Specification Standards For Kansas State University

Manhattan Campus
Vet Med Campus
Salina Campus
ESARP

Campus Planning and Facilities Management
March 2026

“This 2026 standard is an update to the 2013 KSU standards. Sections lined through are deleted or edited sections for reference to the previous standard.”

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CHAPTER 0 - GENERAL REQUIREMENTS

These standards are intended to be a living document and will be revised by KSU on a regular basis. To ensure that you are viewing the most current version of the standards, visit KSU's website at the following URL: https://www.k-state.edu/facilities/campus/design-construction-standards/

0.1 Construction Site Parking

0.1.1 Contractor parking shall be limited to inside the project staging area fencing. All other parking is to be obtained by purchasing a campus parking permit and following those permitted areas.

0.1.2 KSU is a pedestrian campus and at times has large amounts of students walking. All large deliveries or work placement shall have flaggers and barriers that protect pedestrians.

0.1.3 No tracking of mud or construction debris from or out of the site is permitted.

0.2 Construction Site Fencing

0.2.1 Fencing Requirements:

0.2.1.1 All exterior construction projects shall have a site screening fence. Fencing and screening shall encompass construction sites and construction dumpsters & materials.

0.2.1.2 Locations of site fencing should be in the Contract Documents. If not, prior to installing fencing, locations shall be approved by Facilities Project Manager.

0.2.1.3 SAFE dig must be notified prior to installing any fencing.

0.2.1.4 The site fence shall be:
0.2.1.4.1 Eight (8) feet tall.
0.2.1.4.2 Attached to post, surface mounted or ground driven and able to withstand 65 mph winds.

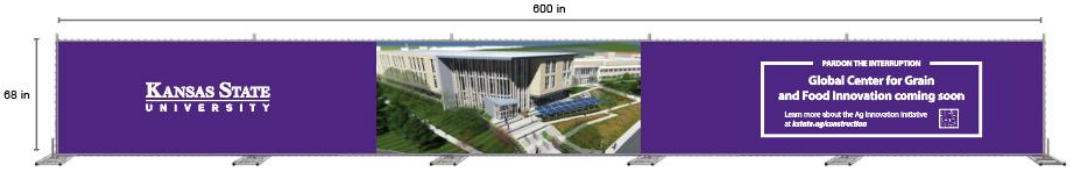
0.2.2 Site Fence Windscreen Requirements:

0.2.2.1 Provide wind screen on site fence with an 80 percent opacity.

0.2.2.2 Standard screening to be KSU purple. Custom Screen color to be approved by Facilities Project Manager.

0.2.2.3 Graphics on the site fence may be required on a case-by-case basis.

0.2.2.3.1 Small projects may not require custom sign graphics. Confirm with Facilities Project Manager.
0.2.2.3.2 Standard KSU project sign graphic for large projects shall be fifty feet in length by five feet eight inches high (50'L x 5'-8"H). Wind cuts-outs shall be included.
0.2.2.3.3 Custom graphics shall be high resolution rendering for large format printing 300 DPI/PPI, CMYK color mode, 1200x1200 pixel resolution minimum). Refer to sample shown.



0.2.3 Fencing Removal: Upon completion of project, all fencing must be removed and the site restored.

0.3 Hazardous Materials

0.3.1 Kansas State University Environmental Health and Safety (EHS) shall be contacted immediately in all cases of suspected hazardous material. It is the intent that KSU remove all hazardous material upon discovery.

0.3.1.1 EHS Contact information:

Environmental Health and Safety
135 Dykstra Hall
1628 Claflin Rd
Kansas State University
Manhattan, KS 66506
Phone: 785-532-5856
Fax: 785-532-1981
Email: safety@k-state-edu

0.3.2 For policies and procedures related to the handling of asbestos, refer to the KSU EHS website at *https://www.k-state.edu/safety/* under Policies and Procedures, Health & Safety, Procedures for Handling Asbestos.

0.3.3 KSU will contract directly for the removal of hazardous materials, including asbestos-containing materials (ACM).

0.3.4 Notify EHS immediately if any spills of flammable or combustible liquids (e.g. hydraulic fluid) occur on KSU grounds, or of any waste needing to be picked up or disposed of.

0.3.5 The Manhattan Fire Department shall be contacted and consulted for fire department-related topics, including but not limited to hydrant placement, fire lane marking and access, and FDC size and location.

0.3.6 Firestopping materials shall be UL Listed/FM approved for their specific application.

0.3.7 The following forms can be found on the EHS website and completed electronically: hot work form, fire protection impairment form, fire watch form.

0.3.8 If any project is assigned an Office of Facilities Project Management (OFPM) state inspector, the KSU campus Fire Marshal and Office of the State Fire Marshal (OSFM) field inspector shall be notified throughout project of mandatory inspections. OSFM requires a 30-day notice for 50% and final inspections. Refer to OSFM for additional information.

0.4 Site Logistics

0.4.1 Site Cleaning

0.4.1.1 Pick up litter within project site and any litter within 50 feet of the University's side of the project site fence, along access routes, Contractor storage yards and parking area, on a daily basis. Debris to be placed in Contractor's trash containers. Contractor is responsible for all removal of construction debris.

0.4.1.2 Keep weeds and grasses in control every five days within project site and in Contractor parking/storage yards (use weed eater or mower for cutting.)

0.4.1.3 Contractor is to use planking, or other protective measures.

0.4.1.4 Contractor is to clean concrete trucks within the project site or off campus property.

0.4.1.5 On a daily basis, power wash streets and sidewalks after Contractor's vehicles have left tracks on the way to or from the project site. Spud hoe up clods of dirt thrown from or crushed by tires, etc. and remove from site. Street sweep access routes used by contractors to edge of campus as well as provide follow-up cleaning; i.e. broom and wash.

0.4.1.6 On a daily basis, remove stains from paved surfaces caused by rubber from tire tracks, oils, fuels, solvents, etc.

0.4.2 Site Access – The campus is a pedestrian campus and must remain accessible for the safe movement of pedestrians through the entire campus.

0.4.2.1 Contractor shall provide alternate or temporary sidewalks to keep people moving, with adequate surfaces for safety.

0.4.2.2 Contractor is to use boring methods to pass utility lines under and keep all paved areas intact to the greatest extent possible.

0.4.2.3 Contractor must share sidewalks and streets with pedestrians and other service vehicles along their access route to their project site boundaries.

0.4.2.4 Alternate traffic methods need to comply with all applicable codes and regulations.

0.4.2.5 ADA accessibility must be maintained.

0.4.2.6 Required fire exit paths from buildings must be maintained with a hard surface and never be blocked by Contractor equipment, materials or work at any time during the workday.

0.4.2.7 Access to site for University personnel or other Contractors must be maintained at all times.

0.4.2.8 Contractor is to remove construction debris from site on a daily basis, or keep debris fully enclosed in commercial containers.

0.4.2.9 Contractor may use sidewalks/streets for limited access to site, provided:

0.4.2.9.1 When the ground is moist, planking is required along the path of access to prevent construction vehicle damage to grounds.

0.4.2.9.1 Contractor Personnel shall direct pedestrian traffic for safety purposes adjacent to project site when heavy equipment needs access to and from project site across sidewalks/streets.

0.4.2.10 Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests.

0.4.2.11 Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

0.4.2.12 Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of lawfully.

0.4.2.12.1 Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Owner.

0.4.3 Existing Underground Conditions - Coordinate with KSU to determine locations of underground utilities, piping, and tunnels in the area of the project. Do not move overweight loads such as cranes over these areas.

0.4.4 Fire Extinguishers - University-owned fire extinguishers within the project area that may be subject to damage will be removed by KSU; it is the responsibility of the project superintendent to provide temporary fire extinguishers during construction.

0.5 New Buildings:

0.5.1 General Roof Requirements:

0.5.1.1 Roofs shall have stair access.

0.5.1.2 Where appropriate, avoid roof designs that require fall protection.

0.5.1.3 Locate HVAC equipment, roof access points, fume hood systems, and other rooftop equipment at least fifteen feet from the leading edge of the building and install fall arrest devices.

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0.5.1.4 Maintenance worker safety on roofs: design to OSHA standard 1910.28 29 CFR § 1910.28(b)(13)(iii)(A). When work is performed 15 feet or more from the roof edge, each employee must be protected from falling by a guardrail system, a safety net system, a travel restraint system, or personal fall protection.

0.5.2 Lighting Installation: Lighting shall be placed in reachable areas over stairs and in large atriums without the use of scaffolding, unsafe ladder locations or rented lifts.

0.5.3 Biosafety: Refer to the following resources for the design of biosafety level 3 and 4 (BSL-3 and BSL-4) facilities:

0.5.3.1 U.S. Department of Health and Human Services, *Biosafety in Microbiological and Biomedical Laboratories,* sixth edition.

0.5.3.2 National Institutes of Health, Office of Research Facilities, News to Use series: "Plumbing Requirements for Biosafety Level 3 Laboratories", November 2014 edition.

CHAPTER 1 – UTILITY METERING SPECIFICATIONS

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Section 1.1 Location of Meters

1.1.1 The Engineer shall provide manufacturers required service and maintenance access space for building energy meters and associated devices at locations approved by KSU Energy Program.

1.1.2 Building energy meters shall be installed on interior of building (i.e. Mechanical Room), near utility-service entrance. In the case of Utility Company provided meter installation, where meters are utilized for billing purposes, the meters shall be installed exterior to the building or per utility company requirements, with pathway as required for communication wiring to enter mechanical room.

1.1.3 General Requirements

1.1.3.1 Meters must support at least one of the following communication methods for integration with the Main Data Collection System:
- 1.1.3.1.1 Scaled dry contact pulse output
- 1.1.3.1.2 RS485 serial connection
- 1.1.3.1.3 BACnet connection
- 1.1.3.1.4 Modbus TCP/IP
- 1.1.3.1.5 Preferred: Ethernet connection with Modbus

1.1.3.2 All wiring and connections must be clearly labeled.

1.1.3.3 Meters must include a full-size bypass to allow servicing without interrupting utility service.

1.1.3.4 Meters must be installed in accessible locations for maintenance and troubleshooting. Accessible means reachable without climbing or crawling over/under obstacles. Flow meters must be reachable from the ground using a 6-foot ladder.

1.1.3.5 Meters near steam piping must withstand high temperatures without ventilation.

1.1.3.6 Digital readouts must be easily visible for manual reading or verification. Do not mount digital readouts in tunnels.

1.1.3.7 Any item(s) that requires special tools and/or test equipment must be brought to the attention of the KSU Utility Department.

1.1.3.8 Flood-Prone Areas (Including Tunnels): Meters must be submersion-rated with proper conduit fittings.

1.1.3.9 If after meetings, reviews, comments, etc., there are documented and/or discussed changes that are not incorporated and equipment is inaccessible, it must be reinstalled at no cost.

1.1.3.10 Equip each flow meter with a metal identification tag indicating the size, location, serial number, and max rated flow rate.

1.1.3.11 Corresponding data shall be included with the Asset Management Data for the asset created in AiM

Section 1.2 Electric Meters

1.2.1 Action Submittals

1.2.1.1 Wiring Diagrams: For power signal and control wiring, identify terminals, wiring descriptions and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.2.2 Quality Assurance

1.2.2.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.2.3 Products

1.2.3.1 Kilowatt-hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

1.2.3.1.1 Voltage and Phase Configuration: Meter shall be designed for use on both 3-phase 3-wire delta and 3-phase 4-wire wye circuits with voltage rating and phase configuration indicated for its application.

1.2.3.1.2 Display: Backlit LCD, indicating accumulative kilowatt-hours, current time and date, current demand, and time and date of historic peak demand.

1.2.3.1.3 Memory: Shall retain 2 channels of accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset. 36 days of accumulated data shall be stored in 15 intervals.

1.2.3.1.4 Meter shall have an option for an external pulse input for use in totalization of other utility usage (water, gas, etc.).

1.2.3.2 General Requirements for Owner's Meters

1.2.3.2.1 Enclosure: Industrial Grade JIC. Option for weatherproof enclosure.

1.2.3.2.2 Sensors: Current-sensing type, with voltage output 0-2V, selected for optimum range and accuracy for meters indicated for this application. Sensors shall allow for remote mounting up to 500 feet from meter without loss of power.

1.2.3.2.2.1 Type: Split Core

1.2.3.2.3 Utility Monitoring Software: Integration Plan.

1.2.3.2.4 Installation diagnostics and verification system.

1.2.3.2.5 Approvals: Shall be UL and CSA listed. Shall comply with ANSI C12.1 and C12.16.

1.2.3.2.6 Must be serviceable without power shutdown (except CT connections).

1.2.3.3 Communications Options

1.2.3.3.1 Modbus TCP/IP

1.2.3.3.2 Must include:
1.2.3.3.2.1 One Ethernet port
1.2.3.3.2.2 One RS485 port
1.2.3.3.2.3 Modbus gateway capability
1.2.3.3.2.4 At least two digital inputs for pulse metering

1.2.3.4 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1.2.3.4.1 Schneider Electric PM Series (e.g., PM5500, PM8000)

1.2.3.4.2 Square D

1.2.3.4.3 Approved Equal, as determined by KSU Energy Dept.

Section 1.3 Flow Meters: Domestic Water Meters, Steam Meters, Natural Gas Meters

1.3.1 Action Submittals

1.3.1.1 General - Submit the following:

1.3.1.1.1 Product data for each type of meter. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

1.3.1.1.2 Product certificates signed by manufacturers of meters certifying accuracy under specified operating conditions and products' compliance with specified requirements.

1.3.1.1.**3** Maintenance data for each type of meter for inclusion in Operating and Maintenance Manuals for project.

1.3.1.1.4 Utility Monitoring Software: Integration plan

1.3.1.1.5 O&M Manuals: Product data, operation and maintenance data

1.3.1.1.6 Meter Asset Management Data

1.3.2 Quality Assurance

1.3.2.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Section 1.4 Domestic Water Meters

1.4.1 Positive Displacement Flow Meter

1.4.1.1 Flow meter shall be non-magnetic, with forward curved impeller blades designed for water containing debris. Materials which will be wetted shall be made from non-corrosive materials and shall not contaminate water.

1.4.1.**2** Sensor accuracy shall be plus or minus 1.5% of reading over the full range of flow, minimum operating flow velocity shall be ~1 foot per second. Sensor repeatability and linearity shall be plus or minus 1%. Materials which will be wetted shall be made from non-corrosive materials and shall not contaminate water.

1.4.1.**3** The flow meter shall be provided with particulate strainer, isolation valves and bypass line to be rated for installation in pipes of 3/4 to 10 inch diameters.

1.4.1.**4** A pulse transmitter shall provide a pulse output that is scalable to gallons per pulse (not to exceed 10 Gallons per pulse) and clearly defined in supporting documentation. The pulse transmitter housing shall be NEMA 1, NEMA 3R or NEMA 4.

1.4.1.5` Low Flow Applications: Use appropriate Badger brand meter with pulse output allowed.

1.4.1.6 Connect to Data collection panel pulse counter or other approved method.

1.4.1.7 Submeters Required For:
- 1.4.1.7.1 Irrigation (post-main meter)
- 1.4.1.7.2 Cooling tower makeup
- 1.4.1.7.3 Cooling tower blowdown/drain/overflow
- 1.4.1.7.4 Chilled water makeup

1.4.1.8 Manufacturers: Subject to compliance with requirements, provide products by one of the following, with registration in gallons:

- 1.4.1.8.1 Badger
- 1.4.1.8.2 Approved Equal, as determined by KSU Energy Dept.

1.4.1.9 Utility Monitoring Software: Integration plan

1.4.2 Electromagnetic Flow Meter (Main Building Meter)

1.4.2.1 Main Building Meter: Badger M2000 Electromagnetic or equivalent

1.4.2.2 Modbus via Ethernet or RS485

1.4.2.3 Must report: Total flow (gallons), Flow velocity, Empty pipe detection and alarm

1.4.2.4 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1.4.2.4.1 Badger M2000 Electromagnetic
- 1.4.2.4.2 Approved Equal, as determined by KSU Energy Dept.

1.4.2.5 Utility Monitoring Software: Integration plan

1.4.3 Domestic Water Pressure Sensor

1.4.3.1 Required near the building water meter and connected to the data collection point.

Section 1.5 Saturated Steam Meters

1.5.1 Flow Meter

1.5.1.1 Required for all buildings connected to central steam.

1.5.1.**2** Calibration: Factory programmed application specific

1.5.1.3 Accuracy: Plus or Minus 1 percent of reading for volumetric flow and plus or minus ~~2~~ 1.5 percent for mass flow over the entire operating range.

1.5.1.4 Operating Range: -40 degrees F to 140 degrees F ambient, -65 degrees F to 425 degrees F medium. Maximum 300 PSI operating pressure.

1.5.1.5 Pipe Connections: ANSI Class 150, 300, or 600 Flange as required by application.

1.5.1.6 Utility Monitoring Software: Integration Plan

(Note: Currently using Yokogawa Meters)

Section ~~1.7~~ 1.6 Natural Gas Meters

1.6.1 Thermal Mass Flow Meter

1.6.1.1 Sensor accuracy shall be plus or minus 0.5% of full scale or plus or minus 1% or reading. Sensor repeatability shall be plus or minus 0.2%. Materials which will be wetted shall be made from non-corrosive materials.

1.6.1.2 The mass flow meter shall be provided with isolation valves and shall be rated for installation in pipes of 1/4 to 36 inch diameters.

1.6.1.3 The transmitter shall provide a 4 to 20 vdc pulse output linearly proportional to flow. The pulse transmitter housing shall be NEMA 1, NEMA 3R, or NEMA 4.

1.6.1.4 Based on supply size: Onicon F-5500 Thermal Mass Flow Meter.

1.6.1.5 Manufacturers: Subject to compliance with requirements, provide products by one of the following, with registration in MCF:

1.6.1.5.1 Onicon F-5500

1.6.1.5.2 Romet Hub with Adem-PTZ

1.6.1.5.3 Romet RMT Series with Adem-PTZ

1.6.1.5.4 Approved Equal, as determined by KSU Energy Dept.

1.6.1.6 Utility Monitoring Software: Integration plan

Section 1.7 Chilled Water Meters

1.7.1 BTU Flow Meter

1.7.1.1 Chilled Water Meters: Must use BACnet over Ethernet.

1.7.1.2 Approved Models: Onicon F-3500 (insertion) or FT-3000 (inline, preferred) with System-20 BTU meter or equivalent.

1.7.1.3 Install Pete's Plugs adjacent to temperature sensors for testing.

1.7.1.4 Utility Monitoring Software: Integration plan

1.7.1.4.1 Integration with SkySpark system

1.7.1.4.2 Building Automation System. See HVAC standards for more info.

1.7.1.5 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1.7.1.5.1 Onicon F-3500 (insertion) with System-20 BTU meters
- 1.7.1.5.2 Onicon FT-3000 (inline, preferred) with System-20 BTU meters
- 1.7.1.5.3 Approved Equal, as determined by KSU Energy Dept.

Section 1.8 Data Collection and Communication Systems

1.8.1 General Communication Requirements

1.8.1.1 Each building data collection panel must include:
- 1.8.1.1.1 One Ethernet connection per meter (as required)
- 1.8.1.1.2 One spare Ethernet port for campus network connection.

1.8.1.2 Ethernet-connected meters must route through the data collection panel for maintenance and troubleshooting.

1.8.1.3 Coordinate BACnet instance IDs with Building Automation and Controls Department.

1.8.2 Pulse Output Systems

1.8.2.1 If a meter only provides pulse output:
- 1.8.2.1.1 A pulse counter with non-volatile registers must be installed in the data collection panel.
- 1.8.2.1.2 If the electric meter supports pulse totalization, it may replace a standalone pulse counter.
- 1.8.2.1.3 Pulse counter connections must be routed through terminal blocks in the data collection panel.

1.8.2.2 Pulse Counter Requirements:
- 1.8.2.2.1 At least one Ethernet and one RS-485 connection
- 1.8.2.2.2 Gateway capability
- 1.8.2.2.3 DIN rail mountable
- 1.8.2.2.4 Subject to approval by Energy and Utilities personnel

1.8.3 Data Collection Panels

1.8.3.1 TBD

1.8.4 Power Requirements

1.8.4.1 referred power for field devices: 24V DC or 24V AC (except electric meters).

Section 1.9 Integration and Commissioning

1.9.1 System Integration

1.9.1.1 Monitoring Software: SkySpark

1.9.1.2 Custom graphics and trending must be created before substantial completion.

1.9.1.3 Provide 2 weeks' notice before integration.

1.9.1.4 Exterior Installations: TBD

1.9.1.5 Submeters may be required based on project scope or possible usage anomalies from expected project baseline.

1.9.2 Commissioning Requirements

1.9.2.1 Utilities will not be energized until:
- 1.9.2.1.1 Meters are permanently installed and powered
- 1.9.2.1.2 Installation is inspected and accepted
- 1.9.2.1.3 Meters are commissioned and startup documentation is submitted

1.9.3 Submittals

1.9.3.1 Flow Meters: Product data, wiring diagrams

1.9.3.2 Energy/BTU Meters: Product data, wiring diagrams

1.9.3.3 Utility Monitoring Software: Integration plan

1.9.3.4 O&M Manuals: Product data, operation and maintenance data

1.9.3.5 Meter Asset Management Data
- 1.9.3.5.1 Network Assignment Matrix:
- 1.9.3.5.2 Device/Equipment Served
- 1.9.3.5.3 Room served from and jack location
- 1.9.3.5.4 Port ID
- 1.9.3.5.5 MAC address
- 1.9.3.5.6 Static IP, subnet mask, gateway, VLAN
- 1.9.3.5.7 BACnet instance number if required

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CHAPTER 2 - FOUNDATIONS

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CHAPTER 2--FOUNDATIONS

Section 2.10 Thermal and Moisture Protection

- 2.10.1 Insulation
- 2.10.2 Waterproofing

Section 2.11 Cleaning Procedures

- 2.11.1 Cleaning Services
- 2.11.2 Contractor Specifications

CHAPTER 2--FOUNDATIONS

Section 2.1 Site Evaluations

2.1.1 Subsurface Investigation

2.1.1.1 Coordinate all subsurface investigation or work to locate all underground utilities prior to commencement of the work by contacting Kansas 811 at least a week prior.

2.1.1.2 All utilities need to be located by the Planning Office 48 hours in advance of start of work.

2.1.2 Soil Borings

2.1.2.1 Most soil borings shall be located, to the extent possible, near the location of proposed footings.

2.1.2.2 For each new building or addition, there shall be at least one boring for every 2,000 square feet of building footprint, with a minimum of four soil borings, or as recommended by the geotechnical engineer.

2.1.2.3 Immediately after completion of soil borings each location is to be backfilled, cleaned up, have all holes plugged/filled and sod, asphalt or concrete restored to original condition.

Section 2.2 Excavation and Backfill

2.2.1 Rock Excavation

2.2.1.1 All contract documents that include any excavation work involving rock shall include a specific amount of each kind of rock excavation in the base bid of the contract. Any requirement for over excavation of rock surfaces is to be clearly stated in the bid documents.

2.2.1.2 A unit price shall be required for each kind of rock excavation that shall be used to adjust the base bid, for either more or less rock excavation than the amount included in the base bid.

2.2.1.3 At a minimum, rock excavation shall be divided into two categories: trench and general. A specific definition shall be included in the specifications for each type of rock excavation.

2.2.1.4 No explosives are to be used for rock excavation on the main campus, within the city limits of the City of Manhattan, without specific written owner approval.

2.2.2 Spread and Pad Footings

2.2.2.1 The bearing soil shall be placed in 6" lifts and compacted to a minimum of 95% of maximum density at optimum moisture content ($\pm$ 2%), standard proctor, or as recommended by the geotechnical engineer. Excavation to undisturbed soil is not considered adequate.

2.2.2.2 Immediately prior to installation of reinforcing steel and placement of concrete, the soil shall be inspected by the geotechnical engineer. The inspecting agency

will be retained by the Owner, but the inspections shall be scheduled by the contractor.

2.2.3 Piles and Piers

2.2.3.1 Auger Cast Piles – To be used only in certain areas of campus, generally bounded along the east and south edges of the main campus: from Justin Hall to Beach Museum, to Memorial Stadium.

2.2.3.1.1 Description: Furnish and install augered pressure grouted intrusion piles as required. The extent of piles is to be shown on the drawings, including locations, diameters of shafts (straight and battered), estimated bottom elevations, top elevations, and details of construction.

2.2.3.1.2 Quality Assurance

2.2.3.1.2.1 Codes and Standards: Perform pier work in compliance with the building code, including provisions for adequate protections to persons and property.

2.2.3.1.2.2 Contractor Qualification: Contractor shall have a minimum of five years experience in work of a nature and scope similar to that required by this section.

2.2.3.1.3 Job Conditions

2.2.3.1.3.1 Soils Report: The Owner will contract with a geotechnical engineer to provide a detailed soils report for the design team and contractors' use. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by the Architect and Contractor. The data are made available solely for the convenience of the Architect and Contractor.

2.2.3.1.3.2 Additional Information: Additional test borings and other exploratory operations may be made by the Contractor, as he deems necessary, and at no cost to the Owner.

2.2.3.2 Products

2.2.3.2.1 Materials

2.2.3.2.1.1 Portland Cement: ASTM C150, Type I or Type II

2.2.3.2.1.2 Special Pozzolan: When available, provide an approved fly ash or other finely powdered siliceous material capable of combining with the lime liberated during the hydration of portland cement.

2.2.3.2.1.3 Grouting Agent: An approved admixture that affects the cement base mortar to reduce mixing water, retard

setting time, decrease bleeding and segregation, and eliminate setting shrinkage.

2.2.3.2.1.4 Water: Fresh, clean and free from injurious amounts of sewage, oil, acid, alkali, salts, or organic matter.

2.2.3.2.1.5 Fine Aggregate:

2.2.3.2.1.5.1 Sand conforming to the requirements of ASTM C33 except that gradation shall be as specified below.

2.2.3.2.1.5.2 Provide hard, dense, durable, uncoated rock particles, free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances. If washed, the washing method shall be such as will not remove desirable fines, and the sand shall subsequently be permitted to drain until the residual-free moisture is reasonably uniform and stable.

2.2.3.2.1.5.3 Sand shall be well graded from fine to coarse, with fineness modulus between 1.40 and 3.40. Fineness modulus is defined as the total divided by 100 of the cumulative percentages retained on U.S. Standard Sieve Nos. 16, 30, 50 and 100.

2.2.3.2.1.6 Piles: Piles shall be of a diameter recommended by the geotechnical or structural engineer, extending at least two feet into the underlying shale bedrock, reinforced as shown on the drawings, and capable of sustaining the minimum allowable working load to achieve the design loading.

