and the machine disconnected from the power source.

During gas welding or cutting operations, to eliminate the possibility of gas escaping through leaks of improperly closed valves, the torch valves must be closed and the fuel-gas and oxygen supply to the torch positively shut off at some point outside the confined area whenever the torch is not to be used for a substantial period, such as during lunch hour or overnight. Where practicable the torch and hose must also be removed from the confined space.

After welding operations are completed, the welder must mark the hot metal or provide some other means of warning other workers.

5. Safety Information

A. Health Protection

A welder or helper working on platforms, scaffolds, or runways must be protected against falling. This may be accomplished using railings, safety belts, lifelines, or some other equally effective safeguards.

Welders must place welding cable and other equipment so that it is clear of passageways, ladders, and stairways.

First-aid equipment must always be available. All injuries must be reported as soon as possible for medical attention. First aid must be rendered until medical attention can be provided.

B. Ventilation

The requirements for health protection and ventilation have been established based on the following three factors in arc and gas welding which govern the amount of contamination to which welders may be exposed:

1. Dimensions of space in which welding is to be done (with special regard to height of ceiling).
2. Number of welders.
3. Possible evolution of hazardous fumes, gases, or dust according to the metals involved.

When performing welding in a space entirely screened on all sides, the screens must be arranged so that no serious restriction of ventilation exists. It is desirable to have the screens so mounted about 2 feet (0.61 m) above the floor unless the work is performed at so low a level that the screen must be extended nearer to the floor to protect nearby workers from the glare of welding.

Local exhaust or general ventilating systems must be provided and arranged to keep the amount of toxic fumes, gases, or dusts below the maximum allowable concentration as specified in 29 CFR 1910.1000 – Air Contaminants.

Numerous potentially hazardous materials are employed in fluxes, coatings, coverings, and filler metals used in welding and cutting or are released to the atmosphere during welding and

cutting. The suppliers of welding materials must determine the hazard, if any, associated with the use of their materials in welding, cutting, etc., and carry the following notices on tags, boxes, or other containers:

CAUTION	Used for all filler metals and fusible granular materials.	Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. See ANSI Z49.1 Safety in Welding and Cutting published by the American Welding Society.
WARNING: CONTAINS CADMIUM – POISONOUS FUMES MAY BE FORMED ON HEATING	Used for brazing (welding) filler metals containing cadmium in significant amounts.	Do not breathe fumes. Use only with adequate ventilation such as fume collectors, exhaust ventilators, or air-supplied respirators – See ANSI Z49.1. If chest pain, cough, or fever develops after use call physician immediately.
CAUTION: CONTAINS FLUORIDES	Used for brazing and gas welding fluxes containing fluorine compounds.	This flux when heated gives off fumes that may irritate eyes, nose, and throat. Avoid fumes - use only in well-ventilated spaces. Avoid contact of flux with eyes or skin. Do not take internally.

Mechanical ventilation must be provided when welding or cutting is done on specific metals.

- In a space of less than 10,000 cubic feet (284 m (3)) per welder.
- In a room having a ceiling height of less than 16 feet (5 m).
- In confined spaces or where the welding space contains partitions, balconies, or other structural barriers to the extent that they significantly obstruct cross ventilation.

Such ventilation must be at the minimum rate of 2,000 cubic feet (57 m(3)) per minute per welder, except where local exhaust hoods and booths as defined by 6.3, or airline respirators approved by the U.S. Bureau of Mines for such purposes are provided.

Natural ventilation is considered sufficient for welding or cutting operations where regulatory restrictions are not present.

1. Local Exhaust Hoods and Booth

Mechanical local exhaust ventilation may be by means of either of freely movable hoods or a fixed enclosure.

Freely movable hoods intended to be placed by the welder as near as practicable to the work being welded and provided with a rate of air-flow sufficient to maintain a velocity in the

direction of the hood of 100 linear feet (30 m) per minute in the zone of welding when the hood is at its most remote distance from the point of welding. The rates of ventilation required to accomplish this control velocity using a 3- inch (7.6 cm) wide flanged suction opening are shown in the following table:

Welding zone	Minimum air flow *(1) cubic feet/minute	Duct Diameter
4 to 6 inches from arc or torch	150	3
6 to 8 inches from arc or torch	275	3 ½
8 to 10 inches from arc or torch	425	4 ½
10 to 12 inches from arc or torch	600	5 ½

*(1) When brazing with cadmium bearing materials or when cutting on such materials increased rates of ventilation may be required.

*(2) Nearest half-inch duct diameter based on 4,000 feet per minute velocity in pipe.

A fixed enclosure with a top and not less than two sides which surround the welding or cutting operations and with a rate of airflow sufficient to maintain a velocity away from the welder of not less than 100 linear feet (30 m) per minute.

2. Ventilation in Confined Spaces

All welding and cutting operations carried on in confined spaces must be adequately ventilated to prevent the accumulation of toxic materials or possible oxygen deficiency.

- This applies not only to the welder but also to helpers and other personnel in the immediate vicinity.
- All air replacing that withdrawn must be clean and respirable.

In circumstances for which it is impossible to provide such ventilation, NIOSH approved airline respirators or hose masks must be used.

In areas immediately hazardous to life, a full-facepiece, pressure-demand, self-contained breathing apparatus (SCBA) or a combination full- facepiece, pressure-demand supplied-air respirator with an auxiliary, self-contained air supply approved by NIOSH must be used.

Where welding operations are carried on in confined spaces and where welders and helpers are provided with hose masks, hose masks with blowers or SCBA approved by MSHA or NIOSH, a worker must be stationed on the outside to ensure the safety of those working within.

Oxygen must never be used for ventilation.

3. Fluorine Compounds

A fluorine compound is one that contains fluorine, as an element in chemical combination, not as a free gas.

In confined spaces, welding or cutting involving fluxes, coverings, or other materials which contain fluorine compounds, additional ventilation must be provided.