2.2.3.2.2 Mixes

2.2.3.2.2.1 Provide cement-based, non-shrink grout consisting of portland cement, special pozzolan, grouting agent, sand, and water so proportioned and mixed as to produce a grout capable of maintaining the solids in suspension without appreciable water gain, and which may be pumped without difficulty, and will penetrate and fill any voids in the adjacent soils.

2.2.3.2.2.2 Hardened grout shall have an ultimate compressive strength of 4,000 psi at 28 days.

2.2.3.2.2.3 Submit proposed grout mix design to Architect for approval at least fifteen days before beginning work.

2.2.3.3 Execution

2.2.3.3.1 Examine areas and conditions under which piles are to be installed. Notify Contractor in writing of conditions detrimental to the proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

2.2.3.4 Installation

2.2.3.4.1 Tolerances: Install piles within a tolerance of 3” or less from locations shown on drawings.

2.2.3.4.2 Log: Maintain accurate record of piles installed showing location, date placed, length of pile, and final tip elevation. Submit three copies of pile log to Architect weekly.

2.2.3.4.3 Obstructions: Should obstructions be encountered which would prevent installation of pile to required depth, stop work on that pile group until corrective methods are provided by the Architect.

2.2.3.4.4 Pile Installation:

2.2.3.4.4.1 Install piles using a continuous flight, hollow shaft auger, drilled to the required depth.

2.2.3.4.4.2 Use only approved pumping equipment in preparing and handling grout. Locate a pressure gauge in good operating condition on the grout pump so that the grouting pressure can be checked continuously by the operator and the Architect. Measure all materials by volume or weight as they are fed into the mixer.

2.2.3.4.4.3 Leave auger in hole and inject grout mix under pressure through the hollow shaft of the auger. Slowly withdraw auger. Use earth or gravel fill surrounding auger to retain shape of hole and prevent grout under pressure from escaping along the sides of the auger. Do not raise auger and spin off earth prior to grouting. Earth fill, at least 10 feet deep, shall remain on auger before grouting operation begins.

2.2.3.4.4.4 Place grout continuously without interruption and in a smooth flow without segregating the mixed materials. Consolidate grout with mechanical vibrating equipment.

2.2.3.4.4.5 Grout piles to an elevation of at least one foot above bottoms of pile cap or grade beam. Cut top of pile accurately to final elevation following placement of reinforcing steel, and when grout has stiffened enough to allow cutting of grout without spalling.

2.2.3.4.4.6 At installer's option, pressure grout piles to approximately 6" above pile cut-off elevation and dip out fresh grout to the cut-off elevation prior to initial set.

2.2.3.4.4.7 Do not permit lateral pressure of soil to reduce pile diameter. Avoid sudden withdrawal of auger to prevent collapse of hole or reduction of pile diameter. Doubt on the part of either the Architect or the Contractor that a pile is continuous and of uniform diameter shall be sufficient cause to require that the grout be reamed out and the pile re-grouted.

2.2.3.4.4.8 Take necessary precautions to prevent mud, frozen material or other debris from falling into uncured grout.

2.2.3.4.4.9 Any concentrated loads from equipment must be distributed to prevent compressing or shearing soil in the top area of the pile. Keep concentrated loads at least 10 feet from pile until initial grout set has occurred.

2.2.3.4.5 Excavated Material: Remove excavated material and legally dispose of it off the site.

2.2.3.5 Field Quality Control Testing

2.2.3.5.1 During the progress of the work, make standard 2” x 2” x 2” test cube samples for determining compressive strength of grout injected into the auger borings.

2.2.3.5.2 Furnish molds, make, cure, and store cubes in accordance with ASTM C109. Deliver samples to the testing laboratory. Furnish testing laboratory with information of the location, mix, admixtures, etc. of the batch from which each set of test cubes was taken. Provide a minimum of three pairs of cubes (six cubes) for each day's work. When special pozzolan is used, provide fourth pair. Make each pair of cubes a minimum of three hours apart in the course of the work. Carefully identify samples and record the location of piles from which each sample of grout was taken.

2.2.3.5.3 From each set of six sample cubes, perform tests as follows:

2.2.3.5.3.1 For greater pile length than indicated on the drawings, per linear foot;

2.2.3.5.3.2 For lesser pile length than indicated on the drawings, per linear foot;

2.2.3.5.3.3 For added or subtracted piles of length indicated on the drawings, each.

2.2.3.6 Backfill

2.2.3.6.1 Typical Backfill Materials

2.2.3.6.1.1 Backfill around foundations shall be installed in no more than 12" lifts. Specific situations or soils may

require smaller lifts, at direction of geotechnical engineer.

2.2.3.6.1.2 Using a standard proctor at optimum moisture content (± 2%), all backfill shall be mechanically compacted to a minimum of 88% and a maximum of 92% of maximum density under landscape areas and minimum of 95% of maximum density under other areas.

2.2.3.6.1.3 The backfill shall be inspected and tested at the discretion of the Owner's representative and the geotechnical engineer. The owner shall retain the services of an engineering inspection and testing firm. The contractor shall be responsible for coordinating and scheduling the inspections.

2.2.3.6.1.4 The use of fly ash and/or lime as an additive shall be considered on a case-by-case basis.

2.2.3.6.2 Alternate Backfill Material

2.2.3.6.2.1 Flowable Fill, such as that provided by MCM Concrete, can be considered for use for subgrade and in trenches backfilling utilities.

Section 2.3 Concrete

2.3.1 All concrete used in footings, foundations, slabs or sidewalks shall have a minimum strength of 4,000 psi. All concrete used in exterior, exposed to the weather type applications shall be air-entrained concrete.

2.3.2 Calcium chloride shall not be used in any concrete. A non-calcium accelerator may be considered for use in concrete.

2.3.3 Masonry units shall not be used for foundation walls below grade.

Section 2.4 Reinforcement

2.4.1 Reinforcing steel and accessories shall conform to CRSI Standards and shall not be placed in contact with soil. Reinforcing steel shall not extend to the surface of the concrete. Chairs shall be used on all horizontal concrete surfaces, either formed or on grade. Chairs and other accessories shall be metal. Use of Fiber Mesh in lieu of reinforcing steel is not allowed.

2.4.2 Reinforcing systems may be required to be engineered.

Section 2.5 Penetrations

2.5.1 General guidelines

2.5.1.1 All penetrations of foundation walls shall be leak-proofed. Where required they shall be fire resistant.

2.5.1.2 All penetrations, except steam tunnels, shall be individual pipes or conduits. Groups of pipes or conduits in a common penetration shall not be allowed.

2.5.1.3 In instances where reinforcing steel is used to attach another mass of existing concrete to the foundation walls (duct banks, steam tunnels, etc.), the steel pins shall be attached to the foundation walls through the use of epoxy capsules similar to those supplied by Hilti.

2.5.1.4 Minimum clearances shall be 3” clearances between pipes or sleeves.

2.5.1.5 The conduit shall penetrate the foundation in the following manner:

2.5.1.5.1 For new construction, the foundation wall shall have a steel sleeve installed that is 2" larger in diameter than the conduit to be installed. For existing construction, the hole shall be core drilled. In multiple duct situations, sufficient space shall remain between the penetrations to maintain the structural integrity of the foundation wall.

2.5.1.5.2 A rubber seal, equal to link-seal, shall be installed in the space between the conduit and the sleeve or drilled hole, near the interior surface of the foundation wall. The same space shall have waterproofing installed on the exterior side of the rubber seal.

2.5.2 Electrical Duct Banks

2.5.2.1 Concrete encased duct banks shall terminate at the exterior surface of the foundation wall. The conduit shall make individual penetrations of the foundation wall.

2.5.2.2 All duct banks shall be attached to the foundation wall in one of two manners. In new construction, the reinforcing steel of the foundation wall may be extended into the concrete encasement of the duct bank at the time of placement. Alternately, reinforcing steel may be drilled into the foundation wall and extended into the duct bank concrete. The steel that is inserted into the foundation wall shall be attached through the use of epoxy capsules, similar to those supplied by Hilti.

2.5.2.3 All duct bank conduits within the limits of the project site of the foundation wall penetration shall be rigid steel conduit. The conduit shall be installed with a sloped grade down and away from the building.

2.5.3 Steam and Condensate

2.5.3.1 The point of attachment for steam tunnels shall have a concrete, cast-in-place transition, with waterstopping material cast into the concrete. The waterstopping shall be embedded into the foundation wall according to the manufacturer’s recommendations. Waterstopping material shall be equal to Volclay RX-102.

2.5.3.2 Individual penetrations of steam and condensate lines shall be installed as follows: The foundation penetration shall be the anchor point. The penetration shall be sleeved with a galvanized steel sleeve.

2.5.4 Other Pipe Penetrations

2.5.4.1 The minimum strength of pipe penetrating foundation walls shall be equal to schedule 40.

2.5.4.2 All penetrations, except steam, steam condensate, or other high temperature piping, shall be waterproofed in the same manner as described in previous paragraph 2.5.1.5.1.

2.5.5 Other penetrations

2.5.5.1 Penetrations of foundation walls by direct burial cable shall be sleeved or core drilled, and shall be sealed through the use of 3M Scotchcase 2114, or equal sealant. Direct burial of cable is described in Chapter 9 of the Specifications: paragraph 9.2.2.

Section 2.6 Drainage Systems

2.6.1 A footing/foundation positive drainage system shall be installed on all buildings with usable space below grade. There are various methods and systems available to provide good foundation drainage. Drainage system recommendations will be provided by geotechnical engineers.

2.6.2 Piping

2.6.2.1 All pipe used in foundation drainage systems shall be a minimum of Schedule 40.

2.6.2.2 Cleanouts shall be installed downstream of each 90-degree elbow, within 12" of the elbow. On straight runs of pipe, cleanouts shall not be located more than 100' apart. All cleanouts shall be supplied with brass plugs.

2.6.2.3 All drainage piping shall be connected as required to storm sewer piping or sump pumps, not sanitary sewer.

2.6.2.4 Filter fabric shall be used.

Section 2.7 Slab On Grade (Interior, Structural)

2.7.1 The bearing soil under slabs on grade shall be compacted to a minimum of 95% of maximum density at optimum moisture content or as recommended by the geotechnical engineer. Excavation to undisturbed soil is not considered adequate. Depth of compaction for slabs on grade to be provided by designer of slab system.

2.7.2 Joints

2.7.2.1 Joint spacing and joint detail shall be shown in the drawings.

2.7.2.2 Expansion joints shall be required with a maximum spacing between joints of 30 feet. Expansion joints shall have dowel bars and shall allow load transfer and slab expansion. Non-extruding expansion joint material shall be used.

2.7.2.3 Control joints shall be cut as soon as the concrete can be walked on without damage to the finish (soft cut). Control joints shall be cut a minimum of 2" deep or to a depth of 25% of the slab thickness; whichever is greater.

2.7.2.4 Slab flatness and levelness shall be within 1/8" in 10'. ASTM E1155 shall not be used to specify flatness and levelness unless the particular use requires a high level of accuracy. Areas that have floor drains shall not be required to meet the levelness tests, but shall have positive slope to the floor drain. The

amount and direction of slope for floor drains shall be indicated on the drawings.

2.7.2.5 All slabs on grade shall have a positive drainage system installed. This can be a system of drain piping beneath the slab, with a sump pump, to collect and remove the water beneath the slab or a drainage system which extends direct to grade.

2.7.2.6 Dowel into existing sidewalks, building or other surfaces.

Section 2.8 Crawl Spaces

2.8.1 Crawl spaces should be avoided in favor of basements. However, they shall not have earth floors. The preferred treatment is the placement of concrete on the floor areas.

2.8.2 Crawl spaces shall be ventilated, have a drainage system to prevent standing water, and shall have LED lighting installed as required by the IBC/NEC with switching at each exit door.

2.8.3 Crawl spaces shall be a minimum clearance of five feet to the lowest hanging pipe**,** beam or ductwork.

Section 2.9 Equipment Pits

2.9.1 Equipment pits shall be drained by gravity.

2.9.2 Where gravity drainage is not possible, a sump with a pump shall be installed. The sump shall have an alarm installed and be connected to the campus security system, to alert maintenance personnel whenever the water level rises and before the water overflows the pit. Where the campus security system is not available, a local alarm shall be installed. In circumstances with a high water table or underground stream install a secondary pump at a higher level for backup in case the first pump were to fail. Verify underground water characteristics prior to design of backup system

2.9.3 A ladder and LED lighting shall be provided in each equipment pit.

Section 2.10 Thermal and Moisture Protection

2.10.1 Insulation

2.10.1.1 Foundation walls shall be insulated on the exterior surface of the wall from the finish grade, to a minimum of 30" below finish grade. Insulation installed on the exterior of foundation walls shall be attached to the wall. All insulation shall comply with ASHRAE 90.1.

2.10.1.2 Foundation walls associated with a slab on grade that is above the surrounding grade shall be insulated in the interior of the foundation wall surrounding the bottom of the slab to a minimum of 30" below the exterior grade.

2.10.2 Waterproofing

2.10.2.1 All foundation walls shall be waterproofed below grade.

2.10.2.2 All foundation drains are to be installed according to Section 2.6, Drainage Systems.

Section 2.11 Cleaning Procedures

2.11.1 Cleaning services to be provided:

2.11.1.1 Daily: Contractor to power wash streets and sidewalks after contractor vehicles have left tracks on the way to or from the project site. Spud hoe up clods of dirt thrown from or crushed by tires, etc. and remove from site. Street sweep access routes used by contractors to edge of campus as well as provide follow up cleaning – broom and wash.

2.11.1.2 Weekly: Contractor to remove stains from paved surfaces caused by rubber from tire tracks, oils, fuels, solvents, etc.

2.11.1.3 Daily: Contractor to pick up litter within project site and any litter within 50 feet of the university's side of the project site fence, along access routes, contractor storage yards and parking area. Debris to be placed in contractor's trash containers. Contractor is responsible for removal of all construction debris.

2.11.1.4 Weekly: keep weeds and grasses in control every 5 days within project site along and either side of project fence and in contractor parking/storage yards (use weed eater for cutting).

2.11.2 Contractor Specifications

2.11.2.1 The campus is a pedestrian campus and must remain accessible for the safe movement of pedestrians through the entire campus.

2.11.2.2 Contractor shall provide alternate or temporary sidewalks to keep people moving, with adequate all-weather surfaces for safety.

2.11.2.3 Contractor to use boring methods to pass utility lines under and keep all paved areas intact to the greatest extent possible.

2.11.2.4 Contractor must share sidewalks and streets with pedestrians and other service vehicles along their access route to their project site boundaries.

2.11.2.5 Alternative traffic methods need to comply with all applicable codes and regulations.

2.11.2.6 ADA accessibility for personnel and vehicles must be maintained.

2.11.2.7 Required fire exit paths from building must be maintained with a hard all-weather surface and <u>never</u> be blocked by contractor equipment, materials or work at any time during the workday.

2.11.2.8 Access to site for university personnel or other contractors must be maintained at all times.

2.11.2.9 Contractor may use sidewalks/streets for limited access to site, provided:

2.11.2.9.1 When the ground is moist, planking is required along the path of access to prevent construction vehicle damage to grounds.

2.11.2.9.2 Contractor personnel shall direct pedestrian traffic for safety purposes adjacent to project site when heavy equipment needs access to and from project site across sidewalks/streets.

2.11.2.10 Contractor is to use planking, or other protective measures.

2.11.2.11 Contractor is to either clean concrete trucks within the project site or do it off campus property.

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CHAPTER 3 – SUPERSTRUCTURE SYSTEMS

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CHAPTER 3—SUPERSTRUCTURE SYSTEMS

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CHAPTER 3---SUPERSTRUCTURE SYSTEMS

Section 3.1 General Requirements

3.1.1 Dead and live loads for all structural systems shall be noted on the drawings.

3.1.2 The owner does not accept any responsibility for design adequacy.

3.1.3 New structural systems shall not be structurally connected to existing structures, except when the new structures are constructed above the existing structure. Additions to existing structures shall be separate from the existing structure with an expansion joint at the point of attachment. This is to prevent the problems created by settlement of new structures as compared to relative stability of the existing structure. It also takes into account the earthquake zone conditions outlined by the IBC (current adopted edition) for this area of Kansas.

Section 3.2 Cast-in-Place Concrete

3.2.1 General Requirements

3.2.1.1 At expansion joint locations, the structure on each side of the expansion joint shall have full structural support.

3.2.1.2 Exposed concrete shall be free of imperfections caused by the forms.

3.2.2 Testing

3.2.2.1 The concrete shall be tested for strength, air entrainment, temperature, and slump. The specifications shall indicate allowable limits for each.

3.2.2.2 The university will retain the services of a testing firm. The contractor shall be responsible for scheduling the tests. The contractor shall be required to notify the owner's representative a minimum of 48 hours prior to all placement of concrete.

3.2.2.3 Concrete shall be tested at the minimum rate of one test for the first 25 CY. placed each day, and one test for each additional 50 CY. placed. The concrete may be tested more often at the discretion of the owner's representative.

3.2.2.4 The specifications shall make it clear to the contractor that quality control is the responsibility of the contractor. The above testing in no way relieves the contractor of the responsibility to comply with the specifications.

3.2.3 Calcium chloride shall not be permitted.

3.2.4 Slab flatness and levelness shall be within 1/8" in 10'. ASTM E1155 shall not be used to specify flatness and levelness unless the particular use requires a high level of accuracy. Areas that have floor drains shall not be required to meet the levelness tests, but shall have positive slope to the floor drain. The amount and direction of slope for floor drains shall be indicated on the drawings.

Section 3.3 Steel Structures

3.3.1 The specifications shall clearly state the responsibility for the design of steel connections. The responsibility may lie with the project designer or with the steel supplier. The responsible party must seal the connection designs.

3.3.2 Testing: The owner will retain the services of an independent testing agency to test all steel connections. Early in the design phase, the A/E shall estimate the cost of steel testing. The contractor shall be responsible for the cost of retesting any steel connections that fail any tests. The contractor shall be required to provide a minimum of 24 hours notice to the owner's representative prior to the time testing will be needed.

Section 3.4 Roof Structures

3.4.1 Gypsum decking shall not be used. The preferred decking material is steel or lightweight concrete.

3.4.2 All roof decks shall be designed with a minimum slope of 1/4" per foot. Positive slope for drainage shall be provided by the roof deck rather than tapered insulation.

CHAPTER 4 – EXTERIOR CLOSURE

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CHAPTER 4—EXTERIOR CLOSURE

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CHAPTER 4---EXTERIOR CLOSURE

Section 4.1 General Requirements

4.1.1 The exterior closure of all buildings shall comply with ASHRAE 90.1.

4.1.2 Specific requirements provided in this chapter are not intended to preclude the use of historic materials in the campus context on a case-by-case basis.

Section 4.2 Wall Types

4.2.1 General information

4.2.1.1 The exterior wall material of choice for all university facilities is bottom ledge "Cottonwood" limestone. Some existing buildings have been constructed with a mix of "Cottonwood" limestone along the ground and "Neeva" limestone in the upper areas of the buildings. "Cottonwood" bottom ledge is a denser stone and withstands weathering better than "Neeva." There are color differences between the two.

4.2.1.1.1 Kansas limestone will be specified for all projects that involve an addition to one of our existing limestone buildings. The bid specifications can include as an alternate the use of other (non-Kansas) limestone for new freestanding buildings to be constructed on the Manhattan campus. However, a decision to accept such material as an alternate would require a careful comparison of that material with the color, texture and overall appearance of the limestone exteriors of surrounding campus buildings.

4.2.1.2 No exterior wall surfaces shall be constructed of wood materials. The possible exceptions to this are areas that need to match existing wood surfaces to provide historical or aesthetic continuity.

4.2.1.3 Waterproofing or water repellent materials shall not be installed on masonry, concrete, or stone surfaces.

4.2.1.4 The use of "Cast stone" or similar man-made products is prohibited.

4.2.1.5 The use of EIFS is prohibited.

4.2.2 Masonry/Stone

4.2.2.1 The design and construction guidelines and technical notes of the Brick Institute of America shall be followed for brick construction, and the Masonry Advisory Council for concrete masonry unit construction.

4.2.2.2 All brick shall comply with ASTM C216 and shall have a rating of no "efflorescence" when tested according to ASTM C67. The owner shall retain an independent testing agency that will randomly test brick delivered to the site for compliance with the above.

4.2.2.3 All shelf angles and other metal objects incorporated into masonry walls shall be hot dipped galvanized and shall have stainless steel fasteners.

4.2.2.4 All flashings shall extend a minimum of 1/4" beyond the face of the wall and shall be bent to form a drip edge.

4.2.2.5 Weeps shall be installed above each flashing. The weeps may be tubes installed at 24"on center, or rope weeps, installed at 16" on center. Other types of weeps may be

used if the manufacturer's recommendations are followed regarding the spacing and installation to ensure adequate drainage.

4.2.2.6 The designer shall evaluate the expected movement for each wall and require adequate expansion joints to accommodate the movement in addition to those required by the Building Code.

4.2.2.7 Wall ties shall be galvanized steel, of a quality equal to Hohmann & Barnard, Inc., DW10 Box Wall Tie.

4.2.2.8 At joints of different types of materials, (brick and stone, brick and cast concrete, etc.) the mortar shall be raked back a sufficient depth to allow the installation of a backer rod and sealant in the joint. The sealant installation details shall comply with the manufacturer's recommendations.

4.2.2.9 Masonry and stone walls shall be installed without mortar dropping in the wall cavity.

4.2.2.10 Coping stones shall be secured with stainless steel anchors and pins and shall have a continuous rubber membrane flashing beneath the stones that extends flush to the surface of the wall, but not past the exterior surface. All head joints of coping stones shall have joint sealant installed rather than mortar or grout.

4.2.3 Concrete

4.2.3.1 Cast-in-place

4.2.3.1.1 Flint and chert shall be limited to 1% maximum, by weight, in all concrete. Lignite shall be limited to 0.07%, by weight of the fine aggregate.

4.2.3.1.2 All exterior concrete shall have a minimum of 6% (±1%) air entrained.

4.2.3.1.3 All accessories in contact with concrete surfaces, other than stainless steel, shall be coated with plastic or epoxy to prevent rust.

4.2.3.1.4 Testing

4.2.3.1.4.1 The concrete shall be tested for strength, air entrainment, temperature, and slump. The specifications shall indicate allowable limits for each.

4.2.3.1.4.2 The university will retain the services of a testing firm. The contractor shall be responsible for scheduling the tests. The contractor shall be required to notify the owner's representative a minimum of 48 hours prior to all placement of concrete.

4.2.3.1.4.3 Concrete shall be tested at the minimum rate of one test for the first 25 CY. placed each day, and one test for each additional 50 CY. placed. The concrete may be tested more often at the discretion of the owner's representative.

4.2.3.1.4.4 The specifications shall make it clear to the contractor that quality control is the responsibility of the contractor. The above testing in no way relieves the contractor of the responsibility to comply with the specifications.

4.2.3.1.5 Calcium chloride shall not be permitted.

4.2.3.2 Pre-cast

4.2.3.2.1 Concrete used in pre-cast panels shall comply with cast-in place requirements noted above.

Section 4.3 Penetrations

4.3.1 Doors and frames

4.3.1.1 All exterior pedestrian doors and frames shall be metal and comply with ASHRAE 90.1.

4.3.1.2 Steel doors and frames shall be a minimum of 16 gauge and shall be reinforced at hardware locations. All steel doors shall be 1 ¾" thick.

4.3.1.3 All pedestrian doors shall have a minimum size of 3' in width and 7' in height.

4.3.1.4 It is required that double doors have a fixed, center mullion. The mullions shall be key removable.

4.3.1.5 In all new construction, all public entrances to the building shall be accessible to persons with disabilities. Exceptions to this must be approved by the owner.

4.3.1.6 In existing structures, a minimum of one entrance shall be accessible to persons with disabilities.

4.3.1.7 In existing structures, any design for construction in the vicinity of an entrance should evaluate the possibility of making that entrance accessible. Whenever it is physically and economically feasible, all entrances should be made accessible.

4.3.1.8 All frames will have reinforcing at hinges and closer.

4.3.1.9 Keyed Removable Mullions - all keyed removable mullions are required to accept ASSA ABLOY 98600IC or Corbin Russwin 7-pin lock cylinders, M03/M1 (A,B,C). Acceptable manufacturers include Precision, Detex, or Sargent. All mullions to be 2-inch minimum thickness.

4.3.1.10 Entry Doors:

4.3.1.10.1 Stile-type doors and their frames shall be made of aluminum with all welded construction. All wide stile doors shall have a center rail. All material shall have a minimum thickness of 3/16" and shall be reinforced at hardware locations. Stile doors shall be 2" thick with a minimum stile width of 3 1/2". All bottom rails shall be a minimum of 10" in height. All doors shall have a center-locking rail. Kawneer 350/500 Series Heavy Duty Wall systems should be used as a standard of quality.

4.3.1.10.2 Low-usage or non-public doors (mechanical areas, etc.) may be steel doors with steel frames. All steel shall be insulated, galvanized, shop-primed, and painted with an epoxy or comparable paint. All steel doors and frames shall be of welded construction. Steel doors shall have a top channel cap, secured in place and sealed.

4.3.1.11 Entry Frames:

4.3.1.11.1 Entry Door Frames Aluminum - extra heavy-duty use, 2-inch, thick aluminum thermal-break frame with 1" insulated glass sidelights. Sidelights to have 7½" minimum bottom frame.

4.3.1.11.2 Entry Door Frames (Hollow Metal) - exterior hollow metal frames to be galvanized and insulated. Painted finish.

4.3.1.11.3 Entry Door Thresholds - use ADA accessible aluminum threshold.

4.3.1.12 Pathway Coordination:

4.3.1.12.1 Coordinate routing of electrical pathways with engineering disciplines. Wire access control devices through frames. New frames may have multiple pathways that require coordination with security and access control devices.

4.3.1.12.2 Pathway routing shall be sensitive to surrounding architecture and finish materials.

4.3.1.12.3 Provide conduit type and size appropriate for pathway and conductor requirements at the latch side of the door. The conduit shall extend out of the corridor side of the wall above the ceiling line and terminate at a three-square foam “block-out” in the wall and frame at the same height as the latch for future installation of low-voltage electric key card latches.

4.3.1.12.4 Refer to Pathway Diagrams at end of Chapter 4.

4.3.2 Door hardware

4.3.2.1 The following door hardware is acceptable. Other proposed equals will be reviewed by the Facilities Planning Office and the Facilities Lock Shop.

4.3.2.1.1 All doors must accept 1-1/4 inch mortise cylinder or 7-pin rim device of prescribed keyway, which shall be ASSA ABLOY in new construction. Hardware in existing facilities shall be evaluated for compatibility with existing conditions on a per-project basis. Keying shall be coordinated with K-State Lock Shop. Key control system will be provided by K-State Lock Shop.

4.3.2.1.2 Mortise Locksets shall be ASSA ABLOY ACCENTRA™ 8800 Series Mortise Locks or Corbin Russwin ML2000.

4.3.2.1.3 Cylindrical Deadbolts shall be ASSA ABLOY ACCENTRA™ 5400 LN Series, 5300 LN Series, 4700LN Series, or 4600LN Series or Corbin Russwin DL 3000.

4.3.2.1.4 Cylindrical Passage Sets shall be ASSA ABLOY ACCENTRA™ 5400 LN Series, 5300 LN Series, 4700LN Series, or 4600LN Series.

4.3.2.1.5 Exit Devices, Pushpad Rim; ASSA ABLOY ACCENTRA™ 1500/1800/2100/6000/7000 series, Sargent Precision 1100 series, or Dorma 9300 series.

4.3.2.1.6 Exit Devices, Crossbar Rim; ASSA ABLOY ACCENTRA™ 1500/1800/2100/6000/7000 series, Sargent 9800 series, or Corbin Russwin ED6000.

4.3.2.1.7 Exit Devices, Vertical Rod; ASSA ABLOY ACCENTRA™ 1500/1800/2100/6000/7000 series, Sargent 8700 series, or Corbin Russwin ED6400 series. Vertical rod devices are not allowed.

4.3.2.1.8 Exit device trim packs shall be ASSA ABLOY ACCENTRA™ 1500/1800/2100/6000/7000 series, Precision 39LC, Sargent ETJ, Corbin L3, or any comparable to Corbin LWA Mortise Trim.

4.3.2.1.9 Door Coordinators shall be DCI 600 Series.

4.3.2.1.10 Weather Stripping and Smoke Seals shall be surface mounted on doorstop and must have ¼² adjustment slots.

4.3.2.1.11 Electric Strikes shall be Hanchett 12 vdc Fail Secure, 7000 Series, 2005 Smart Pack II or Folger Adam with Precision door hardware for fire rated devices.

4.3.2.1.12 Electric Key Switches shall be Locknetics 640 Series, HD Key Switch 643 0404, L2 option.

4.3.2.1.13 Electric Door Holders shall have metal covers.

4.3.2.1.14 Overhead Doors shall accept ASSA ABLOY 98600IC or Corbin 7 pin Rim Cylinders.

4.3.2.1.15 Salvage rights of door hardware by owner - notify the K-State Lock Shop 10 working days prior to demolition/construction projects. The K-State Lock Shop will remove the hardware prior to the day that the contractor will start the project.

4.3.2.2 Locksets: (rim latch devices are required; this will require a center mullion)

4.3.2.2.1 All public areas shall be served by lever-handle locksets, similar to Corbin Russwin ML2200 series.

4.3.2.2.2 All non-public areas (mechanical, custodian, serving, etc.) shall be served by knurled handle locksets, similar to Corbin Russwin ML2200 series.

4.3.2.2.3 Mortise locksets shall be used in all areas. Cylindrical style locksets will require special approval.

4.3.2.2.4 All locksets shall be grade 1 and be on the approved list for KSU.

4.3.2.2.5 All locksets shall accept ASSA ABLOY 98600IC or Corbin Russwin 7-pin cores or cylinders.

4.3.2.2.6 These brands of locksets are acceptable to the owner: ASSA ABLOY, Corbin Russwin and Sargent. Other brands require the approval of the owner. Brands found unacceptable to the owner are: Falcon, Yale, and Lockwood.

4.3.2.2.7 Any other types of locksets used must have a key override function.

4.3.2.2.8 Occupancy Indicator Locksets shall be provided at mothers' rooms and single-occupant restrooms.

4.3.2.3 Panic devices:

4.3.2.3.1 All panic devices shall be heavy-duty grade.

4.3.2.3.2 All panic devices shall be of the "touch-bar" or "cross-bar" type and shall have a dogging function.

4.3.2.3.3 Rim latch devices are preferred. In double door situations this requires a center mullion. In cases where center mullions are not desirable or not allowed by code, surface-mounted latches are preferred over concealed vertical rods.

4.3.2.3.4 These brands of panic devices are acceptable to the owner: Von Duprin, Sargent and Precision. Other brands require the approval of the owner. Brands found unacceptable are: Yale, Monarch and Dor-A-Matic. Precision should be used as a standard of quality.

4.3.2.4 Closers:

4.3.2.4.1 All closers shall be heavy-duty or institutional grade. Parallel arms are preferred.

4.3.2.4.2 Surface mounting is preferred. Other types of mounting require the approval of the owner. All doors and frames shall be reinforced at mounting locations. All screw and bolt holes shall be drilled and tapped. Self-tapping screws are not acceptable.

4.3.2.4.3 Accessible doors are preferred to be power-operated: refer to 4.3.3 for details. Those that are not power-operated shall meet the pounds-of-pull requirements of ADA.

4.3.2.4.4 All closers shall be mounted on the interior side of the door/frame whenever possible.

4.3.2.4.5 These brands of closers are acceptable to the owner: LCN, Corbin Russwin, and Sargent. Other brands require the approval of the owner. LCN should be used as a standard of quality.

4.3.2.5 Hinges:

4.3.2.5.1 All hinges shall be heavy-duty grade, ball-bearing type. All doors require 1½ pairs of hinges per door.

4.3.2.5.2 Exterior door to have pivot style hinges 1 ½ pair.

4.3.2.5.3 Hager model #1191BB should be used as a standard of quality.

4.3.2.6 Thresholds:

4.3.2.6.1 All thresholds, regardless of door configuration, shall be heavy-duty grade, constructed of aluminum and meet ADA requirements.

4.3.2.7 Colors:

4.3.2.7.1 All door hardware shall have either US 10 or US 26D finish. Other colors of hardware finish must be approved by the owner. In existing construction, the hardware color should match the existing hardware color. The standardization on colors will allow Division of Facilities to stock replacements. Some buildings have more than one color of hardware already. New hardware should match the predominant color if it is one of the two standard colors. Otherwise, the owner will pick one of the standard colors.

4.3.2.8 Keys and cylinders:

4.3.2.8.1 Early in the design phase, the Architect should discuss the keying of lock cylinders with the Owner. For large and/or new projects, hardware manufacturer to provide pre-keyed locksets. K-State Lock Shop to provide keying requirements. For small and/or renovation projects, K-State Lock Shop may perform keying of locks.

4.3.2.8.2 Where K-State Lock shop provides keying, the specifications shall require the Contractor to supply cylinders complying with the requirements of section 4.3.2.1, with two key blanks, as required for each lock.

4.3.2.8.3 Where pre-keyed locksets are to be provided, Contractor to supply products complying with the requirements of section 4.3.2.1. Contractor to supply keys to fit each lock cylinder. The Contractor will install the lock cylinders and provide location-tagged keys to the Owner.

4.3.2.9 Door pulls with an offset design shall not be used.

4.3.2.10 Entry Door Kickplates - All non-aluminum entry doors are required to have kickplates.

4.3.3 Power operated doors

4.3.3.1 Applications for power operated doors

4.3.3.1.1 In all new construction, all public entrances to the building shall be accessible to persons with disabilities. Any exceptions to this must be approved by the owner. The main entrance shall be provided with one door, or set of doors, that is power operated. Additionally, if an entrance to the building other than the main entrance is located closer to the parking designated for persons with disabilities, that entrance shall also be power operated.

4.3.3.1.2 The above item should be regarded as a minimum requirement. If the expected users of the building include a larger than normal percentage of persons with disabilities, other entrances to the building shall also be power operated.

4.3.3.1.3 In existing structures, a minimum of one entrance shall be accessible to persons with disabilities. That entrance shall be power operated. The accessible entrance shall be either the main entrance or the entrance closest to the parking designated for persons with disabilities.

4.3.3.2 Type of operations

4.3.3.2.1 The preferred operation is for the doors to be power operated only on demand. Without specific action the door should function as a normal door. The desire is to have the most maintenance-free installation that serves the needs of persons with disabilities. Swinging-type doors that are normally operated in a manual mode and power operated on demand is considered to be the best combination.

4.3.3.2.2 It is recognized that in some instances it will be necessary or preferred for the door to operate in a fully automatic mode. This type of installation requires the approval of the owner. It should only be considered in areas that can reasonably expect a high level of usage by persons with disabilities.

4.3.3.2.3 It is preferred that the doors be swinging-type doors. In areas that may receive high usage by persons with disabilities, sliding doors may be appropriate. This type of installation requires the approval of the owner.

4.3.3.2.4 In new construction, and in existing construction where possible, the inner and outer doors of a vestibule should operate individually. This will require the user to separately activate both doors of a vestibule. Individual operation of the inner and outer doors allows the vestibule to maintain its integrity as an airlock for energy conservation purposes.

4.3.3.2.5 In existing construction, where space is not available for individual activation, the doors should both open upon activation by the user.

4.3.3.2.6 In double door situations, only one leaf should be power operated unless the anticipated traffic levels indicate otherwise.

4.3.3.3 Activating devices

4.3.3.3.1 The preferred activating device is push-button. This device shall be used on all non-automatic installations.

4.3.3.3.2 In installations where the operation is fully automatic, the activating devices shall be of the infrared light beam type that detects the presence of the user in a very narrow area.

4.3.3.3.3 The least preferable devices are area motion sensors and floor mats. Use of these devices should be avoided and requires prior approval of the owner.

4.3.3.3.4 During the design phase of a project, the designer should determine the need for after-hours access by persons with disabilities. In those cases where such access is needed, additional secure activating devices and electric strikes or locks may be required. Discuss all options with Owner prior to proceeding.

4.3.3.3.5 All installations shall be wired to support the future installation of additional secure activating devices, hold opens and electric locks or strikes.

4.3.3.3.6 Automatic opening door openers for wheelchair entry shall be Besam, Dor-o-matic or LCN.

4.3.3.4 Locking and Security for Power-Operated Doors
(Note: As of November 2024, locking and security standards are currently pending revision by KSU; the requirements below will be updated when available. Refer also to Chapter 9 for security system requirements).

4.3.3.4.1 All installations shall be provided with positive locking devices. Simply deactivating the door operating system does not provide the security level desired.

4.3.3.4.2 The preferred locking system uses the panic devices normally found on entrance doors.

4.3.3.4.3 On those systems that require after-hours operation, the use of electric strikes is preferred. Electric locks should be avoided if possible.

4.3.3.4.4 Classrooms which require alarms, approved electric strike, electric key switches, and burglar alarm devices shall be provided by the Contractor. Contractor to provide conduit pathway and coordinate location and sizing per requirements found in these standards with Owner.

4.3.3.5 Signage

4.3.3.5.1 All signage related to power operated doors shall use the universally recognized blue symbols and characters on a white background.

4.3.3.5.2 Every power-operated door shall have the universal symbol for accessibility located near the latch side of the door. The sign should be mounted either on the wall next to the door (preferred) or on the door (if necessary), depending on the situation.

4.3.3.5.3 Every switch or other operator requiring user action shall have a sign located in close proximity to the switch. This sign shall consist of the universal symbol for accessibility and any instructions that apply to the operation of the door. The switches are sometimes lost in the surrounding structure. These signs are to alert the users to the existence of the switches and to give instructions.

4.3.3.6 Equipment

4.3.3.6.1 Power assist equipment of any type shall not be allowed. Pneumatically actuated equipment of any type shall not be allowed.

4.3.3.6.2 All door operating equipment shall be rated for heavy duty service.

4.3.3.6.3 In specifying and approving door-operating equipment, prime consideration shall be given to the ready availability of service and replacement parts

4.3.3.6.4 All control equipment shall be compatible with the voltage requirements of the university building security system.

4.3.3.6.5 All door operating equipment shall have a two-year warranty.

4.3.3.6.6 In manual mode, no power assist of any type shall occur. The operators shall require no more than 15 lbs. to set in motion and not more than 10 lbs. to continue movement.

4.3.4 Windows

4.3.4.1 All windows shall be constructed of aluminum and shall comply with ASHRAE 90.1. No steel shall be allowed.

4.3.4.2 All windows shall have thermal break construction.

4.3.4.3 All windows installed in areas normally occupied by people shall be operable. All operating mechanisms shall be of heavy-duty, institutional grade construction. All operable windows shall be capable of being cleaned from the interior of the building and shall be supplied with a positive locking device.

4.3.4.4 Screens shall not be supplied with windows.

4.3.4.5 All windows installed in existing structures, shall match the color of the existing windows and/or doors with the concurrence of the Owner.

4.3.4.6 In specifying windows, consideration shall be given to the replacement of broken glazing. It is preferred that replacement be possible from the interior of the building. Other types of windows require the approval of the Owner.

4.3.4.7 The details of the window installation shall provide for a thermal break between the window material and the finish material of the interior wall.

4.3.4.8 Window sills in new construction shall be stone, synthetic stone, or another similarly durable material.

4.3.4.9 In existing construction, if any of the existing windows or parts of windows are removed, that material shall be returned to the owner for storage.

4.3.4.10 All window units shall comply with ASTM E283, E331, and E547. These tests shall be performed on the site after installation. The owner will retain the services of a testing company to perform these tests on window units chosen at random by the owner. If any window units fail the tests, the contractor shall be responsible for retesting.

4.3.5 Glass and glazing

4.3.5.1 All new glazing shall be insulated double-pane glass with thermal-break frame construction and shall carry a 10-year warranty on replacement of defective material.

4.3.5.2 All glazing shall be of the Low-E type.

4.3.5.3 Glazing in windows on the campus shall have a light bronze tint.

4.3.6 Access Control Devices – Exterior Doors
(Note: As of November 2024, locking and security standards are currently pending revision by KSU; the requirements below will be updated when available.)

4.3.6.1 Refer to Chapter 9 for additional security and telecommunications system devices and requirements to be coordinated with hardware devices described in this Chapter.

4.3.6.2 Coordinate with engineering disciplines for operation, pathways, and other access control system characteristics.

4.3.6.3 Door access control components:

4.3.6.3.1 Passive Infrared Detector: Bosch DS160/161 Request-to-Exit

4.3.6.3.2 Electric Strike: Hanchett 9600 Series 613 Dark Bronze

4.3.6.3.3 Multi-Tech Reader: Gallagher T-Series – T11/C300430 or T15/C300480

4.3.6.3.4 Door Channel Magnet: George Risk Industries MC180 for mounting in top channel

4.3.6.3.5 Door Channel Magnet: George Risk Industries 180-12WG for wide-gap closed loop.

4.3.6.3.6 Smart Relay: IDEC FL1F-H12RCE with display.

4.3.6.4 Provide Gallagher Command Centre software, 7000 Controller, 8 port HBUS module and cabinet.

4.3.6.5 Provide LifeSafety Power FPO250 power supply board.

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CHAPTER 5 – ROOFING SYSTEMS

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CHAPTER 5—ROOFING SYSTEMS

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CHAPTER 5—ROOFING SYSTEMS

Section 5.1 General Requirements

5.1.1 Whenever feasible, roofs with slopes greater than 3 inches per foot should be considered.

5.1.2 On low-sloped roofs, the minimum slope shall be 1/4" per foot. On new construction, and on existing construction where possible, the slope shall be a minimum 3/16 inches per foot.

5.1.2.1 Tapered insulation shall not be allowed on new construction. The new roof structure needs to provide the slope – not the insulation.

5.1.2.2 Tapered insulation may be used on existing roofs to achieve proper slope to drains.

5.1.2.3 Lightweight concrete (LWC) may be used in in conjunction with insulation on concrete decks to achieve slope.

5.1.2.4 Where feasible, parapet heights on existing roofs may be increased to achieve increased slope**.**

5.1.3 Two or Three -ply Modified Bitumen Sheet. Consider contaminants and pollutants known to be present when choosing the membrane material. The mod-asphalt membrane to meet or exceed 20 year warranty, cold application of membrane. Recent projects have used the following for low-sloped roofs: Derbigum APP (Atactic Polypropylene) Modified Bituminous membranes by Performance Roof Systems. Refer to Section 5.2.

5.1.4 The specifications shall prohibit:

5.1.4.1 The use of any asbestos-containing materials for the entire system.

5.1.4.2 Organic felts shall not be used. Modified Bitumen is required.

5.1.4.3 Pitch pans shall not be used.

5.1.4.4 Top nails shall not be used.

5.1.5 Avoid penetration and placing of equipment directly on roofs as much as possible.

5.1.6 All roofs shall have overflow systems. If overflow piping is used, the piping systems shall be separate from the regular roof drain system. Consideration should be given to the use of scuppers or other highly reliable overflow systems.

5.1.6.1 Exterior gutters to downspouts may be considered in lieu of interior downspouts in existing buildings with leak issues.

5.1.7 The specifications and drawings shall note that often the manufacturer is willing to warrant a roof system for the required period of time if details are used that are less comprehensive than the details shown in the drawings. In those cases, <u>we require the details drawn to be used.</u> – No exceptions!

5.1.7.1 Use a minimum 20-year warranty for all specifications. 30-year warranty is preferred.

5.1.8 New roofing systems shall not be installed over an existing roof system without removal and replacement of the old roof system.

5.1.9 The following references and guidelines should be used in roofing design:

5.1.9.1 NRCA Roofing and Waterproofing Manual, including NRCA Construction Details.

5.1.9.2 SMACNA Architectural Sheet Metal Manual.

5.1.9.3 FM Approval Guide, current edition.

5.1.9.3.1 Roof systems shall meet FM standards for design to the greatest extent possible for wind uplift and severe hail protection. Where achievable, Tornado protection is recommended.

5.1.10 The design system shall be able to meet FM 1-90 wind uplift ratings.

5.1.11 All roofing systems shall include the use of a vapor barrier. Review vapor barrier on a roof by roof basis with Owner to determine final needs.

5.1.12 Insulation

5.1.12.1 The insulation specified shall be compatible with the application method required and the other materials of the roofing system. Require the roofing membrane manufacturer to approve the insulation in writing. Preferred insulation is polyisocyanurate meeting ASTM C 1289, Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces. Coverboard is ~~¾" fiberglass.~~ 1/4" GP-DensDeck Prime, USG-Securock, or Soprema-Sopraboard)

5.1.12.1.1 Polyisocyanurate Insulation: recent projects on campus have used Holcim Elevate, IOS 95+ GL, 48 inch by 48 inch nominal, 20 psi. Thickness will vary per application.

5.1.12.2 Where overall insulation thickness is 2" or greater, it is preferred that the insulation be installed in more than one layer with the joints staggered. For this purpose, a recovery board can be considered a layer.

5.1.12.3 Lightweight concrete insulation systems are ~~not~~ allowed unless prior approval of the Owner is obtained.

5.1.13 Use crickets, saddles, and edge strips to direct water flow away from penetrations and parapet walls. Provide a minimum of 2 times the roof slope to ensure resulting finished surfaces are sloped, not flat. Show all cricket layouts on the roof plan.

5.1.14 Penetrations

5.1.14.1 Minimize use of roof penetrations to the greatest extent possible. Maintain proper clearance between penetrations to allow for flashing installation. Do not install penetrations in valleys or near drains or scuppers.

5.1.14.2 Maintain a minimum of 12 inches between penetrations. Maintain a minimum of 8 feet to all roof drains and scuppers.

5.1.14.3 Show all penetrations on the roof plan and provide applicable details including detail references keyed in the roof plan or legend. Clearly show all details of the construction requirements for the deck, insulation, membrane, curbing, base flashing and counterflashing, etc. necessary to completely communicate requirements. Use of pre-manufactured pipe boots is not allowed.

5.1.14.4 All penetration flashings shall extend a minimum of 12" above the roof membrane.

5.1.14.5 All penetrations are to be through a box; pitch pans are not allowed.

5.1.14.6 Penetrations that are no longer necessary in existing re-roof locations shall be cleaned and removed/infilled, including ductwork. DO NOT abandon in-place if feasible to remove. Remove above ceiling below roof if feasible. Cap services as needed.

5.1.14.7 Replace glass vent piping serving Labs if feasible with acid-resistant PVC piping. Coordinate with Supervisor and Department.

5.1.15 Equipment Supports

5.1.15.1 Use round shapes to construct equipment supports. Equipment supports should be as shown below. Note that these minimum apply at the end of the equipment support on the upslope side of the framing.

5.1.15.2

Width of Equipment	Height of Legs above Membrane
Up to 24”	24”
25 to 47”	36”
Over 48”	48"

5.1.16 Flashings

5.1.16.1 Copper is the preferred material for flashings and removable counterflashings. Galvanized sheet metal shall not be used. Other materials may be considered based on prior Owner approval.

5.1.16.2 On new construction, and on existing construction whenever feasible, install counterflashings a minimum of 12" above the roof system.

5.1.16.3 Before designating sheet metal items for reuse in reroofing work, consider whether the component can withstand removal, reinstallation, bending, or resetting without damage and as necessary to perform its intended function.

5.1.16.4 Where fascia replacement is required, the preferred system is a two-piece system similar to Anchor-Tite as manufactured by Metal-Era Roof Edge Systems.

5.1.17 Walkways shall be provided to all roof-mounted equipment. Walkway shall be in contrasting color to membrane.

5.1.18 The designer shall include snowguards or ice breakers, especially on roofs with eaves over sidewalks.

5.1.19 Required elements common to KSU roof projects include placement of roof hatches, ladders between roof levels, hose bibs and electrical access on each roof level. Metal expansion joints only – no neoprene materials are allowed on KSU projects.

Section 5.2 Modified Bituminous Systems

5.2.1 Modified Bitumen Sheet (MBS) – Refer to the detailed specification draft used on all KSU roofing projects for greater detail of requirements.

5.2.1.1 All MBS roofs shall be designed to 20-year standards, regardless of the warranty period. Refer to 5.1.7.1 for requirements of bid specifications.

5.2.1.2 All MBS systems shall use a layer of recovery board.

5.2.1.3 Recently used products include: Derbigum APP (Atactic Polypropylene) Modified Bituminous Membrane System by Performance Roof Systems.
5.2.1.3.1 Roof Membrane Base Sheet: Derbibase Ultra, 120 mil.
5.2.1.3.2 Granulated Surface Cap Sheet: Derbicolor GP FR, White

5.2.1.4 Manufacturer's warranty shall be Twenty (20) years from date of Substantial Completion.

5.2.1.5 Installer's warranty shall be Five (5) years from date of Substantial Completion.

Section 5.3 Metal Systems

5.3.1 Metal roof systems shall meet FM Standards for wind uplift and hail damage.

5.3.2 Metal roofing systems shall be of the standing seam type only. The minimum height for the seam is 1 ¾ ".

5.3.3 Minimum metal thickness is 24 gauge.

5.3.4 In the field, mechanically crimped seams are preferred. Other types of seams may be considered. However, seams utilizing a "U" clip will not be considered.

5.3.5 The minimum slope for metal roofing systems is 1" per foot.

5.3.6 All panels shall be continuous with no lateral splices.

5.3.7 The roof support systems shall be designed for the anticipated loadings per IBC, Current Edition code, but in no case shall the metal be required to span more than 5'.

5.3.8 All clips shall be concealed and shall allow for expansion and contraction of the metal.

5.3.9 All accessories shall be pre-manufactured and approved as a part of the roofing system.

5.3.10 All fasteners shall be stainless steel.

5.3.11 Underlayment shall be a minimum of 15 Lb. felt. Other systems may be considered.

5.3.12 For those roofs that need to be colored for aesthetic reasons, the standard of quality for the color finish is Penwalt Corp. Kynar 500 resin. Roofs that do not need to be colored shall have a "Galvalum" finish.

Section 5.4 Other Systems

5.4.1 Asphalt Shingles

5.4.1.1 Architectural laminated asphalt shingles shall be warranted for 40 years and must be of the seal tab Iam, type TAMKO ~~Heritage 40~~ Titan XT "Oxford Grey" to match the University standard color.

5.4.1.2 The minimum roof slope for fiberglass shingles is 3" per foot.

5.4.1.3 All fiberglass shingles shall have an underlayment of a minimum of two layers of 30 Lb. felt.

5.4.1.4 A galvanized drip edge shall be installed on all fiberglass shingle roofs. Copper may be used in some locations.

5.4.1.5 Material warranty shall be Forty (40) years from date of Substantial Completion.

5.4.2 Single Ply Membrane Systems

5.4.2.1 This is not a preferred system. Discuss with Owner prior to considering this system.

5.4.2.1.1 Instances of EPDM (ethylene propylene diene terpolymer) roofing membrane shall be 75 mil puncture-resistant (or 90 mil thickness) with 30-year warranty. Comply with manufacturer fastening, thickness, detailing, and other requirements for stated warranty duration.

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5.4.2.1.1.1 Basis-of Design EPDM: Holcim's Elevate, RubberGard EcoWhite, 90 mil thickness, reinforced. Color: White

5.4.2.1.2 At locations indicated to receive new single-ply Thermoplastic Polyolefin (TPO) membrane roofing system provide the following or approved comparable, with 30-year warranty. Comply with manufacturer fastening, thickness, detailing, and other requirements for stated warranty duration.

5.4.2.1.1.1 Holcim Elevate UltraPly TPO Adhered Roofing System with reinforced flexible fabric-backed TPO sheet. Thickness: 60 mils, with 55 mil fabric backing. Total thickness of 115 mils, minimum Color: Grey

5.4.3 Cold Liquid-Applied Membrane Roofing

5.4.3.1 Use is limited to maintenance of existing cold liquid-membrane applied roof sections where existing and other options are not feasible. Approval is required from Campus Architect.

5.4.3.2 Products previously used include the following by Performance Roof Systems:
5.4.3.2.1 Base Ply: Derbibase SA Ultra
5.4.3.2.2 Field Membrane (PMMA): Derbiflash RS 230 Field, Grey
5.4.3.2.3 Flashing Membrane (PMMA): Derbiflash RS 230 Flash, Grey
5.4.3.2.4 Accessories: Derbiflash and Derbibase recommended products for PMMA applications.

Section 5.5 Roof Accessories

5.5.1 Roof Hatches

5.5.1.1 Provide thermally broken, metal roof-hatch units with R-20 insulated lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.

5.5.1.1.1 For vertical ladders provide single-leaf lid, 36 by 30 inches.

5.5.1.1.2 For ships ladders provide single-leaf lid, 30 by 54 inches.

5.5.1.2 Ladder Assist Post – Provide roof-hatch manufacturer's standard device for attachment to roof-access ladder.

5.5.1.3 Safety Railing System – Provide Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

5.5.1.4 Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant. Equip hatch with water diverter or cricket on side that obstructs water flow.

5.5.2 Roof Access

5.5.2.1 Performance Standard: Units designed and manufactured to meet or exceed ANSI A14.3, OSHA 1910.23, OSHA 1910.28 and OSHA 1910.29.

5.5.2.2 Fabricated Ladders: Provide Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.

5.5.2.2.1 Side Rails: Provide 18 inches clear between siderails minimum
5.5.2.2.2 Rungs: Minimum 3/4 inch diameter solid round bar spaced 12 inches (300 mm) on center.
5.5.2.2.3 Space rungs 7 inches (175 mm) from wall surface.