The need for local exhaust ventilation or airline respirators for welding or cutting in other than confined spaces will depend upon the individual circumstances. However, experience has shown such protection to be desirable for fixed-location production welding and for all production welding on stainless steels.

Where air samples taken at the welding location indicate that the fluorides liberated are below the maximum allowable concentration, such protection is not necessary.

4. Zinc

In confined spaces welding or cutting involving zinc-bearing base or filler metals or metals coated with zinc-bearing materials, additional ventilation must be provided.

Indoors, or cutting involving zinc-bearing base or filler metals coated with zinc-bearing materials must be done under a hood or in an equivalent exhaust system.

5. Lead

In confined spaces, welding involving lead-base metals (erroneously called lead-burning), additional ventilation must be provided.

Indoors, welding involving lead-base metals must be done under a hood or in an equivalent exhaust system.

In confined spaces or indoors, welding or cutting operations involving metals containing lead, other than as an impurity, or metals coated with lead-bearing materials, including paint, must be done using local exhaust ventilation or airline respirators.

Such operations, when done outdoors, must be done using a NIOSH approved respirator.

In all cases, workers in the immediate vicinity of the cutting operation must be protected by local exhaust ventilation or airline respirators

6. Beryllium

Welding or cutting indoors, outdoors, or in confined spaces involving beryllium-containing base or filler metals must be done using local exhaust ventilation and airline respirators.

Local exhaust ventilation and airline respirators are not required when atmospheric tests under the most adverse conditions have established that the workers' exposure is within the acceptable concentrations.

In all cases, workers in the immediate vicinity of the welding or cutting operations must be protected as necessary by local exhaust ventilation or airline respirators.

7. Cadmium

In confined spaces or indoors, welding or cutting operations involving cadmium-bearing or cadmium-coated base metals must be done using local exhaust ventilation or airline respirators. Local exhaust ventilation and airline respirators are not required when atmospheric tests under the most adverse conditions show that employee exposure is within acceptable concentrations. Such operations, when done outdoors, must be done using a NIOSH approved respirator, such as fume respirators.

Welding (brazing) involving cadmium-bearing filler metals must be done using adequate ventilation.

8. Mercury

In confined spaces or indoors, welding or cutting operations involving metals coated with mercury-bearing materials, including paint, must be done using local exhaust ventilation or airline respirators.

Local exhaust ventilation and airline respirators are not required when atmospheric tests under the most adverse conditions show that employee exposure is within acceptable concentrations.

Such operations, when done outdoors, must be done using NIOSH approved respirators.

9. Cleaning Compounds

In the use of cleaning materials, because of their possible toxicity or flammability, appropriate precautions such as manufacturer's instructions must be followed.

Degreasing and other cleaning operations involving chlorinated hydrocarbons must be so located that no vapors from these operations will reach or be drawn into the atmosphere surrounding any welding operation.

In addition, trichloroethylene and perchloroethylene should be kept out of atmospheres penetrated by the ultraviolet radiation of gas-shielded welding operations.

10. Stainless Steel

Oxygen cutting, using either a chemical flux or iron powder or gas-shielded arc cutting of stainless steel, must be done using mechanical ventilation adequate to remove the fumes generated.

C. Industrial Applications – Mechanical Piping Systems

The requirements in this program for fire prevention and protection, protection of personnel, health protection and ventilation, oxygen-fuel gas welding and cutting, and arc welding and cutting must be observed.

The use of X-rays and radioactive isotopes for the inspection of welded piping joints must be in conformance with the ANSI Standard for Non-Medical X-ray and Sealed Gamma-Ray Sources, ANSI Z54.1.

D. Hot Work Permit

Prior to starting hot work, a hot work permit must be initiated by the individual that will be conducting the hot work operations, or their onsite supervisor. The requester must notify the Fire and Life Safety Team before beginning hot work operations by requesting a hot work permit. The requestor must conduct a thorough safety inspection prior to submitting the hot work permit for processing. The hot work area must be inspected by the Fire and Life Safety Team before the hot work begins. In the event during normal hours fire alarm system/devices need to be disabled, contact the Fire and Life Safety Supervisor at 470 578-3321 or visit 601 Chamblee Way SE Marietta, GA. Normal Business hours are Monday through Friday, between 7am and 3pm.

Hot work permits can be issued via email by completing the online form [here](#) or in person between the hours of 8:00 AM and 12:00 PM Monday through Friday at the Fire and Life Safety Office located at 601 Chamblee Way SE Marietta, GA. Bldg. F1. Hot work permit requestors are expected to plan for the day. Be prepared to provide the following information:

- Affiliation to the campus (e.g., employee or contractor).
- Cell phone number of the person requesting the permit.
- Type of hot work to be conducted.
- Location of work area (must be specific).
- Time hot work activity is to begin.
- Expected duration of hot work activity.

The following procedures provide the requirements needed to obtain a hot work permit during normal business hours versus off business hours. A hot work permit will be issued for a period of no more than 1 day unless written authorization has been given on the permit signed by a member of the Fire and Life Safety Team.

- When necessary, the Fire and Life Safety staff will be contacted and meet the requestor at the designated hot work activity area and will complete an inspection with the individual who is to perform the hot work activity.
- Once the work area is deemed safe to conduct hot work, the Fire and Life Safety Supervisor will make the necessary arrangements to have the fire alarm system and/or devices potentially affected by the hot work activity disabled.
- Prior to signing the hot work permit, the Fire and Life Safety Team must contact Facilities Operations Department to confirm the affected fire suppression system is fully operational.
- The Fire and Life Safety Team must complete the inspection and issue the hot work permit specific to the hot work activity in the area for the designated time frame. Hot work activities occurring over multiple days will require a new hot work permit each day.
- If hot work activities will extend past the original time frame, the requestor must contact the Fire and Life Safety Supervisor immediately to ensure that the fire alarm system has not been reactivated.