5.5.2.3 Standard Ladders: Provide welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical.

5.5.2.3.1 All components shall be aluminum alloy 6005-T
5.5.2.3.2 Stringers: Extruded Aluminum channel
5.5.2.3.3 Treads: Extruded channel with deeply serrated surface to maximize traction
5.5.2.3.4 Finish: Mill finish aluminum
5.5.2.3.5 For ladders exceeding 24 feet in height provide fall arrest system or ladder safety system as required by OSHA 1910 Subpart D.

5.5.2.4 Ship’s Ladders: Provide welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical.

5.5.2.4.1 All components shall be aluminum alloy 6005-T5
5.5.2.4.2 Stringers: Aluminum channel

5.5.2.4.3 Treads: Extruded channel with deeply serrated surface to maximize traction
5.5.2.4.4 Handrails :1-1/4″ schedule 40 pipe
5.5.2.4.5 Finish: Mill finish aluminum
5.5.2.4.6 Incline/pitch: 60 degrees

5.5.3 Fall Protection

5.5.3.1 General: Provide permanent, modular, free-standing, roof edge railing system that does not penetrate the roofing system including but not limited to pipe railings, uprights, bases, counterweights, fittings and accessories as indicated or required to match design indicated on Drawings and to provide complete installation.

5.5.3.2 System shall meet OSHA Standard 29 CFR 1910.140 and 1926.502 and all applicable codes.

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CHAPTER 6 – INTERIOR CONSTRUCTION

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CHAPTER 6—INTERIOR CONSTRUCTION

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CHAPTER 6---INTERIOR CONSTRUCTION

Section 6.1 General Design Guidelines

6.1.1 For wet areas or wash down areas the following wall system is preferred: Concrete masonry unit (CMU) wall, 1/8" fiberglass panel bonded to the CMU wall with mastic, and nylon anchors.

6.1.2 Stairwells and elevator shafts are preferred to have masonry or concrete construction. Floors in stairwells shall be hard surfaced with a slip resistant covering.

6.1.3 All mechanical rooms shall have concrete floors and masonry or concrete walls.

6.1.4 The designer shall carefully evaluate the need for sound proofing for all walls.

6.1.5 In corridors and other public areas, no wall covering shall be used.

6.1.6 Ceramic Tile shall not be used in restrooms.

6.1.7 All color selections for all materials shall be listed in the specifications.

6.1.8 For conference rooms and similar areas the designer shall evaluate the need for chair rails to prevent wall damage.

6.1.9 For classrooms: refer also to Kansas State University Classroom Design Standards, current version. Contact KSU project manager for additional information.

Section 6.2 Floor and Room Numbering

6.2.1 The Division of Facilities Planning shall review and provide final approval of all newly assigned room numbers to match the standard University Numbering system. The designer shall use the University numbering system in lieu of the typical architectural system for numbering.

6.2.2 At the initial design development phase and throughout the design and construction phases,
room numbers shall be altered only as needed to comply with the following guidelines.

6.2.3 Floors shall be numbered beginning with the lowest floor that has a grade level entrance. The floor that is immediately below the first floor shall be called the basement. Floors below the basement shall be called the first sub-basement, second sub-basement, etc., as needed.

6.2.4 Room numbering:

6.2.4.1 Sub-basement rooms shall be labeled by alpha indicators only.

6.2.4.2 Basement rooms shall be labeled with numbers 001-099.

6.2.4.3 First floor rooms shall be labeled with numbers 101-199, second floor rooms with numbers 201-299, etc.

6.2.4.4 For new buildings, or additions to existing buildings, with more than 100 rooms per floor, the numbering system shall consist of 4 digits.

6.2.4.5 The University numbering systems skip ending room numbers in 5's and 10's for future use.

6.2.4.6 Rooms that are not accessible from a corridor or common area shall be numbered by the use of an alpha suffix. The prefix and the number shall be the same as the room through which common access is available. For example, rooms accessible through room E101 shall be numbered E101A, E101B, etc. Do not use alpha prefixes for major room numbers.

6.2.4.7 Rooms that are not accessible from a corridor or common area and are at a different level than the room that provides access shall be called mezzanines. Mezzanines shall be numbered according to paragraph 6.2.4.6, above.

6.2.4.8 If a room is subdivided into more than one room and the new rooms created are accessible from the corridor or common areas, and if room numbers in the appropriate sequence are not available for use, the original room number shall be retained and numerical suffixes (-1, -2, -3, etc.) shall be used for each new room created.

6.2.4.9 For remodeling projects that require new room numbers: the new room numbers shall fall between room numbers not being remodeled. 5's and 10's can be used if needed.

6.2.4.10 Rooms that span more than one floor shall be numbered according to the main level entrance to the room if one entrance is on the main level. If no entrance is on the main level, the room shall be numbered according to the entrance closest to the main level.

6.2.4.11 The main corridor shall be numbered 100, 200, 300, etc. on the first, second, third, etc. floors. Other corridors, stairwells, vestibules, and elevators shall be numbered using the number of the main corridor with the addition of an alpha suffix, applies in a clockwise fashion.

6.2.4.12 Room numbers shall be applied by beginning at the Northeast corner of the building, numbering each room or area in a clockwise direction. Where corridors are present, even/odd numbers may be used to differentiate sides of the corridor. The same clockwise convention shall be used in applying the alpha suffix to rooms not directly accessible from a corridor or common area.

Section 6.3 Wall Types

6.3.1 Stud and drywall

6.3.1.1 For new construction and major renovations, studs for drywall construction shall be metal. For minor renovations, metal or wood studs may be used. When metal studs are used, 20 gauge shall be the minimum thickness of the metal.

6.3.1.2 Drywall shall be a minimum of 5/8" thickness. Always specify type "X" drywall as a rule. The need for water resistant type drywall should be

considered. Water-resistant drywall shall be used in all rest rooms, washrooms, custodial closets, animal rooms, etc. Provide USG Durock or Wonderboard backing board for all ceramic tile in wet areas such as shower stalls. Consider glass-mat tile backer board for dry areas such as restroom walls. Specify waterproofing membranes appropriate for the area being tiled.

6.3.1.3 In areas where gypsum board is used and it is subject to physical abuse, high impact gypsum board is to be used.

6.3.1.4 The drywall shall be attached to the studs with screws and glue.

6.3.1.5 A minimum of three coats of drywall finishing material (tape and mud) shall be used.

6.3.2 Modular

6.3.2.1 The use of full-height-modular wall systems is not preferred. This type of wall should be used only to match existing conditions.

Section 6.4 Wall Finishes

6.4.1 Paint

6.4.1.1 Flat paint may be used on walls. The preferred finish is “eggshell” or semi-gloss.

6.4.1.2 Flat paint may be used on ceilings.

6.4.1.3 Door and window trim shall be a minimum of oil base, stain finish. Semi-gloss may also be used.

6.4.1.4 For woodwork, the minimum finish shall be oil base, stain finish. Urethane is the preferred material for woodwork finishes.

6.4.1.5 If epoxy paints are needed, two-part epoxies are preferred.

6.4.1.**6** All walls shall be primed as required by the paint manufacturer.

6.4.2 Ceramic Tile/Porcelain Tile

6.4.2.1 Tile products shall meet the certification standards in ANSI A138.1 - Green Squared - American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials.

6.4.2.2 Tile products shall comply with the provisions of ANSI A137.1 - Standard Specifications for Ceramic Tile.

6.4.2.3 Tile installation shall comply with the provisions of ANSI A108/118/136

6.4.2.4 Light colored tiles with medium to dark grout are preferred when deemed appropriate by the designer.

6.4.2.**5** Existing ceramic tile shall be restored if possible. If not possible, it is to be removed and replaced with other materials.

6.4.3 Wall covering

6.4.3.1 The use of wall coverings in high traffic areas shall be discouraged. Use as an accent in non-high traffic areas should be reviewed with the Facilities Planning Project Manager.

6.4.3.2 When wallcoverings are used, they shall be GREENGUARD Certified.

6.4.3.3 The minimum grade of wall covering acceptable is commercial grade. If vinyl wall covering is used it shall be Type II.

6.4.4 Specialty finishes

6.4.4.**1** Thin coat veneer plaster is considered to be a good durable finish. It is particularly useful when matching existing plaster walls.

6.4.4.3 Acoustical panels shall be terminated a minimum of 4" above the finished floor level to prevent damage from vacuum cleaners.

Section 6.5 Ceilings

6.5.1 General requirements

6.5.1.1 No concealed spline or tongue-and-groove type ceiling tiles shall be used.

6.5.1.2 Suspended grid type ceilings are preferred. Avoid the use of drywall on ceilings, with the exception of public restrooms.

6.5.2 Suspended grid

6.5.2.1 Ceiling tile of 2’ x 2’ size Armstrong-704 “Cortega**”** is generally preferred for the cost savings. Other sizes and types may be considered as required but need prior approval of Facilities Planning.

6.5.2.2 Do not use Mylar or foil faced fiberglass unless matching existing tile. Consideration should be given to the use of tiles with non-sag warranties in high humidity or unconditioned spaces.

6.5.2.3 Suspend the ceiling grid directly from the building structure. Do not hang other objects from the ceiling support system. All light fixtures, HVAC boxes, speakers, etc. shall be supported independently of the ceiling support system.

6.5.2.4 The standard of quality for the grid system is the 15/16” wide Armstrong Prelude XL grid system.

6.5.3 Drywall ceilings, when used, shall be a minimum of 5/8" Type “X” drywall, screwed to the support system, with a smooth finish.

6.5.4 Concrete, when exposed in occupied areas, shall be provided with a finish free of form defects, pitting, etc.

Section 6.6 Floors

6.6.1 General requirements

6.6.1.1 Do not mix types of floor covering within a room. Provide manufacturer's recommended transition pieces at junctions of differing flooring types.

6.6.1.2 Use of carpet in high traffic or high abuse areas should be avoided.

6.6.1.3 The preferred floor covering for most areas is ~~vinyl composition~~ Luxury Vinyl tile.

6.6.1.4 Particular attention shall be given to the preparation of the subfloor. Prepare subfloor as recommended by the floor covering manufacturer's specifications, including but not limited to Moisture Testing and Alkalinity Testing.

6.6.1.5 Flooring shall meet required Dynamic Coefficient of Friction (DCOF) for flooring type and location. Slip resistant materials are required at wet locations, paths of egress and along all accessible routes as required by Code.

6.6.2 Carpet

6.6.2.1 Broadloom carpet is generally not preferred. Carpet tile is the preferred format when utilizing this floor finish.

6.6.2.2 MATERIALS: Acceptable material quality: equal or better than Dupont Antron Legacy nylon and Antron Lumena nylon.

6.6.2.2.1 Yarn: 100% solution dyed, bulk continuous filament nylon type 6 or 6.6 offering a construction and performance standards testing program by fiber producer.

6.6.2.2.2 Construction: tufted or woven, level or multi-level loop pile with maximum height variation of 1/32 inch.

6.6.2.2.3 Dye Method: Meets or exceeds Stain Resistance specification with greater than 5 years on the floor performance history.

6.6.2.2.4 Face Weight: minimum 17 oz/yd2

6.6.2.2.5 Primary Backing: polypropylene or non-woven

6.6.2.2.6 Secondary Backing: to provide permanent moisture barrier Resistance to Delamination: ASTM D3936 minimum 3.0 lbs/inch

6.6.2.2.7 Tuft Bind: ASTM D1335 minimum 20 lbs Pile density 36 x face weight/finished pile HEIGHT: minimum 5800

6.6.2.2.8 Meet Flooring Radiant Panel Test – Class 1. NBS Smoke Chamber – must meet or exceed 350 or less in flaming mode.

6.6.2.2.9 Colorfastness to Light: AATCC 16E, 200 AFU, International Gray Scale for Color Change rating min 3-4. Colorfastness to atmospheric contaminants: AATCC 164(ozone) & AATCC 129 (oxides of nitrogen) for 2 cycles, International Gray Scale for Color Change rating min. 3-4.

6.6.2.2.10 Stain Resistance - AATCC 138 for 5 washings to simulate removal of topical treatments by hot water extraction, followed by: AATCC 175, minimum level 8 using AATCC Red Dye 40 Scale with greater than 5 years on the floor performance history.

6.6.2.2.11 Soil Resistance: An average of 3 fluorine analyses (AATCC 189) of a single composite sample to be a minimum of 500 ppm fluorine by weight when new and 400 ppm fluorine by weight after 2 AATCC 171 (HWE) cleanings.

6.6.2.2.12 Coloration: Color hue and values to be in optimum light reflectance rating for soil hiding enhancement.

6.6.2.2.13 Appearance Retention - Vetterman Drum Test ASTM D5417 for 22,000 cycles. This is a minimum rating of 3.0 using CRI TM-101 Reference Scale. Testing without underpad or brushing.

6.6.2.2.14 Indoor Air Quality - maximum 0.5 mg/m2hr total VOC emission, ASTM D5116 Warranty: Must meet or exceed 10-year warranty

6.6.3 Vinyl composition tile (VCT)

6.6.3.1 Vinyl Composition Tile, 1/8 inch thick, thru-pattern or thru-chip construction and meets the requirements of the ADA for static coefficient of friction when installed in accordance with manufacturer's guidelines, waxes and coatings. Recycle content (post-consumer and post-industrial waste) minimum 10%. Resilient tile is prohibited next to urinals. Specify standard tile sizes.

6.6.3.1.1 Static load limit: 75 PSI

6.6.3.1.2 Flooring Radiant Panel Test: Passes

6.6.3.1.3 Flame Spread: Passes

6.6.3.1.4 The A/E may propose resilient materials other than vinyl composition tile that are advantageous to the project. Approval of the University Architect is required prior to specifying such materials.

6.6.3.1.5 Acceptable material quality: equal or better than Armstrong Excelon Vinyl Composition Tile.

6.6.3.1.6 WARRANTIES: Meet or exceed 5 years material warranty.

6.6.3.2 Particular attention shall be given to the preparation of the subfloor**.** Follow manufacturer's instructions for subfloor preparation and condition before installation.

6.6.3.3 Tile installed on slopes or inclines shall be slip resistant with a minimum Dynamic coefficient of friction (DCOF) of 0.30-0.45 for sloped surfaces exceeding a 2% slope.

6.6.4 Ceramic tile / Porcelain floor tile

6.6.4.1 Designers are required to identify and specify the surface friction criteria for any selected floor tile finishes according to the DCOF Acutest (or similar) testing method.

6.6.4.2 Any selected floor tile materials used in public areas must be certifiable according to ANSI A137.1 by each manufacturer.

6.6.4.3 All floor tiles shall be non-slip and rated for heavy duty use.

6.6.4.4 Restroom floors: Recommend tile pieces with matching cove base. Slope finished floor to drain over the entire room.

6.6.4.5 Glazed or polished floor tiles are prohibited.

6.6.4.6 Existing ceramic tile shall be restored if possible. If not possible, it is to be removed and replaced with other materials.

6.6.5 Quarry tile or ceramic tile are preferred for heavy use floor areas such as Toilet Rooms, kitchens and corridors, as the budget allows.

6.6.6 Vinyl sheet goods are acceptable in specific applications requiring prior approval. If used, particular attention shall be paid to the seaming method and the subfloor preparation.

6.6.7. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, high-performance aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

6.6.7.1 Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

6.6.7.2 System Characteristics:
Color and Pattern: As selected by Architect from manufacturer's full range.
Wearing Surface: Smooth with slight profile created by broadcast aggregate for slip resistance.

6.6.7.3 Overall System Thickness: 1/8 inch

Section 6.7 Signage

6.7.1 All signage shall meet the requirements of the current version of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the University Signage Standards.

6.7.2 Reference current signage standards provided by Campus Planning and Space Management, and University Printing Services.

6.7.3 Placement

6.7.3.1 Signs shall be installed on the wall adjacent to the latch side of the door whenever possible. If wall space is not available on the latch side of the door, coordinate the placement of the sign with the project manager. Meet all other requirements of ADAAG when choosing an alternate placement.

6.7.3.2 Mounting height shall be 60" above the finished floor to the centerline of the braille portion of the sign. Mount signs flush with the door trim.

6.7.3.3 Do not mount signage on or above doors.

6.7.3.4 Consult with University Printing Services for specifics on signage.

Section 6.8 Specialties

6.8.1 The following toilet accessories are the preferred products for restrooms. Any substitutions require approval by KSU.

6.8.1.1 Toilet Tissue Dispensers:

6.8.1.1.1 Tork Elevation Jumbo Bath Tissue Roll Dispenser, Model 552538
6.8.1.1.2 Tork Twin Jumbo Bath Tissue Roll Dispenser, Model 247549A

6.8.1.2 Sanitary Napkin Dispenser: Aunt Flow Tampon & Pad Dispenser, Model E

6.8.1.3 Sanitary Napkin Disposal: Bobrick ConturaSeries Surface-Mounted Sanitary Napkin Disposal, Model B-270.

6.8.1.4 Paper Towel Dispensers:

6.8.1.4.1 Tork Elevation Peak Serve Hand Towel Dispenser, Model 552528, Color: Black.
6.8.1.4.2 Tork Elevation Peak Serve Mini Continuous Hand Towel Dispenser, Model 552538, Color: Black.

6.8.1.5 Soap Dispenser: Rubbermaid Autofoam, Touch-Free Dispensing System Powered by Light, Color as selected by Architect. Model No. 1980826

6.8.1.6 All accessories must follow campus ADA standards.

Section 6.9 Custodial and Storage Rooms

6.9.1 Custodial Closet

6.9.1.1 Size: Minimum size requirements – 5' by 6' with door opening out or 5' by 8' with door opening into the room.

6.9.1.2 Ceiling Height: 8' minimum ceiling height.

6.9.1.3 Doorways: Minimum measurement of 3' wide by 6'-8" high. These measurements do not include a door sill or center post.

6.9.1.4 Custodial closets are not to be used for placement of other building systems, related equipment or services.

6.1.9.5 In larger buildings an office of 160-180 square feet is required to manage all custodial activities.

6.1.9.6 Review 8.2.6.2 for data on plumbing needs and equipment in custodial closets.

6.9.2 Storage Rooms/Closets

6.9.2.2 Minimum of one closet per floor for filter and lights storage. Size should be adequate to accommodate the filters for all units and any lights on that floor.

6.9.3 Telecommunications Rooms

6.9.3.1 Location: A minimum of one telecommunications closet shall be located on each floor. Distance limitations or other considerations may require more than one closet on each floor. Closets should be located as close to the core of the structure as possible and should be stacked one above the other in multiple floor buildings

6.9.3.2 Size similar in size to custodial rooms see 6.9.1.1 and 6.9.1.2

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CHAPTER 7 – CONVEYANCE SYSTEMS

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CHAPTER 7—CONVEYANCE SYSTEMS

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CHAPTER 7---CONVEYANCE SYSTEMS

Section 7.1 Elevators

7.1.1 All elevators must comply with the latest version of the Americans with Disabilities Act, ANSI/ICC A117.1 and Kansas Statute 58-1301, Accessibility Standards for Public Buildings and Facilities.

7.1.1.1 All elevators must comply with regulatory requirements of the current version of ASME A17.1/CSA B44 as enforced by the Kansas State Fire Marshal.

7.1.1.2 All elevators must comply with the Kansas Elevator Safety Act and Amendments.

7.1.2 All elevators shall have an information plate permanently attached listing the maximum weight capacity of the elevator.

7.1.3 Controls

7.1.3.1 All elevator control systems shall be such that ANY elevator repair company is able to troubleshoot, repair, maintain, or adjust the control system. No proprietary software or repair tools shall be allowed. If an elevator control system has such software or repair tools, the complete codes, tools, or other necessary means for monitoring or repairing the control system shall be supplied to the owner at the time of installation. If updates or changes are required, these shall also be supplied to the university at no additional cost.

7.1.3.2 Emergency Communication System: Shall comply with Section 2.27.1.1 of the 2016 version of ASME A17.1/CSA B44. Under a standing blanket variance from the Kansas State Fire Marshal's Office, the two-way communication requirements of subsequent versions of ASME A17.1/CSA B44 will not be required or enforced until further notice.

7.1.3.3 All elevator controls and indicators shall use a vandalism-resistant design.

7.1.3.4 All elevators shall be equipped with a fireman's recall system in accordance with ANSI A~~+~~17.1, 211.3. Car and hall key switches shall be operated by Chicago ACE 7 pin tumbler locks, combinated to the fireman service control master XX3835. One fireman recall system key per elevator shall be furnished.

7.1.4 The installing vendor shall be responsible for all maintenance and service during the warranty period.

7.1.4.1 Response to non-emergency service calls shall be within four hours of the call. Response to emergency service calls shall be within 2 hours of the call. The vendor shall be financially responsible for these calls except those caused by power outages, acts of God, vandalism, and false reports.

7.1.4.2 The contract bid form shall provide for a unit price for the hourly labor rate for these service calls at both the standard rate and overtime rate.

7.1.4.3 During the warranty period, contractors will be required to adhere to the maintenance contract. During the last month of the warranty period, the contractor will perform the ASME 17.1 Section 10 requirements for new elevators.

7.1.4.4 The contractor will be required to submit monthly inspection reports as to the contract.

7.1.5 For each installation, the designer shall evaluate the expected usage of the elevator. All elevators shall be of vandalism resistant construction.

7.1.6 The preferred type of elevator is hydraulic.

7.1.7 All elevator lighting shall be LED**.**

7.1.8 All telephone equipment shall be compatible with the University telecommunications system. Refer to Section 7.1.3.2.

7.1.9 Proximity type detectors shall be used on elevator doors.

7.1.10 The designer shall evaluate the expected use of the elevator when choosing the floor covering. In academic and research areas with high student or high traffic use, the preferred covering is smooth surface (no texture**)** vinyl tile. In administrative areas with low office type use carpet may be considered. If carpet is used, carpet tiles are preferred for ease of replacement. Use of carpet requires prior approval.

7.1.11 All hydraulic elevators shall be equipped with PVC containment piping encasing the cylinder ram and casing. The containment shall be installed subsurface and shall be sealed at the bottom. Provide a means of testing the bottom seal and a means of evacuating any material that may enter the containment. Prevent any materials from entering the top of the containment.

7.1.12 All new elevators need to include bumper and wall pads.

7.1.13 Interior finish of elevators to be non-mar stainless steel; plastic laminate is prohibited.

7.1.14 Sump pit and pump coordination; Provide oil detection on pump for hydraulic elevators.

7.1.15 Floor designations shall be provided in both tactile characters and braille at both jambs of elevator hoistway entrances. Tactile characters shall be 2 inches (51 mm) high minimum. At the main entry level, a tactile star shall be provided on both jambs and the word "main" written in braille.

BID SPECIFICATIONS

1. LOCATION: (Provide description of Building and refer to drawings to locate elevator.)

2. For good cause, and as consideration for executing this contract, the contractor, acting herein by and through its authorized agent, hereby conveys, sells, assigns and transfers to the State of Kansas all rights, title and interest in and to all causes of action it may now, or hereafter acquire under the anti-trust laws of the United States and the State of Kansas, relating to the particular products or services purchased or acquired by the State of Kansas pursuant to this contract.

3. PATENTS: The contractor shall hold and save the State, its officers, agents, servants and employees harmless from liability of any nature or kind, including costs and expenses for, or on account of, any patented or unpatented invention, article or appliance manufactured or used in the performance of this contract.

4. LIABILITY: The contractor shall not be liable for injuries or damage to persons or property except those directly due to his own acts or omissions. The contractor shall not be liable for any loss, damage or delay caused by strikes, lockouts, fire, explosion, theft, floods, riot, civil commotion, war, malicious mischief, acts of God or any cause beyond his reasonable contract. The contractor shall furnish proof of liability insurance in amounts of $500,000.00 for each claim, $1,000,000.00 maximum.

5. All work shall be performed by skilled elevator persons directly employed and supervised by the contractor. Comply with all applicable licensing requirements for Elevator Contractors, Elevator Mechanics, and Elevator Apprentices as established by the Kansas Elevator Safety Act (Amended) as enforced by the Kansas State Fire Marshal.

6. All work shall be performed during regular working hours of regular working days of the trade. If at any time it should become necessary to perform any overtime work, the contractor must have authorization in writing by State officials.

7. The contractor will be responsible for supplying, repairing, and replacing all parts of all description other than those identified and listed under “Items Not Covered By Contract.” Materials to be used shall be genuine parts of the same material and chemical compositions as manufactured by the company furnishing the elevators or appliances. The State of Kansas recognized equivalencies. The contractor shall have, and maintain on hand locally, a supply of spare parts sufficient for the normal maintenance and repair of the elevators. The contractor shall not be required, under this agreement, to install new attachments as may be recommended or directed by the insurance companies or by Federal, State, Municipal or Governmental authorities. The contractor will notify the State agency of the part not covered by the contract so the State may put out for bid. Work performed or parts replaced without written authorization by the State will be at the contractor’s own expense. All replaced parts will be given to the Kansas State University Facilities Electric Shop supervisor.

8. STATE’S RIGHT TO INSPECTION AND TEST: The State reserves the right to make such inspections and tests as and when deemed advisable to ascertain that the requirements of these specifications are being fulfilled. Should it be found the standards herein specified are not being satisfactorily maintained, the State may immediately demand that the contractor place the elevators in condition to meet these requirements. If the contractor fails to comply with such demands within a reasonable time, the State may give written notice to the contractor and terminate his right to proceed further with the work. In such event, the State may take over work and prosecute it to completion, by the contract or otherwise and the contractor and

his sureties (if any) shall be liable to the State for any excess cost occasioned the State thereby.

9. MANNER AND TIME OF CONDUCTING THE WORK: The contractor shall be responsible for regular and systematic examinations, adjustments, cleaning and lubrication monthly, or more often if necessary to provide efficient and safe operation of the cars is required. All lubricants, cleaning materials, paint, cotton waste, etc., are to be supplied by the contractor. All lubricants shall be of the proper grade recommended by the manufacturer for the purpose used.

   Providing emergency call-back service, which shall consist of promptly responding to request from the State for emergency service at all hours of all days. Failure to respond to such emergency call, within two (2) hours after such call is made, may be justification for cancellation of the contract. Emergency response service is of particular importance because these are handicap-access elevators. The contractor bears all responsibility for responding to all calls as reported to the contractor by the State; these service calls will be included in the original contract and not charged as a service separate from the contract. When an elevator is out of service, it will be the responsibility of the contractor to establish written and properly displayed notification on all floors serviced by the out of use elevator. Before the installation is put back in service, it shall be subject to all of the required routine and periodic tests and inspections of the one-year test (ASME A17.1, ~~sec. 10, rule 1000.3~~ **Section 8.11.1.4(b**)).