- Upon completion of the hot work activity, the requestor must contact the Fire and Life Safety Supervisor (470-578-2954) stating that the hot work activity is complete, and that the Fire Watch(s) as appropriate is/are now posted and will remain at the location(s) for a duration of 30 minutes.
- Following the minimum 30-minute Fire Watch period, the requestor or individual performing Hot Work will re-inspect the hot work area(s), and then contact the Fire and Life Safety Team reporting all conditions are safe.
- The Fire and Life Safety Team will close out the hot work permit by conducting a final inspection, which shall be a minimum of one hour following the Fire Watch period, to ensure all conditions are safe and then have the fire alarm system and/or device(s) re-instated back into full operational status by contacting the Facilities Operations Department.

The following procedures provide the requirements needed to obtain a hot work permit during off business hours. This hot work permit request procedure applies to hot work activities which will begin, occur, or be completed during off business hours.

- The requestor must complete the [Hot Work Permit Request Form](#) online and submit the form to the Fire and Life Safety Team. The form must be submitted with a minimum of one week's advanced notice.
- The Fire and Life Safety Team will review the Hot Work Scheduling Request Form for approval and notify the requestor and the Facilities Operations Department. The review process may require a site visit and further discussion into the scope of the hot work activity.
- If the request is approved, the requestor will either conduct the hot work activity during normal business hours or have the contractor's project manager contact EHS to further discuss the hot work activity with the Fire and Life Safety Team and Facilities Operations.

After hours emergency requests should be directed to EHS at 678-449-7693 or 470-578-6666.

E. Personal Protection

Employees exposed to the hazards created by welding, cutting, or brazing operations must be protected by personal protective equipment (PPE).

1. Head Protection

Helmets or hand shields must be used during all arc welding or arc cutting operations, excluding submerged arc welding, and must be made of a material which is an insulator for heat and electricity. They must be arranged to protect the face, neck, and ears from direct radiant energy from the arc.

Helmets must be provided with filter plates and cover plates designed for easy removal. All parts must be constructed of a material which will not readily corrode or discolor the skin. Helmets, shields, and goggles must be not readily flammable and must be capable of withstanding sterilization.

2. Eye Protection

Goggles or other suitable eye protection must be used during all gas welding or oxygen cutting operations. Helpers or attendants must be provided with proper eye protection.

Spectacles without side shields, with suitable filter lenses are permitted for use during gas welding operations on light work, for torch brazing or for inspection.

All operators and attendants of resistance welding or resistance brazing equipment must use transparent face shields or goggles, depending on the job, to protect their faces or eyes, as required.

Eye protection in the form of suitable goggles must be provided where needed for brazing operations. Goggles must be ventilated to prevent fogging of the lenses as much as practicable.

All glass for lenses must be tempered, substantially free from striae, air bubbles, waves, and other flaws. Except when a lens is ground to provide proper optical correction for defective vision, the front and rear surfaces of lenses and windows must be smooth and parallel.

Lenses must bear some permanent distinctive marking by which the source and shade may be readily identified. The following is a guide for the selection of the proper shade numbers. These recommendations may be varied to suit the individual's needs.

Welding Operation		Shade #
Shielded metal-arc welding	1/16-, 3/32-, 1/8-, 5/32-inch electrodes	10
Gas-shielded arc welding-nonferrous	1/16-, 3/32-, 1/8-, 5/32-inch electrodes	11
Gas-shielded arc welding-ferrous	1/16-, 3/32-, 1/8-, 5/32-inch electrodes	12
Shielded metal-arc welding	3/16-, 7/32-, 1/4-inch electrodes	12
	5/16-, 3/8-inch electrodes	14
Atomic hydrogen welding		10-14
Carbon arc welding		14
Soldering		2
Torch brazing		3 or 4
Light cutting	Up to 1 inch	3 or 4
Medium cutting	1 inch to 6 inches	4 or 5
Heavy cutting	6 inches and over	5 or 6
Gas welding (light)	Up to 1/8 inch	4 or 5
Gas welding (medium)	1/8 inch to 1/2 inch	5 or 6
Gas welding (heavy)	1/2 inch and over	6 or 8

*Note: In gas welding oxygen cutting where the torch produces a high yellow light, it is desirable to use a filter or lens that absorbs the yellow or sodium line in the visible light of the operation.

All filter lenses and plates must meet the test for transmission of radiant energy prescribed in ANSI/ISEA Z87.1 - American National Standard Practice for Occupational and Educational Eye and Face Protection.

For protection from arc welding rays, where the work permits, the welder should be enclosed in an individual booth painted with a finish of low reflectivity such as zinc oxide (an important factor for absorbing ultraviolet radiations) and lamp black, or must be enclosed with noncombustible screens similarly painted.

Booths and screens must permit circulation of air at floor level.

Workers or other persons adjacent to the welding areas must be protected from the rays by noncombustible or flameproof screens or shields or shall be required to wear appropriate goggles.

3. Protective Clothing

Appropriate protective clothing required for any welding operation will vary with the size, nature, and location of the work to be performed.

6. Training

All personnel performing hot work must be trained in proper equipment operation; handling and storage of welding materials; compressed gas safety; chemical hazards; and the Hot Work Program. Additional training may also be necessary in permit required confined space entry, control of hazardous energy, and the proper selection of use and PPE. KSU does not accept responsibility for the training of contractors. Contractors must be made aware of the hazards related to the tasks being performed.

Appendix A – Hot Work Permit

 KENNESAW STATE UNIVERSITY Environmental Health & Safety Department	Hot Work Permit
EOSMS-505-1	Effective Date: 10/01/2014
FORM_EHS_01	Page 1 of 1

All temporary operations involving open flames or producing heat and/or sparks require a Hot Work Permit. This includes, but is not limited to, brazing, cutting, grinding, soldering, thawing, and welding.

Instructions for Fire Safety Supervisor

1. Verify precautions listed at right (or do not proceed with the work).
2. Complete page 1 and retain for job files.
3. Post page 2 in vicinity of hot work.

DATE _____ JOB NO. _____

LOCATION/BUILDING & FLOOR (be specific) _____

DESCRIPTION OF WORK BEING PERFORMED _____

NAME OF PERSON DOING HOT WORK _____

The above location has been examined, the precautions checked on the Hot Work Checklist have been taken to prevent fire, and permission is authorized for this work.

SIGNED: _____

(Permit Authorizing Individual)

SIGNED: _____

(Person doing Hot Work)

SIGNED: _____

(Fire Watch)

TIME

STARTED: Date: _____ Time: _____ AM/PM

Date: _____ Time: _____ AM/PM

Fire Watch Sign Off

Work area and all adjacent areas to which sparks and heat might have spread were inspected during the fire watch period and were found fire safe.

SIGNED: _____

Final Checkup (minimum 30 minutes after Hot Work)

Work area was monitored for ____ hour(s) following hot work and found fire safe.

SIGNED: _____

Hot Work Checklist

- ☐ Sprinklers and hose streams in service/operable.
- ☐ Hot Work Equipment in good condition.
- ☐ Alarm system is in test/bypass, if needed.
- ☐ Multi-purpose fire extinguisher and/or water pump can.

Requirements Within 35 Feet of Work

- ☐ Dust, lint, debris, flammable liquids, and oily deposits removed; floors swept clean.
- ☐ Combustible floors (e.g., wood, tile; carpeting) protected.
- ☐ No flammable or combustible material present or otherwise protected.
- ☐ All wall and floor openings covered.
- ☐ Walkways protected beneath hot work.

Work on Walls or Ceilings

- ☐ Combustibles moved away from other side of wall.

Work in Confined Spaces

- ☐ Confined space cleaned of all combustibles (example: grease, oil, flammable vapors).
- ☐ Containers purged of flammable liquids/vapors.
- ☐ Follow confined space guidelines.

Fire Watch/Hot Work Area Monitoring

- ☐ Fire watch will be provided during and for 30 minutes after work, including any breaks.
- ☐ Fire watch personnel is trained in use of this equipment and familiar with location of sounding alarm.
- ☐ Fire watch may be required for opposite side of walls, above, and below floors and ceilings.

Other Precautions Taken

☐



Introduction

Kennesaw State University “KSU” seeks to provide and maintain, as far as is practicable, an environment for its students, faculty, staff, contractors, and members of the public, that is safe and without risk to health. As a condition of the contract, KSU requires that Contractors and their subcontractors seeking to perform a service on any of our campuses exercise all necessary precautions to safeguard the health and safety of all persons including university employers, students, members of the public, and the employees, agents, and subcontractors of the Contractor.

It is the responsibility of each Contractor to inform him/herself of applicable KSU’s health and safety policies, and procedures implemented by the University. The contractor will comply with the applicable Federal, State, Local and KSU internal policies, procedures, or measures. In the event of any inconsistency, Contractor will comply with the procedures or measures that produce the highest level of health and safety outcome.

1. Purpose

This document describes Environmental Health and Safety requirements for Service Providers (Contractors) while working on Kennesaw State University property/facility. The goal is to ensure safety of KSU’s students, employees and visitors and comply with federal, state, and local safety and environmental regulations

2. Scope:

This program applies to all work performed by Contractors in or on all properties owned, leased, or controlled by KSU.

3. Definitions

Contractor

For the purposes of this document, a Contractor is an organization or individual with a contractual agreement with KSU or with a Contractor who have contracted with KSU to provide a specific service or range of services related to the property, facilities or buildings owned or leased by KSU, in accordance with the contract terms and defined scope of work. This includes but is not limited to the following:

- General Contractors
- Sub-Contractors
- Professional Firms
- Service Contractors

4. Roles and Responsibilities

Contractor Responsibilities:

- The Contractor should have a written Environmental Health and Safety programs in place and is solely responsible for ensuring that such programs comply with federal, state and local regulations.
- Contactor should designate at least one supervisor as the “Competent Person” to be responsible for safety coordination on the job site
- Contractor is responsible for taking all steps necessary to protect the safety and health of KSU’s students, employees, and visitors during the performance of their work by establishing, administering, and enforcing safety rules that meet KSU’s environmental health and safety policies and procedures and federal, state and local EHS laws and regulations.
- The Contractor bears sole responsibility for ensuring the safety of his or her employees.
- It is the responsibility of the Contractor to inform their personnel of the hazards associated with specific operations of a project and ensure the necessary controls are in place, including providing employees with the appropriate personal protective equipment (PPE).
- The Contractor should ensure that all incidents/injuries relating to the job are promptly reported to KSU and investigated.

- The contractor who coordinates the work of Subcontractors shall assure that the Subcontractor abides by the requirements of this document and is responsible for communication of safety-related information and requirements to its' Subcontractors.
- It is the contractor's responsibility to appropriately dispose of all waste materials resulting from the project.

Submittals

- KSU or its representative may elect to require a contractor to submit any or all of the following document/records prior to beginning, during the project or upon completion of work.
 - ✓ Contractors project safety plan including substance abuse control program
 - ✓ Workplace incident and illness records, including Experience Modification Rates (EMRs)
 - ✓ Permits/Licenses certifying knowledge and skills
 - ✓ Safety inspection reports
 - ✓ Accident investigation reports
 - ✓ Safety training records
 - ✓ Safety Data Sheets (SDSs)
 - ✓ Copies of waste manifests, disposal documents and any other relevant records
 - ✓ Statutory notifications, including Notice of Intent (NOI) and Notice of Termination (NOT)
 - ✓ Records of noncompliance citations
 - ✓ Record of regulatory agency citations.