10. REQUIRED TESTS AND INSPECTIONS (master forms attached)

    INSPECTIONS FOR ELECTRIC ELEVATORS:
    Six-month inspection (ASME A17.1 Appendix N, Req. 8.11.2.1: 2022 Code)
    One-year inspection (ASME A17.1 Appendix N, Req. 8.6.4.19: 2022 Code)
    Five-year inspection (ASME A17.1 Appendix N, Req. 8.6.4.20: 2022 Code)

    INSPECTIONS FOR HYDRAULIC ELEVATORS:
    Six-month inspection (ASME A17.1 Appendix N, Req. 8.11.3.1: 2022 Code)
    One-year inspection (ASME A17.1 Appendix N, Req. 8.6.5.14: 2022 Code)
    Three-year inspection (ASME A17.1 Appendix N, Req. 8.6.5.15: 2022 Code)
    Five-year inspection (ASME A17.1 Appendix N, Req. 8.6.5.16: 2022 Code)

KANSAS STATE UNIVERSITY
Monthly Electric Elevator Inspection
(ASME A17.1, Sec. 8.6 and Appendix N)

Building: _____ Elevator: _____

Date: _____ Time: _____ Inspected By: _____

INSIDE CAR INSPECTION:

____ 1) Door reopening device

____ 2) Stop switch

____ 3) Operating car device

____4) Car floor and landing sill

____5) Car lighting

____6) Car emergency signal

____7) Car door or gate

____8) Door closing force

____9) Car ride

____ 10) Power closing of door or gates

____ 11) Power opening of doors or gates

____12) Car enclosure

____ 13) Emergency exit

____ 14) Ventilation

____15) Signs and operating device symbols

____ 16) Rated load, platform area, data plate

____ 17) Restricted opening of car

MACHINE ROOM INSPECTION

____1) Access to machine space

____2) Head room

____3) Lighting and receptacles

____4) Enclosure of machine space

____5) Housekeeping

____6) Ventilation

____7) Fire extinguisher

____ 8) Pipes, wiring & ducts

____ 9) Guards for auxiliary equipment

____10) Numbering of elevators, machines &

____11) Disconnecting means & controls

____12) Controller wiring, fuses, grounding

____ 13) Static control

____ 16) Traction drive machines

____ 17) Gears and bearings

____ 18) Winding drum machine

____ 19) Belt-or chain-drive machine

____ 20) Motor generator

____ 21) Absorption of regenerated power

____ 22) AC drives from a DC source

____ 23) Traction sheaves

____ 24) Secondary & deflector sheaves

____25) Rope fastenings

____26) Terminal stopping device

____ 27) Slack rope devices

____ 28) Governor, overspeed switch & seal

____ 14) Overhead beam & fastenings

____ 15) Drive machine brake

____ 29) Car & Counterweight safeties

TOP-OF-CAR INSPECTION

____ 1) Top-of-car stop switch

____2) Car top light & outlet

____3) Top-of-car operating device & working platforms

____ 4) Top counterweight clearance

____ 5) Car, overhead & deflector sheaves

____6) Normal terminal stopping devices

____7) Final terminal stopping devices

____8) Broken rope, chain, tape switch

____ 9) Car leveling devices

____ 10) Crosshead data plate

____ 11) Top emergency exit

____ 12) Counterweight safeties

____ 13) Hoistway construction

____ 14) Hoistway smoke control

____ 15) Floor & emergency identification numbering

____ 16) Pipes, wiring & ducts

____ 17) Top-of-car clearance & refuge space

____ 18) Counterweight and counterweight buffer

____ 19) Hoistway clearances

____ 20) Multiple hoistways

____ 21) Traveling cables & junction boxes

____ 22) Door & gate equipment

____ 23) Car frame & stiles

____ 24) Guide rails fastening & equipment

____ 25) Governor rope

____ 26) Governor releasing carrier

____ 27) Wire rope fastening & hitch plate

____ 28) Suspension rope

____ 29) Compensation ropes & chains

____ 30) Windows, projections, recesses & setbacks

OUTSIDE HOISTWAY INSPECTIONS

____ 1) Car platform guard

____ 2) Hoistway doors

____3) Vision panels

____ 4) Hoistway door locking devices

____ 5) Access to hoistway

____ 6) Power closing of hoistway doors

____ 7) Sequence operation

____ 8) Hoistway enclosure

____ 9) Elevator parking devices

____ 10) Emergency doors blind hoistways

____ 11) Separate counterweight hoistway

____ 12) Standby power section switch

PIT INSPECTION

____ 1) Bottom clearance & runby

____ 2) Car & counterweight buffer

____ 3) Final terminal stopping devices

____ 4) Normal terminal stopping devices

____ 5) Pit access, lighting & stop switch & condition

____ 6) Traveling cables

____ 7) Governor-rope tension devices

____ 8) Car frame & platform

____ 9) Car safeties & guiding members

____ 10) Compensating chains, ropes, & sheaves

KANSAS STATE UNIVERSITY
One-Year Electric Elevator Inspection
(ASME A17.1, Sec. 8.6 and Appendix N)

Building: _____ Elevator: _____

Date: _____ Time: _____ Inspected By: _____

1) Test oil buffers

_____

2) Inspect and test safeties

_____

3) Inspect and manually operate governors

_____

4) Inspect and operate manually slack – rope devices on winding drum machines

_____

5) Inspect and test normal and final terminal stopping devices

_____

6) Inspect and test firefighter's service

_____

7) Inspect and test power operation of door system

_____

8) Test broken rope, tape, or chain switch

_____

KANSAS STATE UNIVERSITY
Monthly Hydraulic Elevator Inspection
(ASME A17.1, Sec. 8.6 and Appendix N)

Building: _____ Elevator: _____

Date: _____ Time: _____ Inspected By: _____

INSIDE CAR INSPECTION:

____ 1) Door reopening device

____ 2) Stop switch

____ 3) Operating car device

____4) Car floor and landing sill

____5) Car lighting

____6) Car emergency signal

____7) Car door or gate

____8) Door closing force

____9) Car ride

____ 10) Power closing of door or gates

____ 11) Power opening of doors or gates

____12) Car enclosure

____ 13) Emergency exit

____ 14) Ventilation

____15) Signs and operating device symbols

____ 16) Rated load, platform area, data plate

____ 17) Restricted car opening

MACHINE ROOM INSPECTION

____ 1) Access to machine space

____ 2) Head room

____ 3) Lighting and receptacles

____ 4) Enclosure of machine space

____ 5) Housekeeping

____ 6) Ventilation

____ 7) Fire extinguisher

____ 8) Pipes, wiring & ducts

____ 9)Guards for auxiliary equipment

____ 10) Governor, overspeed switch, & fitting assemblies seal

____ 11) Numbering of elevators, machines, & disconnect switches

____ 12) Disconnecting means & controls

____ 13) Controller wiring, fuses, grounding

____ 14) Hydraulic power unit

____ 15) Relief valves

____ 16) Control valve

____ 17) Tanks

____ 18) Supply line & shutoff valve

____ 19) Flexible hydraulic hose & fitting assemblies

____ 20) Pressure switch

TOP-OF-CAR INSPECTION

____ 1) Top-of-car stop switch

____ 2) Car top light & outlet

____ 3) Emergency terminal speed limiting devices

____ 4) Top-of-car operating device

____ 5) Anti-creep leveling device

____ 6) Normal terminal stopping devices

____ 7) Slack rope device

____ 8) Traveling sheave

____ 9) Hoistway construction

____ 10) Crosshead data plate

____ 11) Top emergency exit

____ 12) Hoistway smoke control

____ 13) Floor & emergency identification numbering

____ 14) Pipes, wiring & ducts

____ 15) Top-of-car clearance & refuge space

____ 16) Governor, safety, ropes & fitting counterweights

____ 17) Hoistway clearances

____ 18) Multiple hoistways

____ 19) Traveling cables & junction boxes

____ 20) Door & gate equipment

____ 21) Car frame & stiles

____ 22) Guide rails fastening & equipment

____ 23) Governor rope

____ 24) Governor rope releasing carrier

____ 25) Wire rope fastening & hitch plate

____ 26) Windows, projections, recesses & setbacks

____ 27) Suspension rope

OUTSIDE HOISTWAY INSPECTIONS

____ 1) Car platform guard

____ 2) Hoistway doors

____ 3) Vision panels

____ 4) Hoistway door locking devices

____ 5) Access to hoistway

____ 6) Power closing of hoistway doors

____ 7) Sequence operation

____ 8) Hoistway enclosure

____ 9) Elevator parking devices

____ 10) Emergency doors blind hoistways

____ 11) Firefighter's service

____ 12) Standby power selection switch

PIT INSPECTION

____ 1) Bottom clearance & runby

____ 2) Plunger & cylinder

____ 3) Car buffer

____ 4) Normal terminal stopping devices

____ 5) Guiding members

____ 6) Pit access, lighting, & stop switch & condition

____ 7) Traveling cables

____ 8) Governor-rope tension device

____ 9) Car frame & platform

____ 10) Car safety

____ 11) Supply piping

KANSAS STATE UNIVERSITY
One-Year Hydraulic Elevator Inspection
(ASME A17.1, Sec. 8.6 and Appendix N)

Building: _____ Elevator: _____

Date: _____ Time: _____ Inspected By: _____

1) Test relief valve setting and system pressure

_____

2) Inspection and test all pressurized valves and piping except for hydraulic cylinders

_____

3) Inspect and test normal and final stopping devices

_____

4) Inspect and test governors

_____

5) Inspect and test safeties

_____

6) Inspect and test oil buffers

_____

7) Inspect and test operation of elevators under fire or other emergency conditions

_____

8) Inspect and test power operations of door system

_____

9) Inspect and test emergency terminal speed limiting device and emergency terminal stopping device

_____

10) Test flexible hose and fitting assemblies and attach metal tag indicating date of the test and name of person or firm who performed the test in a permanent manner

_____

11) Test pressure switch

_____

12) Test slack rope device

_____

CHAPTER 8 – MECHANICAL SYSTEMS

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CHAPTER 8---MECHANICAL SYSTEMS

Section 8.0 Codes

8.0.1 Codes listed below are applicable to the following standards within this document. Designers and Contractors shall be responsible for adhering to all applicable codes adopted at time of project design and construction.

8.0.2 Codes as applicable to MEP are as follows:

2018 International Building Code (IBC)
2018 International Existing Building Code (IEBC)
2018 International Mechanical Code (IMC)
2018 International Plumbing Code (IPC)
2018 international Energy Conservation Code
2018 International Fire Code (IFC)

8.0.3 Kansas Fire Prevention Code

2017 NFPA 70, National Electric Code (NEC)
2017 NFPA 96, Ventilation Control and Fire Protection for Commercial Cooking Operations
2016 NFPA 110, Emergency and Standby Power Systems

8.0.4 Miscellaneous Codes

Current Edition, ASME A17.1 / CSA B44 Safety Code for Elevators and Escalators
2010 Edition K.S.A. 58-1301 et seq ADA Standards for Accessible Design

Section 8.1 General Mechanical Guidelines Plumbing

8.1.1 The designer is notified that the campus water distribution system operates at 90-100 psi. The designer is to verify pressure in lines prior to beginning design.

8.1.1.1 The International Plumbing Code (604.8) requires a maximum of 80 PSIG with a strainer installed ahead of the pressure reducing valve. Pressure Reducing Valves (PRV) will be required at each service to limit the pressure within the respective building to the maximum code allowable pressure.

8.1.2 All motors shall be high efficiency.

8.1.3 All piping systems shall be labeled with the type of service and the direction of flow. Insulated piping shall be labeled as “non-asbestos.”

Section 8.2 Building Plumbing Systems

8.2.1 General guidelines

8.2.1.1 Plumbing Chases and Access doors

8.2.1.1.1 A chase with minimum interior dimension of 24” clear shall be provided anytime a water closet carrier is provided to support a wall mounted water closet.

8.2.1.1.2 Access doors shall be supplied for all concealed valves or other equipment that may require operation or adjustment.

8.2.1.1.3 The access doors shall have a minimum size of 24" x 24". In some instances, this size may not be possible. The doors should be sized to allow access to the valves or other equipment. Doors into accessible chases shall be hinged hollow metal doors with full perimeter frames and key locking bolt action lock. Doors providing access to equipment that is above hard ceilings shall be steel with hinge and screwdriver actuated cam type locking mechanism at each corner that is on the side of the panel opposite of the hinge. In restrooms, shower rooms or other areas subjected to levels of high water vapor access doors in hard ceilings shall be constructed of aluminum. Ceiling access doors shall be provided with a prime finish to allow for field painting.

8.2.1.1.4 Both the mechanical and architectural drawings shall note the need for access doors, the number of doors needed, and the general locations. Exact locations are not desired. The design should require that access doors be located to allow access to the valves or other equipment. A problem often arises because the access doors were not noted on the ceiling drawings or in the ceiling specification. Exact locations are not wanted because an exact location that may work during design may not work after construction is started.

8.2.1.1.5 Access doors shall have keyed locks.

8.2.1.1.6 In single toilet rooms, where it is not possible to provide an access door into the chase, a removable wall panel behind the water closet shall be provided to allow access to the closet carrier by removal of the water closet and panel.

8.2.1.2 Thermometers and gauges

8.2.1.2.1 All thermometers and gauges shall have dial faces between 2" and 5" in diameter. All thermometers installed more than 8' from floor level shall have a minimum dial face of 6" and shall be installed to allow reading from floor level. (See also 8.6.5.5.4)

8.2.1.2.2 All thermometers shall be of the dry well type. All thermometers shall be installed with thermal conductive material in the dry wells. Installation without the thermal conductive material yields inaccurate readings.

8.2.1.2.3 All thermometers and gauges shall be selected with the expected operating conditions near the middle of the range of the device.

8.2.1.2.4 Thermometers and pressure gauges shall be accurate to 1% of full scale.

8.2.1.2.5 All gauges shall be installed with gauge cocks.

8.2.1.2.6 All CW and HW systems should have thermometers as well as pressure gauges installed on both supply and return lines and/or on both sides of pumps. No Pete's plugs are allowed.

8.2.1.2.7 Refer to the following schedule for thermometer, gauge, and gauge cock locations. A minimum of (2) pressure gauges and (2) thermometers, configured to fit into the provided gauge cock shall be provided for each project. These gauges and thermometers shall be delivered to the Owner’s maintenance personnel in a manufacturer’s fabricated carrying case.

THERMOMETER, GAUGE, GAUGE COCK INSTALLATION SCHEDULE

	Thermometer & Well	Press Gauge & Gauge Cock	Gauge Cock	Pete's Plug
Hot water leaving each domestic water heater.	X		X	
Hot water entering and leaving each hot water recirculating pump				X
Omit thermostat on undercounter domestic water heaters				

8.2.1.3 Metering

8.2.1.3.1 All meters shall be coordinated with KSU Utility Systems. The designer should coordinate the sizing of the meters with that office. The contractor shall be responsible for the purchase and installation of the meter. The water meter shall be provided in the service entrance piping within a building prior to any take off to fixtures within the respective building. The meter shall be accessible and installed within a mechanical space. The meter shall be above slab only. Meters installed in a meter pit will not be acceptable.

8.2.1.3.2 All fluid meters shall be installed with a three-valve bypass design. The bypass valve shall be full flow and capable of being locked. The valves shall be as indicated in the valve schedule. The meters shall be installed in a straight run with no obstructions 10 diameters upstream and 5 diameters downstream. All meter installations shall have 40" of clear space above the location of the meter. This is to allow the meter to be serviced without a water outage. The lock is to prevent operation of the bypass mode without the knowledge of KSU Utility Systems.

8.2.1.3.3 All meters shall be connected to the respective building's automatic control system. All meters shall be configured for Modbus TCP/IP with units of "Gallons / Gallons per Minute".

8.2.1.3.4 Meter shall be "Badger" rotary meter with pulse outlet.

8.2.1.4 A water-sampling tap shall be installed on all water mains upon entering the building. The tap shall consist of a 1" tap with a ball valve installed at the 12 o'clock position.

Two 90° elbows shall be installed to direct the water flow toward the floor, similar to a faucet. Locate tap so that discharge outlet is a minimum of 12" above the floor. Do not locate tap in any pit that is below the main floor level.

8.2.1.5 All piping systems, except natural gas, shall be tested at a minimum of one and one-half times the expected working pressure, or a minimum of 100 psig and a maximum of the design pressure of the pipe and fittings. Test all systems for a minimum of four hours. For natural gas, test at twice the working pressure or a minimum of 3 psig. When the test pressure exceeds 125 psig, the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50% of the specified minimum yield strength of the pipe.

8.2.1.6 Gas pressure within a building shall not exceed 5 PSIG, except where allowed by IFGC 402.7

8.2.1.6.1 Excerpt of the IFGC is as follows:

402.7 Maximum operating pressure.

The maximum operating pressure for *piping* systems located inside buildings shall not exceed 5 pounds per square inch gauge (psig) (34 kPa gauge) except where one or more of the following conditions are met:

1. The *piping* joints are welded or brazed.
2. The piping joints are flanged and pipe-to-flange connections are made by welding or brazing.
3. The *piping* is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.
4. The *piping* is located inside buildings or separate areas of buildings used exclusively for any of the following:
   - 4.1. Industrial processing or heating.
   - 4.2. Research.
   - 4.3. Warehousing.
   - 4.4. Boiler or mechanical rooms.
5. The *piping* is a temporary installation for buildings under construction.
6. The piping serves appliances or *equipment* used for agricultural purposes.
7. The *piping* system is an LP-gas *piping* system with an operating pressure greater than 20 psi (137.9 kPa) and complies with NFPA 58.

8.2.1.7 All piping systems shall be installed with section valves at all branch connections.

8.2.1.8 All equipment, fixtures, or other appliances attached to any piping system shall have a shut off valve located at the connection to the piping system.

8.2.1.9 All piping shall be labeled at intervals no greater than 20 feet on straight runs including risers and drops, adjacent to each valve fitting, and at each side of penetrations of structure or enclosure. All labeling shall comply with ANSI A13.1.

8.2.1.10 All valves shall be tagged with an engraved brass tag, each with a number. A corresponding table shall be provided in a frame and mounted in conspicuous location within a mechanical room in the building. The table shall provide the type of valve, the type of service, the area controlled by the valve and the valve Cv. In addition, a copy of the valve tag table shall be included in the project IOM.

8.2.2 Domestic Water Systems

8.2.2.1 Piping Materials

8.2.2.1.1 No PVC piping shall be used for domestic water systems.

8.2.2.1.2 PEX piping will be allowed only when specifically approved by KSU Facilities.

8.2.2.1.3 All pipe and fittings, 3" and smaller, shall be copper, Type L, hard or soft drawn for solder joint connections, ASTM B88. All solder shall be lead-free.

8.2.2.1.**4** Connections in piping systems 2-1/2" and larger, provided for access to valves, equipment, etc. shall be flanged. Flanges shall have a minimum rating of 150 psi. Flanges shall be flat faced with full face rubber or composite gasket as required by the intended service.

8.2.2.1.5 Refer to the piping material schedule in the Appendix.

8.2.2.2 Valves

8.2.2.2.1 Valves shall be provided as required to isolate all equipment.

8.2.2.2.2 Valves shall be provided to isolate all floors, wings and sections of a respective building.

8.2.2.2.3 Low point drain valves shall be equipped with a hose adaptor fitting.

8.2.2.2.4 Refer to the valve schedules in the appendix.

8.2.2.3 Hot Water Systems

8.2.2.3.1 Instantaneous, tankless water heating systems utilizing campus steam are preferred whenever feasible. All installations should be evaluated for the possibility of using this type of system.

8.2.2.3.2 All domestic hot water systems shall have recirculating pumps except in those systems that have the heating in close proximity to the use. Close proximity is considered to require less than 50' of piping between the heat source and the farthest outlet on the system. Where practical the recirculating pumps should be controlled by the building energy management system.

8.2.2.3.3 A check valve shall be provided ahead of each domestic hot water heater. A properly sized expansion tank shall also be provided.

8.2.2.3.4 Recirculating pumps in hot water systems shall be constructed of non-ferrous material.

8.2.2.3.5 The desired temperature for hot water is a maximum of 120°F at the point of usage for normal faucet applications. Other types of usage may require other temperatures (dishwashers, cage washers, etc.) and should be evaluated individually. Where temperatures higher than 120°F are required at certain outlets for a particular intended use, separate heaters or booster heaters shall be installed for those outlets.

8.2.2.3.5.1 An ASSE 1070 Thermostatic Mixing Valve shall be provided at each lavatory to limit the hot water delivery temperature.

8.2.2.3.5.2 All shower valves shall meet the requirements of ASSE 1016 for both Thermostatic and Pressure Balance operation.

8.2.2.3.6 Expansion Tanks

8.2.2.3.6.1 All water systems that have backflow preventers shall be designed and installed with provisions for thermal expansion.

8.2.2.3.6.2 Allowing the pressure relief valve to dump excess water due to expansion is not acceptable.

8.2.2.3.6.3 All expansion tanks shall be bladder type and installed with provisions for draining and venting. Provisions shall be provided to adjust the tank pressure.

8.2.2.4 Water Softeners

8.2.2.4.1 Water softening is required on the cold water supply to all hot water systems. Other water shall not be softened except for specific applications that require softened water.

8.2.2.4.2 All water softeners shall be provided with a programmable controller to allow regeneration based on usage with a maximum time / day interval between regeneration.

8.2.2.4.3 All water softening equipment shall be installed with a test port immediately downstream from the softening equipment.

8.2.2.4.4 Water softening systems should be designed to supply water at less than 1 grain of hardness. The water supply on the KSU campus typically has 13.5 grains of hardness.

8.2.2.4.5 A three-valve bypass shall be provided to allow for water softening systems to facilitate maintenance and also to trim, if desired, the hardness of the supply water. The valve in the bypass shall be a globe style balance valve.

8.2.2.5 Electric Water Coolers

8.2.2.5.1 All electric water coolers shall be of the refrigerated type.

8.2.2.5.2 ADA guidelines shall be used in the selection and installation of all electric water coolers.

8.2.2.5.3 Locations of electric water coolers shall be noted on the electrical plans as well as plumbing and architectural plans.

8.2.2.5.4 A bottle filler shall be provided at each electric water cooler location.

8.2.2.6 Hose Bibbs and Wall Hydrants

8.2.2.6.1 A hose connection shall be installed in each mechanical room.

8.2.2.6.2 In mechanical rooms, provide a service sink faucet, connected to both the domestic hot and domestic cold-water supply with vacuum breaker and hose end connection on the spout for maintenance purposes. Check stops shall be provided to prevent cross flow.

8.2.2.6.3 Freeze proof wall hydrant style hose connections shall be located on the exterior of each building. A minimum of one hose connection shall be installed on each side of the building. The preferred spacing for hose connections is one every 100'. Where feasible, hose connections should be installed within 15' of the main entrance to the building. Vacuum breakers/backflow preventers are required at all connections.

8.2.2.6.4 All exterior hose connections shall be of the recessed socket type.

8.2.2.6.5 All wall hydrants shall have individual shutoff valves, located on the supply line within the building, for repair work and to facilitate isolation and draining of the piping system that feeds the wall hydrant.

8.2.2.7 Backflow Preventers

8.2.2.7.1 All domestic water systems shall have backflow prevention devices at the point of building entry.

8.2.2.7.1.1 Backflow preventions devices on service entrances shall be of the “Reduced Pressure Zone” type (RPZ).

8.2.2.7.1.2 No metering devices, taps, or other fittings shall be located upstream of the backflow preventer. If a common supply serves both the domestic water system and the fire protection system, the two systems shall be split immediately upon entering the building. Install the backflow preventer for each system at this point. For a description of the backflow preventer for the fire protection system see “Fire Protection Systems”.

8.2.2.7.2 All backflow preventers shall be located and configured to allow ready accessibility for maintenance and testing. Minimum clearance is 24" in all directions.

8.2.2.7.3 No backflow preventers shall be located more than 4' above floor level.

8.2.2.7.4 Pit installations of backflow preventers will not be allowed.

8.2.2.7.5 Drainage from backflow preventers must be possible by gravity only, either to a floor drain or to the surface of the ground. Drains should be sized for the size of backflow. The average 2" floor drain will take about 55 G.P.M.

8.2.2.7.6 All backflow prevention devices must be approved by the Kansas Department of Health and Environment. Watts type RPZ’s is the preferred device to match existing University testing equipment.

8.2.2.8 Insulation

8.2.2.8.1 All domestic water systems shall be insulated with fiberglass insulation.

8.2.2.8.2 Insulation on piping in plenum areas shall be plenum rated.

8.2.2.8.2.1 Insulation shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50.

8.2.2.8.3 All insulation thicknesses shall comply with ASHRAE 90.1.

8.2.2.8.4 Refer to the insulation schedule in the appendix.

8.2.3 Sanitary Waste and Vent

8.2.3.1 Materials

8.2.3.1.1 Above grade piping and fittings shall be cast iron or DWV copper.

8.2.3.1.1.1 Cast iron piping shall be service weight no hup piping.

8.2.3.1.1.2 No hub connectors shall be heavy duty using 4 band clamps.

8.2.3.1.2 Below grade piping and fittings shall be DWV Schedule 40 PVC.

8.2.3.1.2.1 Below grade piping that receives effluent from autoclaves, high temperature dish machines or similar appliances shall be epoxy coated cast iron for the first 50 ft of piping to allow the effluent to cool.

8.2.3.1.3 All sanitary waste systems shall be designed for a maximum of 140°F material.

8.2.3.1.4 Chemical Drain Waste and Vent Piping

8.2.3.1.4.1 Chemical drain waste and vent piping shall be molded fire-retardant polypropylene with electrofusion drain waste and vent pattern fittings, specifically designed for use in chemical waste applications.

8.2.3.1.4.2 Piping installed in return air plenums shall meet ASTM E-84 and UL 723 standards for flame spread and smoke generation.

8.2.3.1.4.3 Piping installed below grade need not be fire-retardant.

8.2.3.1.4.4 The designer shall verify that the piping provided in lab applications is suitable for the intended service and suitably resistant to all chemicals that will be transmitted through the piping system.

8.2.3.1.4.5 Chemical neutralization vessels shall be provided.

8.2.3.1.4.5.1 Chemical neutralization vessels shall be located so as to allow for the required maintenance.

8.2.3.1.5 Refer to the piping schedule in the appendix.

8.2.3.2 Floor drains and floor sinks

8.2.3.2.1 All floor drains shall have a minimum pipe size of 2", a minimum strainer size of 6", and have a removable strainer.

8.2.3.2.2 Upon completion of the installation of the floor drain and the floor around it, each area shall be tested to ensure that water on the floor in the area served by the drain is able to reach the drain by the force of gravity alone. We often

have floor drains that are too high or that have a ridge around them, making them useless.

8.2.3.2.3 All mechanical rooms shall have a minimum of one floor drain. More floor drains shall be installed as required to maintain a ratio of one floor drain for every 500 square feet of floor area. These floor drains are in addition to those drains required for equipment.