- Where submittals are required from the Contractor, they shall be made in writing directly to the KSU's Project Manager/Coordinator in charge of the project, or EHS department upon request.
- Submittals should be made sufficiently in advance to avoid delay of the project. Where review, approval, or coordination of submittals is required, submittals shall be made at least ten (10) working days prior to the start of the project unless prior arrangements have been made.
- Post-job submittals, where required, shall be made no later than fifteen (15) working days after completion of the project or as specified in the request.

4. Procedures

Worksite Isolation and Access Control

- The Contractor shall isolate and establish controls of worksite to restrict unauthorized access to the work zone. Requirements for entry should be clearly posted at all access points.
- Wherever necessary, contractor shall erect appropriate barricades and signs to provide protection and alert others of the hazards created by construction activities and shall be used to safely control traffic, both vehicular and pedestrian, through or around the work site. If necessary, contractors may engage the services of Police or Parking Services details when pedestrian and/or vehicular traffic is impeded.
- Barricades should meet the requirement of 29 CFR 1926 Subpart G – Signs, Signals, and Barricades and the US DOT Manual on Uniform Traffic Control Devices.
- Signs should clearly indicate required personal protective equipment that must be worn in the restricted area.
- The Contractor must not perform work over the heads of people or leave tools or equipment overhead. The Contractor must abide by all posted signage (i.e., radiation hazard, authorized personnel only, no smoking, chemical hazard, caution, danger, biohazard)
- All portable ladders including extension, step, and job made ladders are the Contractor's sole responsibility to maintain and use according to 29 CFR 1910.27.

Training:

- Contractors shall provide and ensure their employees have received the appropriate EHS training in compliance with federal and State regulations and for the employee to safely perform their assigned tasks.

Hazardous Materials and Hazard Communication:

Hazardous Material:

- Contractor shall not use solvents, paints, or similar flammable, toxic, or irritating materials in areas occupied by university employees, or students without prior notification to and approval approved by KSU Project manager/Coordinator. The contractor shall provide KSU with a copy of Material Safety Data Sheets (SDS's) for such materials upon request.
- Contractors shall maintain SDSs for all hazardous chemicals being handled at the job site.
- The Contractor shall maintain appropriate control, including adequate ventilation to keep exposure levels below applicable OSHA (Occupational Safety and Health Administration) Permissible Exposure Limits (PEL).
- If exposure levels exceed as are expected OSHA PEL, all personnel exposed shall be provided with and required to use appropriate Personal Protective Equipment (PPE), including NIOSH approved respirators, where necessary.
- The contractor is responsible for ensuring the personnel wearing respirators are medically evaluated and fit-tested, as stipulated in the OSHA Respiratory Protection Program (CFR 1910.134).

Hazard Communication:

- The Contractor shall develop and maintain their own Hazard Communication Plan that complies with OSHA Hazard Communication Program (29 CFR 1910.1200).
- The Contractor shall maintain copies of Safety Data Sheets (SDS's) for all hazardous materials that are brought / used on KSU property on-site and available for review.
- All containers of hazardous materials should be properly labeled and inspected as required by applicable regulations.

Personal Protective Equipment

- All contractors shall ensure their employees have been trained, issued, and wear the appropriate Personal Protective Equipment (PPE) where required. It is the contractor's responsibility to ensure the correct use of PPE per OSHA standards.

Management of Asbestos Containing Materials (ACM)

- Unless otherwise noted, KSU will have determined, before work starts, the presence, location, and quantity of asbestos containing materials (ACM) or potential ACM that will be specifically impacted by the work under contract.
- KSU is responsible for hiring an Asbestos Abatement Contractor to remove the identified ACM in coordination with the contractor.
- Under no circumstances should the Contractor disturb asbestos-containing materials unless such activities are part of contracted work, and the Contractor is specifically licensed in the State of Georgia as Asbestos Abatement Contractor.
- If during work the Contractor discovers material to be suspected of containing asbestos, Contractor should immediately notify the KSU Project Manager or EHS Department at 470-578-3321 or. The contractor shall ensure that the suspected material is not disturbed or moved until the material has been evaluated by KSU EHS department and approval to disturb/move the material is granted.
- The Contractor shall not sweep, dust, vacuum or mop dust or debris that is believed to be ACM. The Contractor shall also not pick up or throw away any suspected ACM waste or trash.
- The Contractor shall immediately notify the EHS Office at 470-578-3321 or KSU Project Manager if material suspected to be ACM is disturbed or becomes airborne.

Protecting Indoor Environmental Quality (IEQ)

- Construction and renovation projects can have a significant negative impact on indoor environmental quality (IEQ) of adjacent occupied spaces.
- Contractors in coordination with KSU project Manager should ensure proper pre-planning efforts that anticipate potential impacts on IEQ and specify adequate control strategies prior to commencing work.
- KSU EHS department has developed procedures to provide Contractors and project managers with guidance on how to minimize the negative impact of construction projects on indoor environmental quality (IEQ) during construction and renovation projects. In this regard, Contractor should:

- Comply with the applicable KSU's IEQ, other health and safety requirements, and applicable federal, state, and local regulations.
- Implement control strategies, including engineering controls, to eliminate or minimize the impact of contraction activities on IEQ in the building subject to construction work or nearby buildings.
- Maintaining acceptable indoor environmental quality within the space or contiguous spaces where the construction project is occurring.
- Provide all safety and personal protective equipment (PPE) required to complete the contracted scope of work. PPE must meet or exceed the requirements of the appropriate governmental regulatory agency.
- Please refer to the KSU "[Guidelines for Protecting Indoor Environmental Quality During Construction and Renovation](#)" for more details.

Fire Protection and Life Safety

Emergency Egress

- The contractor shall keep all corridors and exit doors always clear. In addition, all external exit ways, walks, and drives shall be kept free from debris, material, tools, and vehicles.
- The Contractor shall not conduct work or operations that obstruct exits or the means of egress from an occupied building without the prior notification and approval of KSU's Project Manager/Coordinator.
- Contractor shall not chock or block open fire-rated doors except temporarily and while maintaining constant supervision. Such chocks/blocks must be immediately removed in a building fire alarm or similar emergency.