8.2.3.2.4 Every piece of equipment that requires indirect waste (backflow preventers, ice machines, autoclaves, etc.) shall be served by a floor sink drain at that piece of equipment. More than one piece of equipment can be served by a drain provided the pieces of equipment are in close proximity to each other and the sizing of the drain provides adequate drainage for the equipment.

8.2.3.2.4.1 Floor sinks shall be minimum 12" x 12" x 8" deep. A funnel shall be provided when the floor sink accepts indirect waste.

8.2.3.2.5 Drains in all finished spaces shall be provided with nickel-bronze grates. Drains in mechanical spaces shall be provided with cast iron grates.

8.2.3.2.6 In no case shall the drainage be accomplished by installing piping across the floor to a central floor drain.

8.2.3.3 All drain piping and domestic hot water piping below accessible sinks that could be touched by the public shall be insulated. This shall comply with the requirements of ADA.

8.2.3.3.1 The insulation system shall be premanufactured. Field fabricated insulation shall not be allowed.

8.2.3.3.2 The insulation system shall be designed to be removable and then reinstalled subsequent to a repair without damage to the insulation system.

8.2.4 Storm Sewer Systems

8.2.4.1 Piping materials shall match that specified "Sanitary Drain Waste and Vent Piping"

8.2.4.2 All surface water shall be directed to a storm sewer system. In no case shall storm water be placed in a sanitary sewer system.

8.2.4.3 Surface discharge of storm water from the primary storm drainage system shall not be allowed.

8.2.4.4 Surface discharge of storm water from the overflow storm drainage system shall **be** terminated above grade.

8.2.4.4.1 Accommodations shall be made for receiving the discharged water. Alternatives include but are not limited to splash blocks, formed concrete flumes and French drains.

8.2.4.5 All interior piping of storm water shall be insulated. Refer to the insulation schedule in the appendix.

8.2.5 Special Systems

8.2.5.1 Emergency showers and eyewashes

8.2.5.1.1 All emergency showers and eyewashes and associated piping and equipment shall comply with ANSI Z358.1-2014.

8.2.5.1.1.1 Showers and eyewash stations shall be positioned so that they are highly visible and accessible, being in locations that take no more than 10 seconds to reach**.**

8.2.5.1.2 A floor sink shall be provided at each emergency shower and eyewash unit. Drain piping shall be upgraded to chemical resistant pipe if a hazard analysis of the program in the lab indicates the necessity. The drain piping shall pass through a neutralization basin prior to it connecting to the building drainage system.

8.2.5.1.3 All piping to emergency showers and eyewashes shall comply with ANSI Z358.1.

8.2.5.1.3.1 Emergency showers and eyewashes shall be provided with a thermostatic water tempering valves so as to provide tempered water to the shower and / or eye wash unit.

8.2.5.1.3.2 Emergency showers and eyewashes should deliver tepid flushing fluid. However, there are certain circumstances in which a facilities safety/health advisor should be consulted for optimum temperature. Tepid fluid is considered 16-38 degrees Celsius (60-100 degrees Fahrenheit).

8.2.5.1.3 In all new construction, any situation requiring either an emergency shower or eyewash should have both installed. It is preferred that they are co-located.

8.2.5.1.4 All emergency showers shall have a local alarm to notify persons in the area that the shower is in use.

8.2.5.1.5 Designs for installations of emergency showers or eyewashes should consider the feasibility of providing an alarm connection to the building security system.

8.2.5.2 Distilled and De-ionized Water

8.2.5.3.1 Pipe and fittings shall be Schedule 80 PVC or other plastic piping systems designed specifically for this type of service.

8.2.5.3 Natural gas

8.2.5.3.1 Pipe and fittings shall be carbon steel, A53 Gr. B or A106 Gr. B, Schedule 40.

8.2.5.3.2 Valves 2" and smaller shall be ball valves, valves 2-1/2” and larger shall be lubricated plug valves, steel, or ductile iron construction with metal-to-metal seat.

8.2.5.3.3 All valves that are exposed to the outdoor elements shall be of ductile iron body construction. No brass shall be used outdoors.

8.2.5.3.4 Valves shall be rated for the intended service.

8.2.5.4 Compressed air and vacuum

8.2.5.2.1 Pipe and fittings shall be Type L or K copper.

8.2.5.4.2 All joints and fittings shall utilize lead free solder.

8.2.6 Fixtures

8.2.6.1 All fixtures and related equipment shall be of commercial grade or better.

8.2.6.2 Custodian closets (Janitor's Service Sink)

8.2.6.1.1 Each custodian closet shall be supplied with a floor sink. The preferred size is 24" x 36" and the minimum size is 24" x 24". The sink shall be supplied with a stainless steel edge cap.

8.2.6.1.2 Floor mounted janitor sinks shall be constructed of terrazzo material. No "molded stone" or plastic service sinks will be allowed.

8.2.6.1.3 Stainless steel Splash plates shall be installed on the wall around the floor sink.

8.2.6.1.4 The faucet shall be equipped with a hose connection and pail hook spout with a wall brace**.** Vacuum breaker/backflow preventer shall be provided as an integral part of all faucet spouts. Both hot and cold water shutoffs are required for faucets. Shut offs shall be provided in the piping ahead of the service sink faucet.

8.2.6.1.5 All custodial closets should be located by a restroom for easy hookup of water supply and drains. These rooms must be large enough to store supplies and all custodial equipment needed for the type of cleaning that will be required. Minimum room size shall be 8' x 8'.

8.2.6.1.6 A minimum of one janitor's sink shall be provided on each floor of a building.

8.2.6.3 Rest rooms

8.2.6.3.1 ADAAG guidelines shall be used in the design of restrooms.

8.2.6.3.2 All fixtures (sinks, urinals, water closets, etc.) shall be white in color. Fixtures shall be vitreous china.

8.2.6.3.3 All fixture hardware (faucets, flush valves, etc.) shall be chrome color.

8.2.6.3.3.1 Faucets shall be constructed of lead-free brass and shall be certified "lead free".

8.2.6.3.3.2 Faucets and flush valves shall be hands free. Faucets and flush valves shall be powered from normal convenience power.

Battery faucets and flush valves will only be allowed after specific approval from KSU Facilities.

8.2.6.3.4 For typical campus applications, no pop-up drain stoppers shall be installed in sinks. In residence halls or other special applications, pop-up drain stoppers may be provided.

8.2.6.3.4.1 In applications without pop-up drain stoppers, the faucets should be specified without the pop-up drain operator.

8.2.6.3.4.2 Where there is no pop-up drain stopper; grid drains shall be specified.

8.2.6.3.5 All water flow control devices, faucets, and flush valves, shall be of the water conserving type.

8.2.6.3.6 In new construction water closets and urinals shall be wall-hung. In existing construction, wall-hung fixtures are preferred and should be provided unless existing conditions do not allow for the wall hung fixtures; in which case, floor mounted water closets are allowed.

8.2.6.3.7 Lavatories shall be mounted in a countertop. Under mount lavatories and sinks shall be provided.

8.2.6.3.8 All water closet seats shall be heavy duty plastic and shall have check hinges.

8.2.6.3.9 All showers shall have anti-scald mixing valves. Shower valves shall be ASSE 1016 compliant for temperature and pressure balancing.

8.2.6.3.10 All plumbing fixtures shall be provided with individual shutoffs for repair work.

8.2.6.3.9.10 All fixture stop valves shall be ¼ turn type.

Section 8.3 Exterior Underground Piping Systems

8.3.1 General requirements

8.3.1.1 In locations where piping passes beneath roadways or driveways, the engineer shall evaluate the expected load and specify appropriate materials to carry the load.

8.3.1.2 All underground piping systems, except copper, shall have a #12 AWG wire attached to the pipe for a tracing wire. The wire shall be labeled and terminated in an accessible location.

8.3.1.3 All underground piping systems shall have a warning tape, with appropriate wording, buried 24" above the pipe.

8.3.1.4 All underground piping systems that are installed using boring methodology shall have a warning system installed above the pipe. Review details of warning system intended for use before completing specification with University Facilities Planning staff.

8.3.1.5 Using a standard proctor at optimum moisture content (2%), all backfill shall be mechanically compacted to a minimum of 88% and a maximum of 92% of maximum density under landscaped areas and a minimum of 95% of maximum density under other areas.

8.3.2 Sanitary Sewer Systems

8.3.2.1 Cast iron systems

8.3.2.1.1 Pipe and fittings, all sizes, shall be cast iron, service weight, bell and plain end spigot, ASTM A 74. No-hub type piping can be considered for use after consultation with University Facilities Planning staff.

8.3.2.1.2 All fittings shall be service weight cast iron DWV pattern.

8.3.2.1.3 Joints in hub and spigot systems, all sizes, shall be rubber gasket, push-on type, ANSI ASTM C 564.

8.3.2.1.4 Joints for no hub cast iron piping systems shall be heavy duty type with minimum of (4) bands.

8.3.2.2 PVC Systems

8.3.2.2.1 The University's preference is for building sewers to be PVC.

8.3.2.2.2 All piping shall be a minimum of Schedule 40.

8.3.2.2.2 All fittings shall be Schedule 40 DWV pattern.

8.3.2.3 Bedding

8.3.2.3.1 All below grade sanitary sewer piping systems shall be bedded using clean well graded washed gravel in size ¾" and smaller.

8.3.2.3.2 Trenches shall be excavated to a minimum of 3" below the pipe. The trench shall be a minimum of 12" wider than the O.D. of the piping to be installed in the trench. The piping shall be installed in the center of the trench width.

8.3.2.3.3 The gravel bedding shall be placed below the piping and shall be compacted prior to placing the pipe. After the piping is placed, the gravel bedding shall fill the trench to a point that is a minimum of 6" above the pipe. This gravel shall also be compacted.

8.3.2.4 Clean outs

8.3.2.4.1 All clean outs shall be located in non-traffic areas.

8.3.2.4.2 A minimum 6" diameter cast iron valve box shall be placed above the clean out with the clean out plug terminating no more than 1" below the bottom of the valve box cover. The backfill around the cleanout shall be compacted as required to prevent settlement. A steel reinforced concrete collar shall be placed around the valve box. The collar shall be a minimum of 36" in diameter and shall be a minimum of 6" thick.

8.3.2.4.3 A cast iron "Y" fitting shall be provided in the main below the cleanout to minimize the potential of penetrating the sewer pipe below the cleanout during cleaning procedures.

8.3.2.4.4 All clean out plugs shall be cast bronze with a hex head.

8.3.2.5 Testing

8.3.2.5.1 All sanitary sewer systems shall be tested with 10' of head pressure for not less 30 minutes. A minimum 10'riser pipe shall be provided and filled with clean water. The water level shall remain constant during the testing period.

8.3.3 Storm Water Systems

8.3.3.1 PVC piping may be used on storm sewer systems. Schedule 40 shall be used for pipe sizes 8" and less. SDR 35 shall be used for piping that is larger than 8".

8.3.3.1.1 Fittings shall match the piping material and shall be DWV Pattern.

8.3.3.2 Cast iron pipe may be used.

8.3.3.2.1 Pipe and fittings, all sizes, shall be cast iron, service weight, ASTM A 74, no-hub type piping and fittings.

8.3.3.2.2 All fittings shall be service weight cast iron DWV pattern.

8.3.3.2.3 Joints for no hub cast iron piping systems shall be heavy duty type with minimum of (4) bands.

8.3.3.3 Concrete pipe and corrugated metal pipe may be used for underground storm drainage piping that is outside of the building.

8.3.4 Water Site Distribution Systems

8.3.4.1 All piping systems shall comply with AWWA standards.

8.3.4.2 All water piping shall have a minimum of 36" of cover.

8.3.4.3 All water meters shall be located inside buildings. See item 8.2.1.3 for more information about water meters.

8.3.4.4 Valves shall be installed with cast iron valve boxes, backfill shall be compacted as required to prevent settlement. Set the valve box in a steel reinforced concrete surround that is a minimum of 36" in diameter and 6" thick. The cover to the valve box shall be marked "Water."

8.3.4.5 PVC systems (Preferred by the University)

8.3.4.5.1 All PVC piping shall be C900 installed according to AWWA M23.

8.3.4.5.2 All fittings shall be ductile iron encased in polypropylene.

8.3.4.5.3 All fittings shall be installed with UL listed and approved retainers. Thrust blocks are required and shall be provided.

8.3.4.6.4 Valves shall be ductile iron, with resilient seats and bronze gates, which conform to AWWA C509. No split (2 piece) gates shall be allowed.

8.3.4.7 Copper Systems

8.3.4.7.1 Copper shall only be used on pipe sizes 2" and smaller and shall be used for building service only.

8.3.4.7.2 All copper pipe shall be Type K, ASTM B88, installed per AWWA C800.

8.3.4.7.3 Fittings shall be ANSI B16.22 wrought copper. All joints shall be brazed.

8.3.4.8 Ductile Iron systems

8.3.4.8.1 Ductile Iron, if used in lieu of PVC, shall be used on pipe sizes 3" and larger.

8.3.4.8.2 Ductile iron piping shall be ANSI/AWWA C151 A21.51 with asphaltic coating and cement lining. An exterior polyethylene encasement shall be provided.

8.3.4.8.3 Piping in sizes 3" to 6" shall be push on "Tyton" joint. Piping in sizes above 6" shall be mechanical joint. Rubber gaskets shall be provided. Joints and fittings shall be ANSI/AWWA C111/A21.11.

8.3.4.9 Valves

8.3.4.9.1 Valves, 2" and smaller, shall be a key operated **"**corporation**"** stop with bronze body and stainless-steel trim. Valves shall be certified "lead free".

8.3.4.9.2 Valves, 2" and larger, shall be ductile iron, flanged or mechanical joint, with key head and dielectric isolation. All bolts shall be stainless steel.

8.3.4.10 Testing and Cleaning

8.3.4.10.1 All water systems shall be hydrostatically tested at 1.5 times the expected working pressure, or 125 psig, whichever is greater, for a minimum of 4 hours.

8.3.4.10.2 The water piping systems shall be cleaned according to AWWA M23.

Section 8.4 Fire Protection Systems

8.4.1 Fire Protection Sprinkler and Standpipe Systems

8.4.1.1 Fire protection sprinkler and stand piping systems shall be designed and installed in strict accordance with NFPA 13 for sprinkler systems and NFPA 14 for standpipe and hose systems. The edition of the respective code to be utilized shall be as listed on the specific project code footprint plan, as approved by the Kansas State Fire Marshal's Office.

8.4.1.1.1 Where applicable in residential occupancies, NFPA 13R shall be applied.

8.4.1.1.2 Where a sprinkler system is to be installed in a non-heated area, a dry pipe system shall be installed.

8.4.1.1.2.1 A chemical system can be considered only if approved, prior to design, by the KSU Office of Facilities.

8.4.2 Piping

8.4.2.1 Interior piping systems shall conform to the requirements of NFPA 13, 13R and NFPA 14 as applicable to the specific system.

8.4.2.2 Piping in sizes 2” and smaller shall be Schedule 40 with threaded fittings. Where piping is protected and the system is designed as “light hazard”, CPVC piping systems that are specifically designed for fire protection is considered as an acceptable alternative.

8.4.2.2.1 Where steel piping is utilized for dry or pre-action systems, the steel piping shall be galvanized.

8.4.2.3 Piping in sizes 2-1/2” and larger shall be schedule 10 black steel with roll grooved connections. Cut grooved connections are not acceptable.

8.4.2.3.1 Piping for dry or pre-action systems shall be galvanized steel.

8.4.2.4 Underground piping systems

8.4.2.4.1 All piping systems shall comply with AWWA standards.

8.4.2.4.2 All water piping shall have a minimum of 36" of cover.

8.4.2.4.3 Valves shall be installed with cast iron valve boxes, backfill shall be compacted as required to prevent settlement. Set the valve box in a steel reinforced concrete surround that is a minimum of 36” in diameter and 6” thick. The cover to the valve box shall be marked “Water.”

8.4.2.4.4 PVC systems (Preferred by the University)

8.4.2.4.4.1 All PVC piping shall be C900 installed according to AWWA M23.

8.4.2.4.4.2 All fittings shall be ductile iron encased in polypropylene.

8.4.2.4.4.3 All fittings shall be installed with UL listed and approved retainers. Thrust blocks are required and shall be provided.

8.4.2.4.4.4 Valves shall be ductile iron, with resilient seats and bronze gates, which conform to AWWA C509. No split (2 piece) gates shall be allowed.

8.4.2.4.5 Ductile Iron systems (if used in lieu of PVC)

8.4.2.4.5.1 Ductile iron piping shall be ANSI/AWWA C151 A21.51 with asphaltic coating and cement lining. An exterior polyethylene encasement shall be provided.

8.4.2.4.5.2 Piping in sizes 3” to 6” shall be push on “Tyton” joint. Piping in sizes above 6” shall be mechanical joint. Rubber gaskets shall be provided. Joints and fittings shall be ANSI/AWWA C111/A21.11.

8.4.2.4.6 Valves

8.4.2.4.6.1 Shall be ductile iron, flanged or mechanical joint, with key head and dielectric isolation. All bolts shall be stainless steel.

8.4.3 General Installation Requirements

8.4.3.1 All test valves shall be located in mechanical rooms in central locations. A minimum number of locations shall be used for test valves. In new construction it is preferred that all test valves be at one location.

8.4.3.2 A pressure gauge shall be installed on the main supply of each sprinkler system, upstream from the main test valve. This is to monitor the pressure drop during operation of the main test valve.

8.4.3.3 Drainage shall be provided for all test locations that are sufficient to carry the full flow of water that can be expected during testing of the systems. This is particularly important at the location for testing the main drain of a system. Directing test water to the exterior of the building is not acceptable, unless an indirect connection to the exterior storm water system is provided.

8.4.3.4 All valves shall be located with sufficient room for maintenance or replacement.

8.4.4 Fire Alarm Interface

8.4.4.1 All sprinkler systems shall have a fire alarm panel installed that is capable of monitoring and reporting flow in all zones and tampering with all valves of the system. The panel shall be equipped for sounding a local alarm and shall be capable of interface with the campus security system. If the campus security system is in place in the building, the fire alarm panel shall be connected to that system. Contractor shall be responsible for marking the location of all fire alarm panels on as-built plans before submitting as-builts to the owner's representative.

8.4.4.2 Fire Alarm system controls shall be from the following product lines:

8.4.4.2.1 Honeywell: Product Line - Honeywell XLS4000/XLS3000
Contacts: Rob, Lear - rob.lear@honeywell.com
Davey, Maci - maci.davey@honeywell.com

8.4.4.2.2 CSC: Product Line – Edwards Fire Alarm System
Contacts: Matthew Adamson - madamson@controlservice.com
Mech Control - Mitch Watson - mwatson@controlservice.com
Fire Alarm - Mike Frieson - mfrieson@controlservice.com

8.4.5 Backflow Requirements

8.4.5.1 All sprinkler systems shall have a double detector check type backflow preventer Installed at the point of building entry.

8.4.5.2 If glycol is provided in a part of the fire protection system for freeze protection, this part of the system shall be protected by an RPZ type of backflow prevention device. It should be noted that NFPA has banned the use of antifreeze in fire protection systems. Therefore, alternative methods for freeze protection shall be designed.

8.4.6 Testing

8.4.6.1 All sprinkler systems shall be tested according to NFPA and at no less than 200 psig for no less than four hours.

Section 8.5 Refrigerant Cooling Systems

8.5.1 General design guidelines

8.5.1.1. It should be noted that there is an existing campus wide chilled water system. This chilled water system shall be used wherever possible. Systems that depend on remote chillers, when the existing campus chilled water system can be utilized, will only be allowed when specifically approved by KSU Facilities.

8.5.1.2 All refrigerant systems shall comply with ASHRAE 90 and KSU Facilities Planning and utility systems Energy Conservation Policies (Appendix 2).

8.5.1.3 Design of cooling systems should avoid operating refrigerant systems when the outside air is less than 55°F.

8.5.1.4 All mechanical room installations shall comply with ASHRAE 15.

8.5.1.5 Systems that depend on wastewater will not be allowed.

8.5.1.6 All condensing units shall be designed to 105°F outside air temperature.

8.5.1.7 Equipment shall be located so as to allow accessibility for service. Minimum service clearances, as identified by the manufacturer of the respective equipment, shall be strictly adhered to. Note that these clearances are minimums additional service clearance shall be provided when possible.

8.5.1.8 Refrigerant relief valves shall be piped to the exterior of a respective building.

8.5.1.9 The quantities of refrigerants and the type of refrigerant used in a given system shall be documented on the respective project “as-built” drawings.

8.5.2 Material in Refrigerant Cooling Systems

8.5.2.1 All refrigerant piping and fittings shall be copper except in an evaporative condenser, where steel piping is acceptable. Long radius fittings shall be provided for HVAC systems where space allows and are required for refrigerant systems.

8.5.2.1.1 Condenser coils in condensing units that are larger than 5 tons can be of aluminum construction.

8.5.2.2 All valves shall be full port.

8.5.2.2.1 Isolation valves shall be provided on each side of all driers.

8.5.2.2.2 Check valves shall be provided on the discharge of compressors.

8.5.2.3 All solder shall be 15% silver solder except on connections to expansion valves, sight glasses, and driers where “Stay-Brite” solder is acceptable.

8.5.2.4 Insulate suction and hot gas bypass in all locations and discharge lines if exposed in occupied areas. For units above 5 tons, use 1" fiberglass insulation. For smaller units, use □" closed cell foam insulation, minimum. All insulation shall comply with ASHRAE 90.1. All insulation on exterior piping shall be protected by a PVC or aluminum jacket.

8.5.2.5 Label all lines at all access points and every 20' of exposed piping with the type of refrigerant contained in the lines.

8.5.3 Equipment

8.5.3.1 All equipment shall be mounted on isolation pads.

8.5.3.2 Compressors

8.5.3.2.1 All compressors shall be supplied with a 5-year warranty.

8.5.3.2.2 Multiple units are preferred over larger single units.

8.5.3.2.3 All compressors shall be variable speed where possible.

8.5.3.2.4 All 3-phase units shall have adjustable voltage monitors for each phase, with manual reset.

8.5.3.2.5 Provide recycle timers and crankcase heaters with all compressors.

8.5.3.2.6 Provide replaceable core driers on all liquid lines with isolation valves on each side of the drier.

8.5.3.3 All solenoid valves shall have a manual lift stem.

8.5.3.4 Condensing units, if designed to operate at temperatures lower than 55°F, shall be provided with head pressure control as is recommended by the unit manufacturer.

8.5.3.4.1 Condensing units that are required to operate at temperatures below 10 degrees F. must be provided with very specific head pressure controls. The manufacturer of equipment in this case shall address, in writing, how this will be achieved.

8.5.3.5 Condenser coils on small systems (5 tons and below) shall have copper tubes and aluminum plate fins. Condenser coils on larger systems may have condensers that are constructed of aluminum.

Section 8.6 Water Cooling Systems

8.6.1 General Requirements

8.6.1.1 With the existence of the Campus chilled water loop, connection to this chilled water loop is required, unless extenuating circumstances preclude its use. KSU Facilities approval is required for systems that do not utilize the Campus chilled water loop.

8.6.1.2 All new chilled water systems shall be Primary/Secondary systems with 2-way control valves. Variable speed pumps shall be provided for secondary systems.

8.6.1.1.1 A controlled by-pass shall be provided, around the secondary pump, to allow the primary pumps that are located at the main chiller plant, to pump the respective building. A check valve shall be provided in this bypass line to prevent recirculation.

8.6.1.3 During the design of all cooling systems, the designer shall evaluate the current and proposed chilled water loops.

8.6.1.4 Piping at HVAC units shall not obstruct filter access panels or any other required maintenance access.

8.6.1.5 Thermometers and gauges

8.6.1.5.1 All thermometers and gauges shall have dial faces between 2" and 5" in diameter. All thermometers installed more than 8' from floor level shall have a minimum dial face of 6" and shall be installed to allow reading from floor level. (See also 8.6.5.5.4)

8.6.1.5.2 All thermometers shall be of the dry well type. All thermometers shall be installed with thermal conductive material in the dry wells. Installation without the thermal conductive material yields inaccurate readings.

8.6.1.5.3 All thermometers and gauges shall be selected with the expected operating conditions near the middle of the range of the device.

8.6.1.5.4 Thermometers and pressure gauges shall be accurate to 1% of full scale.

8.6.1.5.5 All gauges shall be installed with gauge cocks.

8.6.15.6 All CW and HW systems should have thermometers as well as pressure gauges installed on both supply and return lines and/or on both sides of pumps. No Pete's plugs are allowed.

8.6.1.5.7 Refer to the following schedule for thermometer, gauge, and gauge cock locations. A minimum of (2) pressure gauges and (2) thermometers, configured to fit into the provided gauge cock shall be provided for each project. These gauges and thermometers shall be delivered to the Owner's maintenance personnel in a manufacturer's fabricated carrying case.

THERMOMETER, GAUGE, GAUGE COCK INSTALLATION SCHEDULE

	Thermometer & Well	Press Gauge & Gauge Cock	Gauge Cock	Pete's Plug
Chilled water entering and leaving each chiller	X		X	X
Condenser water entering and leaving each cooling tower	X			
Chilled water entering and leaving each chilled water pump	X		X	X

Condenser water entering and leaving each condenser water pump	X		X	X
Chilled water entering and leaving each chilled water Coil	X		X	X

8.6.2 Connection to Campus Chilled Water Loops

8.6.2.1 All piping connections to the Campus chilled water loops shall be two-pipe.

8.6.2.2 Material for below grade chilled water loops shall be PVC C900, class 150 piping only, with ductile iron fittings. Insulation will be provided if economically justified. Insulation shall be provided where the below grade chilled water lines pass close to steam lines.

8.6.2.2.1 Ductile iron pipe and fittings shall be provided when the below grade chilled water piping passes in close proximity to a buried steam line. Refer to requirements for below grade ductile iron piping, indicated previously in chapter 8 of these standards.

8.6.2.3 All fittings shall be installed with UL listed and approved retainers. Thrust blocks shall be provided.

8.6.2.4 All underground piping shall have a minimum earth cover of 36" to the top of the pipe.

8.6.2.5 All underground piping systems shall have a #10 AWG copper wire attached to the pipe for a tracing wire. The wire shall be labeled and terminated in an accessible location with an adapter fitting accessible at grade with label indicating the piping system that is monitored. The adapter fitting shall be set into a reinforced concrete collar with a minimum diameter of 36” and a minimum thickness of 6”. The soil around the concrete collar and below the concrete collar shall be adequately compacted so as to prevent any settlement.

8.6.2.6 All underground piping systems shall have a warning tape, with appropriate wording, buried 24" above the pipe.

8.6.2.7 Isolation valves shall be installed for each building service. The isolation valve, if below grade, shall be a gate valve with **cast iron operating nut,** installed with a valve box, located as close as practical to the main line.