Fire Protection Equipment:

- The Contractor shall NOT disable or modify any fire protection equipment or system without prior notification to the KSU's Project Manager/Coordinator and approval by EHS Department.

- Disabling of the fire protection system must follow the Fire Protection Impairment Procedure

Building Alarm

- Contractor personnel shall respond appropriately to all alarms by exiting the building immediately and remaining at least 50 feet from the building to allow for emergency response access. Call KSU emergency number (470) 578-6666 to report the incident.
- In a fire, contractor personnel should sound the alarm and/or notify other building occupants immediately.

Electrical Safety

- When performing work that involving existing electrical systems and/or equipment, Contractor must be effectively coordinate work with KSU's Project Manager and other involved parties.
- KSU will make reasonable effort to inform Contractors, in advance, if the worksite contains energized electrical systems over 600 volts so that qualified personnel and appropriate protective equipment can be considered in the bidding process.
- KSU Project Manager is responsible for coordinating access to the jobsite, scheduling, pre-planning for outage and coordinating requests for shutdowns of existing electrical systems.
- KSU Operation and Maintenance personnel will shut down and start up electrical systems in coordination with Contractor performing work on such systems, unless otherwise specifically directed by KSU.
- When contractor is involved in performing work on or near energized electrical systems or equipment with greater than 50 volts, contractors shall;
 - Ensure all work is being conducted in accordance with applicable OSHA regulations and the National Fire Protection Association (NFPA) 70E Standard for Electrical Safety in the Workplace.
 - Ensure that only qualified Electricians are permitted to work on electrical systems and equipment that uses or controls electrical power.

- Ensure the “Limited Approach Boundary” for energized electrical equipment is established and that the area is restricted to authorized personnel only.
- In the event of a circuit breaker or other protective device "tripping," the Contractor shall ensure that a qualified Electrician examine checks the circuit and equipment and corrects problems before resetting the breaker.

- The Contractor shall not leave electrical boxes, switch gear, cabinets, or electrical rooms open when Contractor personnel are not present at the worksite. Energized parts shall be insulated when covers have been removed or doors are ajar. Cardboard, plywood, or other combustible materials shall not be used to cover energized circuits.
- If a Contractor comes across a potential electrical hazard such as missing protective guards or covers, damaged equipment, etc., Contractor should immediately make reasonable effort to notify KSU Project Manager of such hazard.

Lockout/Tag-Out

- The Contractor working on hazardous energy sources shall maintain and implement a Lockout/Tag-out (LO/TO) program in accordance with OSHA regulations (29 CFR 1910.147 – Control of Hazardous Energy Sources (Lockout/Tag-out) and 29 CFR 1910.269 Electric Power Transmission and Distribution Standard) as it applies to the work of their contract.
- The Contractor should maintain a copy of its Lockout/Tag-out Program on-site and readily available for examination by KSU officials before the start of any work where 29 CFR 1910.147 is applicable.
- KSU's Operation and Maintenance personnel will shut down and start up utility systems, unless otherwise specifically directed by the university.
- The contractor shall use standard locks and tags, as required by OSHA standards to control the start-up of equipment being serviced or maintained by its employee.
- Whenever the Contractor and KSU personnel must perform a group LO/TO, both LO/TO programs must be coordinated to comply with 29CFR 1910.147 and the KSU's LO/TO program.
- A Contractor or its employees shall not override any locks or tags they encounter during its work.
- The Contractor shall maintain a log of all machines and equipment that are locked out and/or tagged out during the performance of the work of while under contract.

Fall Protection:

- Contractors must protect their employees from fall hazards and falling objects, in accordance with OSHA Standard on Fall Protection (29 CFR 1926 Subpart M), whenever an affected employee is working 6 feet (1.8 meters) or more above a lower level. Protection shall also be provided to workers exposed to the hazard of falling into dangerous equipment.
- The contractor shall secure tools and equipment to prevent objects from falling to ground below.
- Contractor shall ensure that all their personnel are trained in accordance with the requirements listed in 29 CFR 1926 Subpart M.
- Where required, the contractor shall provide its employees with personal fall protection equipment or other hazard control measures listed in the fall protection standard and ensure proper usage of the equipment.
- The contractor shall ensure that fall hazards are communicated to their employees and that of the Sub-Contractors.
- Any opening from which there is a drop of more than 4 feet where KSU's faculty, staff, students, or the public may fall shall be guarded in accordance with "29 CFR 1910 Subpart D – Walking - Working Surfaces".
- Contractors must maintain guardrails, mid rails and toe boards located in KSU buildings or on KSU property unless removal is approved by the KSU Project Manager as part of the work of a contract.
- All open holes, skylights, trenches, or excavations into which KSU's employees may fall shall be covered and/or properly secured.

Trenching, Excavation and Utilities Locate

Locating and Protecting Utilities

- The Contractor is solely responsible for locating all utilities and shall be solely responsible for the protection and the repair of any damage to utilities in connection with the work.
- The contractor shall ensure coordination of trenching, blasting or excavation work with the university Project Manager to facilitate proper coordination of utilities shutdowns, if necessary.

- Contractor shall not commence, perform or engage in blasting, excavation or trenching work, including driving of spikes/stakes into the ground or drilling, until the Contractor has properly submitted utilities locate request to the Utility Protection Services (UPC) ('Call Before You Dig'), as required by Georgia laws (O.C.G.A § 25-9-6). Contractor should note that UPC WILL NOT locate all utilities on campus and Contractor therefore should make necessary arrangements with a utility location contractor for location and marking of remaining utilities.
- When using mechanized excavating equipment Contractor shall not strike, damage, injure, or loosen any utilities or sewer lateral which has been staked, flagged, or marked.
- When excavating or blasting is to take place within the tolerance zone (2 feet) of utilities, Contractor shall exercise such reasonable care to protect the underground utilities. Such protection shall include hand digging, pot holing, soft digging, vacuum excavation methods, pneumatic hand tools, other mechanical methods with the approval of the KSU Project Manager, or other accepted methods.
- In the event a Contractor strikes, damages, injures, or loosens any underground utility or sewer lateral, regardless of whether the utility facility or sewer lateral was marked, Contractor shall immediately cease such blasting or excavating and notify KSU Project Manager and the UPC and IMMEDIATELY make temporary or permanent repair of the damaged utility.
- Should Contractor fail to repair damaged utilities immediately, KSU reserves the right to make the needed repairs and will recover the cost thereof from the payment, then or thereafter, due the Contractor, without limitation to other remedies available to the KSU.
- The contractor shall not engage in excavating or blasting activities that may cause further damage to the utility facility or sewer lateral, until the damage previously done has been repaired and approval to proceed has been granted by KSU Project Manager.

Trenching and Excavation

- All excavation work shall follow OSHA Standards on excavation (29 CFR 1926 Subpart P).
- The contractor shall designate a Competent Person for every exaction work.
- The Competent Person shall inspect the trench every day before work, after rain and when conditions change. When there is a problem, the competent person shall have the authority to stop work and fix the problem.

- All trenches 5 feet (1.5 meters) or more in depth shall have a protective system. If excavation is less than 5 feet, the Competent Person should determine if a protective system is needed or not.
- Trenches 20 feet (6.1 M) deep or greater shall have protective systems designed by a registered engineer or based on tabulated data prepared and/or approved by a registered professional engineer.
- Trenches 4 ft or more in depth should be provided with a fixed means of egress and tested for atmospheric hazards such as low oxygen, hazardous fumes, and toxic gases when > 4 feet deep
- The area around the trench/excavation must be kept clear of surface encumbrances.
- Contractor must develop and implement procedures to protect employees from being injured or killed by vehicle traffic.
- Contractors must develop and implement procedures to protect employees from loads or objects falling from lifting or digging equipment.
- The contractor must develop and implement procedures for a warning system for mobile equipment to prevent vehicles from accidentally falling into the trench.
- Surface crossing of trenches is discouraged. Such crossings are permitted only under the following conditions:
 - Vehicle crossings were designed by and installed under a registered professional engineer's supervision.
 - Walkways or bridges are provided for foot traffic. These structures shall:
 - ✓ have a safety factor of 4;
 - ✓ have a minimum clear width of 20 in (0.51 m);
 - ✓ be fitted with standard rails; and
 - ✓ Extend a minimum of 24 in (.61 m) past the surface edge of the trench.
- Contractors must develop and implement procedures for controlling standing water and water accumulation if employees are permitted to work in the excavation.

- Contractors must conduct atmosphere testing before entering excavations where hazardous atmospheres have the potential to exist.
- The excavation must be treated as a permit required confined space if a hazardous atmosphere is found and managed per confined space requirements in this document.

- Adjacent structures must be stored in accordance with the design documents to prevent collapse. Where necessary, the contractor shall install guardrails or some other means of protecting people from falling into the trench/excavation.

Cranes and Rigging:

- Contractors must ensure that each crane, rigging, or hoist brought onto KSU property has been subject to an annual inspection performed by a certified testing agency.
- Documentation, including a logbook, must be provided to the KSU Project Manager or their designee, upon request.
- All Crane/hoisting equipment operators should be certified and present proof of certification upon request
- Lifting and rigging equipment/components should be inspected by a Competent Person before each use, and as conditions warrant.
- At no time shall loads be hoisted by a non-licensed operator.
- No lifts shall be made over faculty, staff, students and public. Lifts over occupied facilities may only be made after consultation with and approval by the KSU Project Manager.

Confined Space Entry

- Whenever contractor's personnel are required to enter confined spaces on KSU property, Contractor must ensure compliance with OSHA Confined Space Program (29 CFR §§ 1910.146 and 1910.269) and KSU's Confined Space Entry Program. Contractor shall develop, implement, and maintain its own Confined Space Entry Program, including provision for emergency rescue.
- KSU EHS department maintains an inventory of confined spaces on campus and their classifications. All sewer holes on campus are and should always be "Permit Required Confined Spaces."
- If in the course of its work, a Contractor encounters a confined space that had not been previously identified by KSU, contractor shall notify KSU's EHS department immediately for an evaluation of the space to determine the appropriate course of action.

- Contractors must use their own confined space entry permits when completing them.
- Contractors should complete and sign a Confined Space Pre-Entry Check before entry into a confined space verifies completion of the required pre-entry procedures. The check list should be maintained at the job site for duration of the job.
- If circumstances dictate an interruption in the work, the space must be re-evaluated, and a new check list must be completed.
- Contractors must provide their own rescue equipment, air monitors, ventilation fans, personal protective equipment, etc. to safely complete confined space entries.
- When both KSU personnel and Contractor personnel are working in or near confined spaces, the Contractor must coordinate all operations with the affected KSU personnel before entry.

Compressed Gas Cylinders:

- The contractor must ensure that valve protection caps are in place when compressed gas cylinders are being transported or stored. Close cylinder valves and replace valve covers when work is complete and when cylinders are empty or moved.
- Cylinders must be secured in an upright position while in use or being transported.
- Cylinders must be stored at a safe distance or shielded from welding or cutting operations and should not be placed where they can contact an electrical circuit.
- Oxygen and flammable gas cylinders should be separated by 20 feet or a 5-foot-high fireproof barrier.
- If a leak develops in a cylinder and it cannot be immediately corrected, move the cylinder to a safe location outside the building. Contact KSU Public Safety immediately at (470) 578-6666 regarding the leak.
- Compressed Gas Cylinders must be identified with contractor's name and contact information
- Compressed gas cylinders must not be taken into or stored in confined spaces, including gang boxes and office/storage trailers. Upon completion of work, Contractor must remove from KSU properties all cylinders belonging to the Contractor.