8.6.2.7.1 Valve boxes shall be set into a reinforced concrete collar with a minimum diameter of 36” and a minimum thickness of 6”. The soil around the valve box and below the concrete collar shall be adequately compacted so as to prevent any settlement.

8.6.2.7.2 Isolation valves on the main building service, that are located within the building, shall be butterfly valves with gear operators.

8.6.2.8 All loop systems shall be provided with a means of air relief at all high points.

8.6.2.8.1 A manually operated ball valve shall be provided at high points within the building. The ball valve shall be provided with a hose end connector to allow for piping to an adjacent floor drain.

8.6.3 Interior Chilled Water Systems

8.6.3.1 Piping

8.6.3.1.1 PVC shall not be used for chilled water systems above ground.

8.6.3.1.2 Welded steel systems shall use black steel piping and fittings, ASTM A106 seamless for piping 2” and smaller and A53 with electric resistance welded seam. All piping shall be minimum Schedule 40. The minimum pipe size shall be 3/4". See “Welding” and “Welding Quality Control” indicated in this standard for requirements.

8.6.3.1.3 Copper systems shall use a minimum of Type L copper pipe. The solder shall be lead-free. Connections on piping in sizes 2-1/2” and above shall be brazed. Flanges shall have a minimum rating of 150 PSI.

8.6.3.1.3.1 “Pro-Press” connections and fittings is allowable.

8.6.3.1.4 Refer to the piping schedules in the appendix.

8.6.3.2 Valves

8.6.3.2.1 Control valves, for pipe sizes 3" and smaller, shall be globe valves. For pipe sizes larger than 3", butterfly valves shall be provided for control valves.

8.6.3.2.1.1 Control valves serving flows that are less than 10 GPM shall be pressure independent type.

8.6.3.2.1.2 Control valves serving flows that are greater than 10 GPM shall be “Smart Valve” as manufactured by “Belimo”.

8.6.3.2.1.3 Control valves on pump bypass lines shall be butterfly style valves.

8.6.3.2.2 Isolation valves, for pipe sizes 2" and smaller, shall be **full port** ball valves. For pipe sizes larger than 2", the isolation valves shall be butterfly valves.

8.6.3.2.2.1 Butterfly valves in sizes 2-1/2” through 5” shall have lever lock handles. Butterfly valves in sizes 6” and larger shall have gear operated handles.

8.6.3.2.3 Butterfly valves shall be resilient seated with bronze or stainless-steel discs and shall be bubble tight. All butterfly valves shall be lug-type.

8.6.3.2.4 Refer to the valve schedules in the appendix.

8.6.3.3 Insulation

8.6.3.3.1 All insulation shall comply with the International Energy Conservation code and ASHRAE 90.1.

8.6.3.3.2 All insulation shall be fiberglass, flexible cellular foam, or cellular glass.

8.6.3.3.3 All exterior, exposed piping shall have an aluminum jacket installed to protect the insulation. The jacket shall be weather-resistant, waterproof, smooth or stippled surface aluminum with a minimum thickness of 0.016".

8.6.3.3.3.1 PVC Jacket is considered an acceptable alternative to the aluminum jacket material.

8.6.3.3.4 All interior piping that is exposed in occupied areas and is within 6' of the finished floor shall have a PVC jacket installed. This jacket shall be either painted to match the surrounding background or be provided in an integral color that matches the surrounding background.

8.6.3.3.5 All interior piping that is exposed in mechanical rooms, and is within 6' of the finished floor, shall have an aluminum jacket installed.

8.6.3.3.5.1 PVC Jacket is considered an acceptable alternative to the aluminum jacket material except where the piping is in close proximity to steam piping.

8.6.3.3.6 All penetrations through fire walls, or floor or roof decks shall have fire-stopping material installed at the penetrations. Fire stopping system shall be UL 1429 and ASME E814 approved.

8.6.3.4 Hanger design, application, and installation shall comply with MSS SP-58 and SP-69.

8.6.3.5 All chilled water systems that are not part of campus loop shall have a fill and make-up connection installed. A backflow preventer shall be installed at each connection. It is preferred that the connection be sized to allow the filling of the system in approximately 4 hours. However, the size should be evaluated in relation to the cost of the backflow preventer.

8.6.3.6 All chilled water systems shall be provided with an air and dirt separator automatic, appropriately set, fill valve and expansion tank installed.

8.6.3.6.1 A meter shall be provided in the makeup water line that connects to the closed loop system.

8.6.3.6.2 Air and dirt separators shall be as manufactured by “Spirotherm”. No equivalents will be allowed.

8.6.4 Condenser Water Systems

8.6.4.1 This applies only to buildings that are remote and as such will not be connected to the central campus chilled water system.

8.6.4.2 The designer shall evaluate the cost/benefit of using PVC, FRP or stainless-steel piping instead of steel piping. It is preferred that steel piping not be used. If PVC is used, it shall be Schedule 80. If stainless steel is used, it shall be Schedule 10.

8.6.5 Equipment

8.6.5.1 The selection of all equipment shall comply with the KSU Energy Conservation Policy #030.

8.6.5.2 All motors shall be high efficiency and meet the KSU Energy Conservation Policy #060.

8.6.5.3 All equipment shall be mounted on isolation pads.

8.6.5.4 Cooling Towers

8.6.5.4.1 The minimum standard of quality is a fiberglass structure with stainless-steel fittings and PVC fill. The designer shall evaluate the cost/benefit of using a tower with stainless-steel structure for each installation.

8.6.5.4.2 Consideration shall be given to the aesthetic qualities of any towers located in the view of the public. A screen or other method of removing the tower from view may be appropriate in some situations.

8.6.5.4.3 If year-round operation is desired, a dry-basin type tower is preferred over sump heaters. An indoor sump is preferred to outdoor types.

8.6.5.4.4 Gravity flow distribution systems are preferred.

8.6.5.4.5 All hot water basins shall have easily removable covers.

8.6.5.4.6 A minimum five-year warranty shall be provided with each cooling tower.

8.6.5.4.7 All cooling towers must have CTI certified performance.

8.6.5.4.8 All fans shall be gear/shaft driven with the motor located outside the air stream. No belt-driven fans shall be allowed. The designer shall evaluate the use of 2-speed or variable speed fans. All variable frequency drives shall be installed with a bypass switch.

8.6.5.4.9 All cooling towers shall have extended lubrication lines.

8.6.5.4.10 All cooling towers shall have vortex breakers installed on cold water sumps.

8.6.5.4.11 The designer shall evaluate the cost/benefit of aluminum or fiberglass support systems over coated steel.

8.6.5.4.12 All cooling towers that are elevated above the surrounding grade shall have deck with safety rails installed around the perimeter of the tower.

8.6.5.5 Chillers

8.6.5.5.1 This applies only to buildings that are remote and as such will not be connected to the central campus chilled water system.

8.6.5.5.2 The type of chiller to install shall be determined by the designer in conjunction with KSU Facilities Planning and Facilities Management.

8.6.5.5.3 The designer shall consider efficiency losses over time when sizing the cooling tower for a chiller.

8.6.5.5.4 Chiller shall be provided with digital type controls. Controls shall be integrated with the building EMS. A hand-off-auto switch shall be provided to allow local control or EMS control. All control panels shall be provided with interface capabilities for connection to the EMS for demand control and chilled water reset.

8.6.5.5.4.1 BacNet / IP control is preferred, if available. If it is not available, then provide BacNet MSTP

8.6.5.5.5 Provide thermometers and pressure gauges for the entering and leaving condenser and chilled water and the bypass lines. The thermometers shall be 6" dial type. Mercury thermometers are not allowed in this application.

8.6.5.5.5.1 Provide gauge cocks for each the thermometers and pressure gauges.

8.6.5.5.5.2 Provide a set of thermometers and gauges, each set up to be threaded onto the gauge cock. The gauges shall be provided in a durable carrying case.

8.6.5.5.6 Provide hour meters on electric chillers.

8.6.5.5.6.1 Provide flow meter on chilled water, condenser water, and steam lines for each building that is connected to the campus chilled water system.

8.6.5.5.6.1.1 Meter shall be “Onicon System 20” BTU meter.

8.6.5.5.6.1.2 Meter shall be provided with BacNet / IP control. If not available, provide BacNet MSTP control

8.6.5.5.7 Provide a flow switch in the chilled water supply piping to all remote buildings.

8.6.5.5.8 Consideration shall be given to sound attenuation when designing the location and installation of a chiller.

8.6.5.5.9 All pipe connections to chillers shall be either flanged or grooved pipe coupling.

8.6.5.5.10 All cold sections and lines shall be insulated.

8.6.5.5.11 All chillers shall be installed on housekeeping pads that are a minimum of 4" in height.

8.6.5.6 Pumps

8.6.5.6.1 All pumps shall have mechanical seals. Pumps that are 7-1/2 horsepower and greater shall have mechanical split seals. A standard of quality for mechanical split seals is Bell & Gossett.

8.6.5.7 Expansion Tanks

8.6.5.7.1 All expansion tanks shall be located on the suction side of pumps, at a design point of no pressure drop. All expansion tanks shall be diaphragm type.

8.6.5.7.1.1 Note that all systems make up water on the Campus chilled water system occurs at the central plant.

8.6.5.8 All condensing water systems shall have stainless steel strainers installed.

8.6.5.9 Controls

8.6.5.9.1 All equipment shall have a hand/off/auto switch installed to allow manual override of the normal controls.

8.6.5.9.2 Chiller controls shall be digital and shall include the capability to interface with the Energy Management Control System for chilled water reset, demand limiting, and remote start/stop. Chillers shall be provided with "BAC NET" control interface.

8.6.5.9.2.1 BacNet / IP control is preferred, if available. If it is not available, then provide BacNet MSTP

8.6.5.10 Water Treatment

8.6.5.10.1 The designer shall coordinate the design of the water treatment system with KSU Facilities utility systems.

Section 8.7 Steam Systems

8.7.1 Distribution (Steam)

8.7.1.1 It is preferred to have steam and steam condensate piping installed in tunnels; however, direct buried systems are allowed.

8.7.1.1.1 Direct buried piping shall be pre-insulated and jacketed. Leak detection shall be provided for all direct buried steam and steam condensate piping.

8.7.1.2 Pipe and fittings

8.7.1.2.1 All piping shall be black steel.

8.7.1.2.1.1 Steam supply piping shall be Schedule 40.

8.7.1.2.1.2 Steam condensate return piping shall be Schedule 80.

8.7.1.2.2 Fittings 2" and smaller shall be forged steel threaded. Fittings 2-1/2" and larger shall be welded, with flanged connections to valves and equipment.

8.7.1.2.2.1 Threaded fittings on low pressure steam and steam condensate systems that operate at a maximum pressure of 15 psig shall be cast iron. Threaded fittings on steam systems that operate above 15 psig shall be forged steel.

8.7.1.2.3 Refer to the piping schedule in the appendix.

8.7.1.2.4 All items that require maintenance shall be located to allow ease of access.

8.7.1.2.5 The designer shall evaluate the cost/benefit of using expansion joints or expansion loops on a life cycle basis.

8.7.1.3 Valves

8.7.1.3.1 Valves 2" and smaller shall be threaded ball valves. Valves 2-1/2" and larger shall be flanged, cast steel, OS&Y, gate valve. Refer to the valve schedule in the appendix.

8.7.1.4 Strainers

8.7.1.4.1 Strainers on low pressure steam systems, operating at a maximum pressure of 15 psig shall be cast iron body. In systems operating above 15 psig, strainers shall be cast steel bodied. Refer to the strainer schedule in the appendix.

8.7.1.5 Traps and Air Vents

8.7.1.5.1 Traps shall be cast iron bodied of 250 lbs. class.

8.7.1.5.2 All drip legs shall have a minimum length of 6".

8.7.1.5.3 All condensate mains shall have float-type automatic air vents, 250 lbs. class, located at the high points of the system. All air vents shall be easily accessible.

8.7.1.6 Pipe Guides and Anchors

8.7.1.6.1 Pipe guides for 4" and smaller shall be axial, full circumference, “spider” type. For larger sizes, "T"-style slides shall be used.

8.7.1.6.2 All anchors shall be fully welded to the pipe and shall be located in manholes or other accessible spaces whenever possible.

8.7.1.6.3 All anchors, guides, and other metal accessories shall be constructed of painted metal, and shall not be mounted on the floor of manholes or chases. All support systems shall be wall mounted. Stainless steel anchors shall be used.

8.7.1.7 Insulation

8.7.1.7.1 All steam and condensate lines shall be insulated to meet KSU Energy Conservation Policy #020 and ASHRAE 90.1

8.7.1.7.2 Pipe insulation shall be pre-molded, Fiberglass in thickness as scheduled in the piping insulation schedule that is located in the appendix.

8.7.1.7.3 Jackets of .020" smooth surfaced aluminum shall be installed in accessible areas. Insulation in non-accessible areas shall not have a jacket installed.

8.7.1.7.3.1 PVC jacket is an acceptable alternative to aluminum jacket.

8.7.1.8 Steam Chases

8.7.1.8.1 Steam chases shall be constructed of “U” channel, reinforced concrete. Weatherproofing shall be provided between sections of the chase.

8.7.1.8.2 The floor of the chase shall have a continuous drain trough that is a minimum of 2" deep and 6" wide. The chase shall be graded to provide drainage of this trough to the manholes. Nothing shall be allowed to obstruct this drain trough.

8.7.1.8.3 The lid for steam chases shall be pre-cast, reinforced concrete, that is notched over the “U” channel walls to prevent movement. Lifting eyes or lugs shall be provided. Weatherproofing shall be installed at the joints between the lid and the chase walls and between the adjoining lids. A weatherproofing system over the top of the chase shall be installed.

8.7.1.8.4 Soil compaction beneath steam chases shall be a minimum of 95% of maximum density at optimum moisture content (+ 2%), standard proctor. Excavation to undisturbed soil is not considered sufficient. Compaction to the sides and above a chase is dependent on the area. If the chase is passing beneath a paved area, the above conditions shall apply. If the chase is passing beneath a landscaped area, the soil shall be compacted to 88-92% of maximum density.

8.7.1.8.5 All supports, where possible, shall be wall mounted with nothing supported from the floor of the chase. Where this is not possible pipe rollers can be supported from the floor. All anchors shall be stainless-steel.

8.7.1.8.6 When a steam chase crosses another utility line, a minimum clearance of 6" shall be maintained and a minimum of 2" of insulation shall be installed between the chase and the other utility.

8.7.1.8.7 When a steam chase is routed through landscaped areas, the top of the chase shall be a minimum of 3' beneath the surface. The designer shall evaluate the need for insulation to protect plantings.

8.7.1.9 Manholes

8.7.1.9.1 All manholes shall be constructed of reinforced concrete.

8.7.1.9.2 All penetrations shall be sealed.

8.7.1.9.3 All manholes shall have a sump with a minimum size of 2' x 2' x 2'. Gravity drainage of the sump is preferred. French or siphon drains are not allowed.

8.7.1.9.4 A pump shall be installed where gravity drainage of the sump is not possible. The pump will be supplied by the plumbing shop and installed by the contractor. A dedicated electrical circuit shall be provided for the pump. Discharge piping shall be copper and shall include a check valve, union, and a shut-off valve. Pumps shall be rated for high temperature liquids.

8.7.1.9.5 Where electricity is supplied to a manhole, a separate circuit with a waterproof GFI duplex receptacle shall be installed for maintenance. All electrical wiring shall be installed in rigid conduit.

8.7.1.9.6 One piece ladders shall be used. Individual rungs mounted or cast to the wall are not acceptable. All ladders shall be welded carbon steel that is hot dipped galvanized. Rungs shall be non-slip, 3/4" diameter on 12" centers.

8.7.1.9.7 Manhole lids shall be sized for any equipment in the manhole, but shall be no smaller than 32" in diameter. The lid shall not be fastened. All manhole covers and frames shall be cast iron. A standard of quality is the Neenah R-6080 with solid cover. All covers shall be imprinted with the word “STEAM”

8.7.1.9.8 A vent hole with a solid lid shall be provided in each manhole. The minimum size is 12" in diameter. All vent covers and frames shall be cast iron. A standard of quality is the Neenah R-6007 with type F underside hooks for locking.

8.7.1.9.9 A high water alarm shall be provided in each manhole. The high water alarm shall close a contact that signals the campus BMS in the case of water in the manhole that is above a predetermined elevation.

8.7.2 Medium and Low-Pressure Steam (Above Grade)

8.7.2.1 General

8.7.2.1.1 Medium pressure steam is defined as being 15-90 psig. Low pressure steam is below 15 psig.

8.7.2.1.2 All drawings shall show drip legs and the specifications shall require drip legs for all risers.

8.7.2.1.3 Pressure Reducing Valves (PRV) shall be manufactured by either “Cashco” or “Ranger”

8.7.2.3.13.1 All PRV's shall be installed with isolation valves, a bypass loop with a globe valve in the bypass, and pressure gauges on both sides of the PRV. All PRV's shall be located and configured to allow ready accessibility for maintenance. Whenever possible, provide a minimum clearance of 24" in all directions. No PRV shall be located more than 8' above floor level. The designer shall evaluate the feasibility of using wall-mounted PRV’s.

8.7.2.2 Pipe and Fittings (see pipe and fitting schedule)

8.7.2.2.1 All piping shall be black steel. For supply, the piping shall be Schedule 40. For condensate, the piping shall be Schedule 80. ASTM A106 seamless for piping 2” and smaller and A53 with electric resistance welded seam for piping that is 2-1/2” and larger. The minimum pipe size shall be 3/4". No malleable iron is allowed on steam or condensate lines.

8.7.2.2.2 Fittings 2" and smaller shall be threaded with cast iron fittings. Fittings 2-1/2" and larger shall be welded, with flanged connections to valves and equipment.

8.7.2.2.3 Refer to the piping schedules in the appendix.

8.7.2.2.4 Piping at HVAC units shall not obstruct filter access panels.

8.7.2.2.5 Piping shall be constructed to the requirements of ANSI Standard B31.1.0 "Power Piping" and the International Mechanical Code – 2018 edition

8.7.12.2.5.1 Welding

8.7.2.2.5.1.1 Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.9.

8.7.2.2.5.1.2 Welding shall be done only by welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required. Each welder shall identify his work with a code marking before

starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders code, date and types of latest qualification test passed by each welder.

8.7.2.2.5.1.3 Welded joints shall be fusion welded.

8.7.2.2.5.1.4 Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weld-o-lets.

8.7.2.2.5.2 Welding Quality Control

8.7.2.2.5.2.1 Prior to the start of any welding, submit a summary of the procedures to be followed by all welders performing work on this project.

8.7.2.2.5.2.2 A sampling of the welds provided by the Contractor for this project may be x-rayed by the Owner in an effort to assure quality welding.

a. The welds to be x-rayed will be selected by the Engineer and / or Owner.
b. The x-rayed welds will be analyzed by a certified x-ray technician.
c. `Allowable anomalies in the welds that are x-rayed shall be as follows:
   (1) Cracks – None permitted.
   (2) Lack of Fusion – The length of unfused areas shall not be more then 20% of the circumference of the pipe, or of the total length of the weld, and no more than 1½ in. any 6 in. of weld.
   (3) Incomplete Penetration – The total joint penetration shall not be less than the thickness of the thinner of the components being joined, except that incomplete root penetration is acceptable if it does not exceed the lesser of 1/32 in. or 20% of the required thickness, and its extent is not more than 1½ in. in any 6 in. of weld.
   (4) Undercut and Reinforcement – Undercut shall not exceed the lesser of 1/32 in. or 12 ½ % of wall thickness. Thickness of weld reinforcement shall not exceed 3/16 in
   (5) Concave Root – concavity of the root surface shall not reduce the total thickness of the joint, including reinforcement, to less than the thickness of the thinner of the components being joined.
   (6) Excess Root Penetration – The excess shall not exceed the lesser of the 1/8 in. or 5% of the inside diameter of the pipe.
   (7) Weld Surfaces – There shall be no overlaps or abrupt ridges and valleys.

8.7.2.2.5.2.3 If the x-ray of any of the various welds reveal deficiencies greater than allowable as indicated herein, the deficient weld shall be ground out, the joint rewelded, and the new weld x-rayed to prove that the criteria indicating maximum allowable anomalies is adhered to.

8.7.2.2.5.2.4 The Contractor shall x-ray an additional 10 welded joints not previously x-rayed in locations selected by the engineer. All joints shall meet or exceed the criteria stated. If they do not, the deficient weld shall again be ground out and the joint rewelded.

8.7.2.2.5.2.5 This process shall be continued until the engineer is satisfied that all welded joints meet or exceed the criteria indicating maximum allowable anomaly in any given weld.

8.7.2.2.5.2.6 The cost for the original x-ray procedure shall be by the Owner. All required x-ray procedures or required corrective action subsequent to the original x-ray procedure as stated above shall be provided by the Contractor.

8.7.2.2.6 Testing Procedures for Piping Systems

8.7.2.2.6.1 All lines and systems shall be tested before they are insulated, painted or concealed by construction or backfilling. All required fuel, water, electricity, materials, labor and equipment required for tests shall be provided by the Contractor.

8.7.2.2.6.2 Where entire system cannot be tested before concealment, test system in sections. Upon completion, each system shall be tested as an entire system.

8.7.2.2.6.3 Defects, leaks and material failures revealed by tests shall be repaired or replaced and then the system shall be retested. Repeat this process until the test results are satisfactory. Repairs shall be made with new materials.

8.7.2.2.6.4 System component ratings shall be reviewed and it should be verified that the components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings remove or isolate components from system during tests.

8.7.2.3 Valves

8.7.11.1 Valves 2" and smaller shall be full port ¼ turn ball valves with a cold working pressure (CWP) of 600 psi.

8.7.11.2 Valves 2-1/2" and larger shall be full lug body butterfly valve with lever lock handles in sizes 6” and smaller and a gear operator on valves in sizes 5” and larger. Globe valves shall be used only for throttling purposes. Globe valves shall be a minimum of 150 lbs. and shall be rated for steam and hydronic applications.

8.7.2.4 Traps

8.7.2.4.1 All traps shall be protected by a strainer upstream. Isolation valves shall be installed on each side of each trap. Unions shall be provided on the inlet and outlet piping to facilitate maintenance. No integral check valves shall be used. Armstrong traps should be used as a standard of quality. An in line stainless steel spring check valve and a trap test valve with threaded cap shall be provided in the discharge piping from each trap.

8.7.2.5 Strainers

8.7.2.5.1 Strainers shall by Y-pattern, rated for steam, with stainless steel baskets. All strainers shall be installed with a blow-down valve.

8.7.2.6 Safety Relief Valves

8.7.2.6.1 Safety relief valves shall have inlet piping that is equal to the inlet connection on the relief valve. Outlet piping shall be at least equal in size of the outlet connection on the relief valve.

8.7.2.6.1.1 The discharge shall be piped to a safe point, preferably to the exterior of the building.

8.7.2.6.1.2 A flanged or union connection shall be provided for replacement.

8.7.2.6.1.3 A drip pan elbow with drain tapping or a relief valve expansion compensator shall be provided. The relief piping shall be designed and installed so as to not put pressure on the relief valve.

8.7.2.6.1.4 Relief piping when receiving discharge from multiple relief valves shall be sized so that the area of the common discharge piping is equal to or greater than the sum total of the areas of the discharge size of the individual relief valves that connect there to.

8.7.2.7 Insulation

8.7.2.7.1 All pipe shall be insulated to meet ASHRAE 90.1 and the KSU Energy Conservation Policy #020.

8.7.2.7.2 Piping insulation shall be pre-molded fiberglass with all service jacket. Closed cell foam insulation shall not be used.

8.7.2.7.3 Relief valve discharge piping need not be insulated.

8.7.2.7.4 See Piping Insulation Schedule.

8.7.2.7.5 All piping that is exposed in occupied areas, and is within 8' of the finished floor, shall have an aluminum jacket installed. Aluminum jacketing material shall be minimum .016” and shall be held in place using band clamps. PVC jacket shall be an acceptable alternative.

8.7.2.8 Heat Exchangers

8.7.2.8.1 Heat exchangers shall be ASME approved and shall be installed with relief valves, rated for the service, on both the steam and hot water systems. Note that the relief valve on the steam supply to the heat exchanger is not required if there is an accurately sized relief valve on the low-pressure steam system at the pressure reducing valve. A vacuum breaker shall be installed on the shell of the heat exchanger.

8.7.2.8.1.1 Heat exchangers all be mounted and installed so as to allow removal of the bundle. Drawings shall clearly show the reserved pulling space to allow removal of the bundle.

8.7.2.8.1.2 Provide isolation valves on all piping entering and leaving heat exchangers so as to facilitate isolation for repair work.

8.7.2.8.1.3 Install gauges and thermometers to indicate the following: Pressure of the entering steam, pressure and temperature of the entering water, and pressure and temperature of the leaving water.

8.7.2.8.1.4 Install diaphragm expansion tanks on the water side of all heat exchangers.

8.7.2.8.1.5 Provide make up water connection that is protected by an RPZ style back flow prevention device, a fill valve, a relief valve and a by-pass style chemical feed unit.

8.7.2.9 Steam Coils

8.7.2.9.1 All coils shall be tube-in-tube, non-freezing type with a minimum 1" O.D. tubing. The designer shall consider the use of integral face and bypass coils, especially in situations using steam to pre-heat outside air. Provide two steam traps with bypass for all pre-heat coils.

8.7.2.9.1.1 Provide adequate elevation change on the outlet piping ahead of the trap so as to assure adequate head pressure to move the condensate out of the coil and through the trap. Provide a vacuum breaker in the discharge piping.

8.7.2.9.1.2 Steam trap on the outlet of coil shall be sized with a minimum safety factor of 3:1 at 1/2 of maximum pressure differential across the trap.

8.7.2.10 Steam Humidifiers

8.7.2.10.1 Steam Humidifiers shall be equipped with normally closed controls to automatically shut off the steam supply during the cooling season.

8.7.2.11 Air Vents and Vacuum Breakers

8.7.2.11.1 Provided air vents and vacuum breakers on steam and condensate piping and on equipment as required to facilitate unencumbered flow throughout the system.

Section 8.8 Hot Water Systems

8.8.1 Piping and Fittings

8.8.1.1 Piping shall be either black steel or copper. Welded steel systems shall use black steel piping and fittings, ASTM A106 seamless for piping 2" and smaller and A53 with electric resistance welded seam. All steel piping shall be minimum Schedule 40. All copper piping shall be minimum Type "L". The minimum pipe size shall be 3/4". See "Welding" and "Welding Quality Control" previously indicated in this standard for requirements.

8.8.1.2 Refer to the piping material schedule in the appendix.

8.8.1.3 Piping at HVAC units shall not obstruct filter access panels or any other clearance requirement for maintenance.

8.8.1.4 Thermometers and gauges

8.8.1.4.1 All thermometers and gauges shall have dial faces between 2" and 5" in diameter. All thermometers installed more than 8' from floor level shall have a minimum dial face of 6" and shall be installed to allow reading from floor level.