Hot Work

- Hot work (welding, cutting, and brazing) activities must be authorized by a KSU Project and approved by EHS.
- The contractor shall develop, implement, and maintain its own Hot work Program in accordance with OSHA regulations.
- The contractor shall obtain a hot work permit for each separate hot work activity and shall ensure that the conditions of the permit are always met. This permit should be from the Contractor's Hot Work Program.
- Request for a fire system inspection to determine if the system needs to be shut down or modified, must be made to the KSU's Project Manager at least 24 hours before starting any hot work.

Powder-Actuated Tools (Nail Guns)

- Operators of powder-actuated tools shall be professionally trained in their use and have valid training documentation.
- Powder-actuated tools shall be inspected for obstructions or other defects before use on each workday.
- Operators shall have and use appropriate personal protective equipment such as hard hats, safety goggles, safety shoes and ear protectors.
- The tools should be left unloaded until they are ready to be used and should be stored in a locked container when not being used.
- Power actuated tools are not to be used in area there is pedestrian traffic within buildings or areas next to construction

Temporary Structures

- All tents, stages and temporary structures shall comply with the requirements of the Georgia State Building Code, County ordinances and a permit shall be obtained where required.

University Equipment

- Contractors shall not use university equipment or vehicles, nor shall the Contractor allow university employees to use the Contractors' equipment or vehicles without the approval of KSU's Risk Management.

Window Washing:

- Window washing must be conducted using OSHA compliant method such as suspended scaffold (single or two points or a boatswain's chair).
- Scaffolding apparatus must comply with the requirements of 29 CFR 1910.28.
- Contractor is responsible for inspecting and verifying working condition and suitability of window washing anchors located on any KSU building before use.
- If the contractor identifies deficiencies on any anchor point, contractor should notify KSU of such deficiencies.

Management of Hazardous and Universal Waste

Universal Waste

- All unbroken fluorescent bulbs, high pressure sodium vapor, and mercury vapor bulbs are "Universal Wastes" and should be treated as such.
 - Contractors must ensure proper handling of fluorescent tubes and high-pressure metal halide/mercury vapor bulbs must be handled so that they remain unbroken.

- Tubes going to Universal Waste Stream must be stored in cardboard boxes obtainable as they are generated. Boxes of tubes and bulbs must be stored indoors.
 - Boxes containing Universal Waste bulbs must always be closed except when waste is being added to the container and labeled as “Universal Waste -- Used Bulbs”. Bulbs are not permitted to stick out of the boxes.
 - Broken fluorescent tubes and high-pressure metal halide/mercury vapor bulbs should be treated as “Hazardous Wastes.” Such tubes must be collected, stored, and disposed of as hazardous waste. Contact KSU EHS Office your KSU PM if you generate such waste.
- Under no circumstances should Contractor dispose any such fluorescent bulbs, high pressure sodium vapor, and mercury vapor bulbs in regular construction waste.
- Older (pre-1980) light ballasts are regulated waste under the EPA (Environmental Protection Agency) Toxic Substances Control Act (TSCA) due to presence of polychlorinated biphenyls (PCB’s).
- Contractors should not dispose ballasts with general trash.
- Ballasts manufactured after 1980 do not contain PCBs (Polychlorinated Biphenyls), however, it is the policy of KSU to collect ballasts and send them off-site for recycling.

Hazardous Wastes

- All chemicals (liquids, solids, gases, etc.) used by Contractors that are characteristic or listed EPA Hazardous Wastes shall be safely stored, managed, and disposed.
- Hazardous waste shall be removed from university property promptly and shall be properly disposed of by a licensed hazardous waste disposal firm off-site when they are no longer usable and have been designated as a waste product.
- Under no circumstances shall a Contractor drain, cause to be spilled/ leaked, deposit or otherwise dispose hazardous waste material on university grounds or any other unauthorized property.
- The contractor is responsible for the proper disposal of all unused chemicals and hazardous materials resulting from the project, in accordance with EPA Hazardous Waste Regulations.

Accidental Spill and Releases

- Contractors shall comply with all Federal, State, and local requirements for the proper handling of hazardous substances and oil while on KSU property.
- In the event of an accidental release or spill of chemicals or other hazardous materials by the Contractor, the Contractor shall:
 - ✓ Immediately take appropriate actions to contain the spill, without jeopardizing the health or safety of its employees,
 - ✓ Call KSU emergency number (470) 578-6666, or fire department, or other entities as needed or required,
 - ✓ Contact KSU's EHS Department at 470-578-3321, and
 - ✓ Notify the university Project Manager/Coordinator
 - ✓ Contractors shall be responsible for any costs associated with damage and/or cleanup of a hazardous substance and/or oil spill caused by the Contractor or their subcontractors.
 - ✓ This responsibility shall extend to freight carriers hired by the Contractor to deliver the commodity or service to the campus.
 - ✓ All university costs associated with responding to or remediation of a chemical or hazardous material spill or release may be assessed to the Contractor.

Control of Fugitive Dust Emissions

- The Contractor shall take all reasonable precautions necessary to prevent fugitive dust from becoming airborne from any operation, process, handling, and transportation or storage facility related to the job. The opacity from any fugitive dust source shall not exceed 19%.
- Reasonable precautions which a Contractor should take to prevent fugitive dust emission includes but are not limited to the following:
 - ✓ Use of water to control dust during demolition of existing structure, construction operations, grading or clearing of land.
 - ✓ Application of asphalt, water, or suitable material on dirt road, material, stockpiles, and other surfaces that can give rise to airborne dusts,

- ✓ Installation of engineering control such as hoods, fans, and filters to enclose and vent dusty operations,
- ✓ Covering, when in motion, open-bodied trucks, transporting materials likely to cause airborne dust.
- ✓ Prompt removal of earth or other materials from paved streets onto which such materials have been deposited.