8.8.1.4.2 All thermometers shall be of the dry well type. All thermometers shall be installed with thermal conductive material in the dry wells. Installation without the thermal conductive material yields inaccurate readings.

8.8.1.4.3 All thermometers and gauges shall be selected with the expected operating conditions near the middle of the range of the device.

8.8.14.4 Thermometers and pressure gauges shall be accurate to 1% of full Scale.

8.8.1.4.5 All gauges shall be installed with gauge cocks.

8.8.1.4.6 All CW and HW systems should have thermometers as well as pressure gauges installed on both supply and return lines and/or on both sides of pumps. No Pete's plugs are allowed.

8.8.1.4.7 Refer to the following schedule for thermometer, gauge, and gauge cock locations. A minimum of (2) pressure gauges and (2) thermometers, configured to fit into the provided gauge cock shall be provided for each project. These gauges and thermometers shall be delivered to the Owner's maintenance personnel in a manufacturer's fabricated carrying case.

THERMOMETER, GAUGE, GAUGE COCK INSTALLATION SCHEDULE

	Thermometer & Well	Press Gauge & Gauge Cock	Gauge Cock	Pete's Plug
Hot water entering and leaving each heat exchanger	X		X	
Hot water entering and			X	

leaving each circulating pump Hot water entering and leaving each hot water Coil	X		X	X

8.8.2 Hot Water Piping

8.2.2.1 All hot water piping shall be insulated to meet ASHRAE 90.1 and KSU Energy Policy #020.

8.8.2.2 Piping insulation shall be pre-molded fiberglass with “all service” jacket.

8.8.2.3 Refer to the insulation schedule in the appendix.

8.8.2.4 All piping that is exposed in occupied areas, and is within *8′* of the finished floor, shall have a jacket installed. The jacket shall be either .016” aluminum or PVC.

8.8.3 Pumps

8.8.3.1 All pumps shall be installed in easily accessible locations and shall have isolation valves installed on each side of the pump.

8.8.3.2 Bell & Gossett shall be used as the standard of quality.

8.8.3.3 All pumps shall have mechanical seals.

8.8.3.4 Horizontal in-line pumps shall have a maximum of 1 horsepower. Vertical in-line pumps shall have a maximum of 5 horsepower, be mounted within 4' of the floor, and shall be protected by a strainer. It is preferred that all in-line pumps be close-coupled.

8.8.3.5 Base-mounted, centrifugal pumps shall be installed with a pressure gauge manifold and a suction diffuser/strainer. The use of triple duty valves is preferred. Pipe vibration isolators shall be stainless steel with stainless steel braided restraint.

8.8.3.6 All motors shall be inverter duty/premium efficiency capable of being fed by a VFD. Shaft grounding rings shall be provided on all pump motors.

8.8.3.7 All pumping systems shall be installed with redundant pumps.

8.8.3.8 Controls shall be provided to turn pumps on and off, monitor status, and turn redundant pump on when a pump fails. Where the system has a VFD the controls will modulate speed to control differential pressure (DP) 2/3 down the system or in more complicated systems several point may be monitored and a low select done of DP.

8.8.4 Air Venting and Drains

8.8.4.1 Air vent valves shall be provided at high points in the piping system and in any additional location required to vent air from the closed loop piping system. Drain valves shall be provided at low point in the piping system to facilitate draining of the piping system.

8.8.4.2 Manual air vent valves and drain valves shall be minimum ½", ¼ turn ball style valve with hose end connector and cap. Automatic air vents are not preferred.

8.8.4.2.1 Air vent valves and drain valves must be provided in locations that are accessible by Facility maintenance personnel.

8.8.4.3 Air and dirt separators are required on all systems. Centrifugal-type air separators shall be provided. Air and dirt separator shall be manufactured by Spirotherm. No equivalents.

8.8.5 Coils

8.8.5.1 All coils shall have a minimum of .025" tube wall thickness and 5/8" O.D. minimum diameter.

8.8.5.2 It is preferred that hot water only coils have a maximum of 8 fins/inch.

8.8.5.3 All coils shall have copper coils, aluminum fins, and non-ferrous headers.

Section 8.9 Air Handling Systems

8.9.1 General requirements

8.9.1.1 Design of air handling systems shall comply with ASHRAE 90.1 and KSU Energy Conservation Policies located in Appendix 2. Equipment shall be limited to the fewest number of components practical. Variable Air Volume (VAV) systems are preferred.

8.9.1.2 Economizer cycles are preferred. If an economizer cycle is used, and the size of the equipment dictates, a return air fan is suggested to prevent over pressurization of the conditioned space. Freeze stats must be installed with all economizer cycles.
8.9.1.2.1 Economizers shall not be used when humidification is provided.

8.9.1.2.2 When economizers are provided for free cooling, a minimum outside air duct with damper and flow grid shall be provided so as to accurately control and measure the required minimum quantity of outside air.

8.9.1.2.3 Outside air-cooling will be used whenever possible.

8.9.1.3 All systems that use 100% outside air should be evaluated for the use of heat recovery systems and/or outside air for free cooling whenever possible.

8.9.1.4 All designers shall consider noise and ease of maintenance when locating equipment.

8.9.1.5 A drawing shall be mounted near the air handling unit showing the as-built locations of all fire dampers, balancing dampers, VAV boxes, coils, and other equipment in the ductwork served by that unit. The drawing shall be protected by glass or other suitable material.

8.9.1.6 The location of outside air intakes shall be carefully considered to prevent intakeof exhaust from other systems equipment or delivery vehicles.

8.9.1.7 Piping at HVAC units shall not obstruct filter access panels or encroach on any required equipment maintenance clearances

8.9.1.8 It is preferred that no HVAC units are to be located in classrooms or where you have to place scaffolding or use extension ladder to get to the equipment.

8.9.2 Air Handling Units

8.9.2.1 For new construction (and existing buildings where possible), locate all air handling units inside the building or in a penthouse. Locating equipment on a rooftop or above a ceiling is strongly discouraged. Variable air volume (VAV) boxes should be located in corridors or other common areas whenever possible.

8.9.2.1.1 Air handling units shall be located with adequate clearance provided for all maintenance requirements.

8.9.2.1.2 Adequate space shall be provided next to the air handling unit to pull and replace a coil. Piping shall be configured to allow for the removal of a coil without requiring major disassembly of the hydronic supply and return piping.

8.9.2.2 All units shall provide thorough mixing of outside and return air. The designer shall evaluate the need for engineered mixing boxes, blenders, or other methods to prevent stratification of the air.

8.9.2.3 Hinged access doors shall be provided on all units to provide access to filters, coils, fans, dampers, etc. Door handles shall be used on these doors. Bolted panels are not acceptable except on very small units.

8.9.2.4 All drain pans shall be insulated and bottom drained. Provisions for cleaning shall include either a removable pan or ease of access for cleaning in place. Traps for drain systems shall be sized for the system served. Ensure adequate room for the size of trap required. Adjust the height of the housekeeping pad as required. However, 6" is the preferred minimum height for housekeeping pads.

8.9.2.5 All units shall have a manometer-type filter pressure differential indicator installed with a manifold and valves to isolate the lines to each side of the filter. Units sized under 10 tons do not need to have this indicator.

8.9.2.6 Thermometers shall be installed to show the temperatures of the mixed, discharge, outside, and return air. Thermometers shall be bi-metal type with a minimum dial face of 6". Units sized under 10 tons do not need to have this indicator.

8.9.2.7 All oil and grease lines shall be extended to the exterior of the case.

8.9.2.8 Casings shall be 2” solid double wall with the interstitial space insulated with minimum (R)value of 13 ft2-h-deg.f. / BTU. Casing panels shall be thermally broken.

8.9.3 Filters

8.9.3.1 Filters shall comply with ASHRAE Systems and Equipment Handbook, Chapter 25, Table 2. Minimum MERV 13 filters shall be provided.

8.9.4 Ductwork

8.9.4.1 Ductwork shall be designed according to the latest edition of the Sheet Metal and Air Conditioning Contractor’s Association (SMACNA) Duct Manual

8.9.4.2 Rectangular duct and duct fittings shall be constructed of new commercial quality, bright spangled galvanized steel. Gauge shall be as required by the SMACNA Duct Manual.

8.9.4.2.1 Manufactured turning vanes shall be provided in all 90-degree rectangular duct fittings.

8.9.4.3 Round duct shall be spiral duct formed from commercial grade G60/G90 galvanized steel conforming to ASTM A90, A658, A653 A924.

8.9.4.3.1 Fittings in round duct systems shall be factory fabricated with smooth radius bends.

8.9.4.4 Flexible ductwork shall have a maximum length of *6′* and shall be properly supported. Flexible ductwork shall only be used for connecting the branch duct to the diffuser. In no case shall flexible ductwork be used upstream of VAV boxes.

8.9.4.4.1 Rigid sheet metal 90-degree bends shall be provided red in flexible duct runs where a 90 degree turn in the duct is required.

8.9.5 Dampers

8.9.5.1 All dampers that will be used in a fully closed position shall be low-leakage type. The standard of quality is Ruskin CD60.

8.9.5.2 Maximum leakage for all duct systems is 5%. To be verified by independent testing and balancing after contractor has provided a rough balanced system.

8.9.5.3 All branch duct takeoffs shall use the 45 degree high efficiency take off design and shall have a balancing damper installed in each branch as close to the main duct as practicable. No splitter dampers or air extractors shall be used.

8.9.6 Duct Insulation

8.9.6.1 Duct insulation shall comply with ASHRAE 90.1.

8.9.6.2 Only external insulation shall be used on medium and high velocity duct systems. Insulation shall be minimum 1-1/2” thick 1.0 lb. density with foil-scrim-craft facing.

8.9.6.3 Only external insulation shall be used on outside air intake duct systems. Insulation shall be minimum 1-1/2” thick 1.0 lb. density with foil-scrim-craft facing. Outside air duct shall be sealed and configured to drain any entrained moisture that to the exterior of the building.

8.9.6.4 Internal duct lining insulation may be used on low velocity duct systems. Insulation shall be minimum 1” thick 1.5 lb. density with smooth interior non erosive facing.

8.9.6.4.1 Exposed edges of the internal insulation in return air and transfer ducts shall be covered with a sheet metal “C” channel.

8.9.6.4.2 Duct liner shall be fully adhered and pinned to the sheet metal duct.

8.9.6.5 In mechanical rooms or other places where ductwork is exposed, rigid fiberglass insulation shall be used. The rigid fiberglass insulation shall have a minimum overall thickness of 2” constructed in layers with all joints offset. Insulatioin shall be glued and pinned to the duct.

8.9.7 Diffusers

8.9.7.1 Diffusers with integral dampers shall not be used. System balance dampers shall be installed in ductwork upstream of diffusers.

8.9.7.2 Louvered diffusers with replaceable core are the preferred style of diffuser for constant volume applications.

8.9.7.3 In suspended grid ceiling installations, diffusers shall be installed in an integral 24" x 24" mounting plate

8.9.7.4 Diffusers for VAV systems shall be specified with consideration given to air dumping at low velocities. Slot style diffusers shall be used for all VAV applications.

Section 8.10 Fume Hoods and Laboratory Systems

8.10.1 General Requirements

8.10.1.1 All fume hood systems shall be designed based on hazard designations from KSU Public Safety.

8.10.1.2 For all fume hood installations or alterations, the balance of make-up air to exhaust air for the affected zone or building shall be evaluated. Fume hoods that will cause or aggravate an imbalance between the make-up air and exhaust air shall not be installed unless the imbalance is corrected. The preliminary design for a project may proceed on the basis of existing drawings and/or balance data. The final design must be based on actual test data.

8.10.1.3 All systems, whether new or replacement, shall be designed using variable air volume (VAV) hoods, VAV supply fans and variable volume exhaust fans. If the complete exhaust-supply system cannot be installed at the time of fume hood installation, this may require a constant velocity-type fume hood be installed. If so, select the fume hood for future modification to a VAV-type fume hood. Minor modifications to existing fume hoods that do not increase makeup air problems or cause other imbalances are exempt from this requirement.

8.10.1.4 A life-cycle economic analysis shall be performed for every fume hood installation. Factors for the analysis shall include, but not be limited to, initial cost of installation, projected energy costs, and projected maintenance costs. Analysis shall give the present worth of the system based on 15 years operation with annual costs listed.

8.10.1.5 All fume hood systems shall be designed according to ANSI Z9.5 with the following exception: The design face velocity shall be 100 FPM.

8.10.1.6 All measurements performed to ensure compliance with the listed face velocities shall be performed with a velocity grid sensor. (KSU Public Safety owns one.)

8.10.1.7 Where feasible it is preferred that systems be grouped to use fewer pieces of equipment.

8.10.1.8 Fume hoods and supply air diffusers shall not be located so that a supply diffuser is in front of a fume hood. Space HVAC supply diffusers shall not create unacceptable air velocities in the front of the hood.

8.10.1.9 Perchloric and radioactive systems shall be completely separate from other exhaust systems.

8.10.1.10 Provide manifold exhaust systems where possible. When manifold systems are used, use redundant, high plume Strobic fans.

8.10.2 Fume hoods

8.10.2.1 The standard of quality for fume hoods is Labconco. A state contract for fume hoods exists and is available for use on projects.

8.10.2.2 All fume hoods shall be equipped with a face velocity monitor and markings on the front of the hood indicating the maximum sash opening height and sash height for maximum air flow. A standard for quality is Phoenix Controls.

8.10.2.3 All fume hoods must be certified by KSU Public Safety before use.

8.10.2.4 All fume hoods shall have half-sash locks with alarms. The alarms may have a user override but, if the override is used, shall sound again after four minutes.

8.10.2.5 All fume hoods shall have flow indicators with low flow alarm

8.10.2.6 Fume hoods shall have vertical sashes. Horizontal sashes are not allowed.

8.10.2.7 All new fume hoods shall be provided with automatic sash closers that require switch activation to raise the sash and a motion sensor to lower the sash once movement is not sensed in the front of the fume hood.

8.10.3 Fume Hood and Laboratory Exhaust System Ductwork

8.10.3.1 All fume hood and laboratory exhaust system ductwork shall be constructed with 304 stainless steel and shall be of riveted and sealed construction unless other materials are required by the uses of a particular system.

8.10.4 Controls

8.10.4.1 Control the fume hood exhaust, room exhaust, and room supply air flows with a variable air volume (VAV) scheme to maintain a constant fume hood face velocity of 100 FPM, at various sash heights, and to provide climate comfort control for the room occupants.

8.10.4.2 Control equipment shall be Phoenix or approved equal. Air flow control devices shall be Venturi type valves.

8.10.4.3 Any control system used shall have a response time of 1 second or less.

8.10.4.4 Sash position type of control design shall be utilized for control. This in lieu of control based on air pressure differential.

8.10.4.5 A proximity sensor shall be provided to reduce the face velocity to 70-80 FPM when no one is in the immediate vicinity of the front of the fume hood and to lower the sash after a predetermined time period.

Section 8.11 Animal Quarters

8.11.1 Design parameters for animal quarters shall include 100% outside air, 100% exhaust, heat recovery on the exhaust air, and a 50% safety factor on the total heat load.

8.11.2 Verify the required space temperatures with the ultimate user of the space.

8.11.3 Where available, use steam for all preheat coils. Use a freeze-proof design on all coils.

Section 8.12 Auditoriums

8.12.1 Design of air handling systems for auditoriums should consider the use of CO2 monitors and occupancy monitors to control the amount of outside air required.

8.12.2 Generally, it is preferred that auditorium systems be separate from other building systems.

8.12.3 Special consideration shall be given to noise issues in auditorium applications. Submit acoustic calculations for the mechanical equipment. Particular attention shall be given to low frequency vibrations.

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CHAPTER 8 – APPENDICES

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APPENDIX 8A: SEQUENCING

BOILER SYSTEM CONTROL - TWO CONDENSING BOILERS PIPED IN PARALLEL

Any building that is not connected to the campus district steam heating system shall be provided with a hydronic boiler heating plant that utilizes condensing boilers with primary pumps.

A minimum of two (2) boilers shall be provided. When two (2) boilers are provided, each boiler shall be sized for the total heating load. When more than two (2) boilers are provided, each boiler shall be sized so that the loss of one boiler in the plant results in total heating capacity provided by the plant.

Secondary pumps shall be provided to circulate heated hot water to coils in air handling units, fin tube radiation, unit heaters, fan coil units etc. that are in the HVAC system.

The boilers shall be of the condensing design and shall be capable of an aggressive reset schedule which results in the condensing of flue gas. The condensate from the flue gas shall pass through a neutralization device and shall then be evacuated to the local drain waste and vent system.

BOILER SYSTEM CONTROL

Two condensing boilers, each with primary pump shall be provided. The boiler system shall be energized any time a requirement for building heat or dehumidification exists.

The boilers shall have an on-board control panel that shall interface to the automatic temperature control system head end for start / stop, monitoring and alarm functions.

A user defined and adjustable hot water temperature reset schedule shall be provided.

Each boiler shall control the associated primary pump.

HEAT EXCHANGERS PIPED IN PARALLEL

Three control valves, installed in the piping ahead of the heat exchangers and configured in parallel, (two globe valves sized at 4” and one ball valve sized at 2-1/2”) shall be modulated as required to satisfy the hot water temperature control as described below.
Hot water temperature control: the hot water supply temperature setpoint is reset from 90 deg. F. to 120 deg. F. (adjustable) as the outside air temperature falls from 60 deg, F. to 40 deg. F. The heat exchanger control valves will be sequenced to maintain the hot water supply temperature setpoint.
High hot water system temp lockout: if the system header temp rises to a high limit of 210 deg. F. (adjustable) or the heat exchanger shell temp rises above 225 deg. F. (adjustable) the heating system will be disabled and operating pumps will be commanded off and an alarm will be generated at FMS computer. The operator must manually reset the heating control in order to start hot water heating system.

BUILDING HOT WATER PUMPING SYSTEM

Two pumps each with capacity for total required flow shall be provided. The pumps shall be alternated by the automatic temperature control system head end as required to equalize run time.

Each of the pumps is provided with a variable speed motor controller. The pump speed shall be adjusted so as to maintain pressure in the piping system at an approximate location of 2/3 of the piping system. Pressure setpoint shall be established at the time of testing, balancing and commissioning.

CHILLED WATER PIPING SYSTEM- BUIILDING CONNECTED TO DISTRICT CHILLED WATER SYSTEM

There is an existing Campus chilled water system. The piping connection from the district chilled water system shall allow the pressure in the district chilled water system to circulate the building; however, pumps shall be provided to boost the pressure as required to circulate the building should the pressure in the main be inadequate to circulate the building.

Two pumps each with capacity for total required flow shall be provided. The pumps shall be alternated by the automatic temperature control system head end as required to equalize run time.

Each of the pumps is provided with a variable speed motor controller. The pump speed shall be adjusted so as to maintain pressure in the piping system at an approximate location of 2/3 of the piping system. Pressure setpoint shall be established at the time of testing, balancing and commissioning.

CHILLER CONTROL – BUILDINGS NOT CONNECTED TO DISTRICT CHILLED WATER SYSTM

Any building that is not connected to the campus district chilled water system shall be provided with a chiller plant that utilizes chillers with primary pumps.

Depending on the size of the chilled water plant, it is preferred that two (2) chillers shall be provided in the plant. When two (2) chillers are provided, each chiller shall be sized for approximately 2/3 of the cooling load.

Secondary pumps shall be provided to circulate chilled water to coils in air handling units, fan coil units etc. that are in the HVAC system.

The Design Engineer shall determine the type of chiller to be provided in the chilled water plant. If the size of the chilled water plant is greater than 100 tons, water cooled chillers with remote cooling towers are preferred. On smaller systems, packaged air-cooled chillers should be considered. The air-cooled chiller should utilize either helical rotary compressors or multiple scroll compressors.

DEDICATED OUTSIDE AIR HANDLING UNIT

The air handling unit provides ventilation air at generally room neutral conditions of 70 degreed and 50% relative humidity during warm ambient conditions and 68 degrees during cold ambient conditions.

The air handling unit will be 100% outside air for ventilation.

The filter bank should be "V" bank design and should be configured to accommodate 4" pleated media, disposable filters. Filters should have a minimum MERV rating of 13.

The heating coil shall be positioned in the preheat position. Note that care should be taken by the Design Engineer to protect this coil from freezing. This coil may utilize a distributing steam coil or internal face and by-pass dampers. As an alternative, a plate & frame heat exchanger can be provided to isolate a loop, that is mixed with propylene glycol, to circulate hot water through the preheat coil

A chilled water coil, sized for the greater of the calculated space heat gain and dehumidification load shall be provided.

A second heating coil in the reheat position shall be provided so as to provide reheat of dehumidified cold supply air to prevent space sub cooling.

A single or multiple direct drive plenum fans shall be provided. A single direct drive plenum fan on smaller units shall be justified by the Design Engineer. Larger units shall have multiple fans, configured in a fan array. The fans shall be designed, as much as is practicable, so that total required air flow is achieved should one of the fan/motor assemblies be taken out of service. Air handling unit fans shall be provided with either backdraft dampers or blank off plates to allow for the servicing of a motor or fan in the fan array.

Each fan motor in the fan array shall be controlled by an independent variable speed motor controller. This is required to provide soft starting of the fan motors.

UVc lighting shall be provided in the chilled water coil section so as to mitigate the propagation of mold on a wet cooling coil.
The preheat coil shall be sized to deliver a discharge temperature of 55 degrees. Note that this coil shall be sized for a -20 deg. F. Entering air temperature.

The control valve on the preheat coil, cooling coil and reheat coil shall modulate so as to maintain the desired discharge temperature.

Upon a drop in discharge temperature, the control valve on the chilled water coil shall modulate to the closed position and the control valve on the pre-heat coil shall modulate so as to maintain a minimum discharge temperature of 55 deg. F. The control valve on the reheat coil shall modulate to maintain the desired discharge temperature.

Upon a rise in discharge temperature, the control valve on the pre-heat coil shall modulate to the closed position, provided entering air temperature is above 55 deg. F., the control valve on the reheat coil shall modulate to the closed position and the control valve on the chilled water cooling coil shall modulate so as to maintain desired discharge temperature.

Upon a rise in humidity of the discharge air above a predetermined (adjustable) set point, initially set at 50%, the control valve on the chilled water coil shall modulate to the full open position, or as required to achieve a maximum 55 deg. F. Leaving air temperature and the control valve on the hot water re-heat coil shall modulate so as to maintain the desired discharge air temperature.

During occupied time periods, the air handling unit fan shall operate continually so as to provide constant air flow.

During unoccupied time periods, the air handling unit fan shall be deenergized.

ENERGY RECOVERY

Energy recovery units, if determined by the Design Engineer to be beneficial, shall be provided to recover energy from the air that is exhausted from the building. Note that if the volume of exhaust air is less than the required outside air volume, then the difference shall be exhausted from the occupied space. The energy recovery device should be positioned between filter bank and the preheat coil.

Care should be exercised if fume hood exhaust is utilized as a part of the energy recovery process. In this case, energy recovery wheels are not recommended and will only be allowed if approved by KSU Facilities and Safety and Security.

VARIABLE AIR VOLUME AIR HANDLING UNIT WITH ENERGY RECOVERY

The air handling unit is a single zone variable air volume air handling unit with minimum outside air damper with flow volume grid, economizer outside air dampers and return air dampers, angle filter rack chilled water coil and fan array; each fan in the array with motor that is controlled by a variable speed motor controller.
Air from this air handling unit is directed to a medium velocity duct system that serves the associated zone of the building.
Air from this air handling unit is generally delivered at 55 deg. F.; however, during cold ambient conditions, when ambient vapor levels are low, the discharge air temperature shall be reset from 55 deg. F to 65 deg. F. (adjustable).
During ambient temperatures below 55 deg. F, (adjustable from the automatic temperature control head end), the chilled water coil control valve shall be closed and the economizer outside air and return air dampers shall modulate to maintain the desired discharge temperature. The minimum outside air damper shall modulate to maintain the required minimum outside air.

An adjustable reset supply temperature schedule shall be provided. Initially, this reset schedule shall be set up to maintain a discharge temperature of 55 deg. F. at ambient temperature of 55 deg. F. and above, and a discharge temperature of 60 deg. F. At ambient temperature equal to and below 30 deg. F
During ambient temperatures between 55 deg. F and 70 deg. F (adjustable) the chilled water coil control valve shall be adjusted to maintain the required supply air temperature. Return air dampers shall be closed and outside air dampers shall be 100% open. Enthalpy in the return air and outside air shall be monitored. If enthalpy of the outside air is higher than that of the return air, then the return air dampers shall be open, minimum outside air damper shall be open, and modulated, to supply the required minimum outside air and economizer outside air dampers shall be closed.

During ambient temperatures above 70 deg. F (adjustable) the chilled water coil control valve shall be adjusted to maintain the required supply air temperature. Return air dampers shall be open and outside air dampers shall be closed. The minimum outside air damper shall be open, and modulated, to supply the required minimum outside air.

SUPPLY FANS
In the occupied mode of operation, the air handling unit fans shall operate so as to provide continuous air flow and to maintain the predetermined, adjustable, static pressure in the supply duct, originally set at 1-1/2". The static pressure sensor shall be located at the 2/3 position in the main trunk duct. Final static pressure setpoint shall be established during system testing, balancing and commissioning.
In the unoccupied mode of operation the air handling unit fans shall be off, should any control zone within a particular air handling unit either rise above a predetermined set up temperature or below a predetermined set back temperature, the associated primary air handling unit, and associated return fan, shall be energized. The unit

shall continue to operate at 0% outside air until the desired set up or set back temperature is achieved for a minimum of 15 minutes (adjustable).

RETURN FAN
A return air fan shall be provided for each air handling unit. The return fans shall be controlled to maintain a positive pressure on the return fan discharge that is set to overcome the pressure required to push the return air either through the return dampers or through the relief air dampers.
Space static pressure shall be monitored. The relief air damper shall modulate in conjunction with the return air dampers in the air handling unit so as to maintain the required space positive static pressure.

The return fan, or fans in an array, shall operate continually during the occupied mode of operation. These fans shall be energized with the main air handling unit supply fan is energized during unoccupied time periods.

ENERGY RECOVERY
An energy recovery ventilator is provided with enthalpy wheel, exhaust fan and supply fan. Filters are provided in each the exhaust air path and the outside air path. These filters are located on the entering air side of the enthalpy wheel and shall be positioned on the suction side of the respective fan. Exhaust air from toilets and / or a portion of the building return air shall be exhausted through this unit. The required minimum outside air shall also be circulated through this unit. The energy in the exhaust air stream shall be transferred into or out of the required outside air (depending on the ambient conditions). The outside air shall be delivered from this energy recovery unit to the minimum outside air damper on the air handling unit.

The energy recovery unit shall run continuously during occupied time periods and shall be deenergized during unoccupied time periods.

SINGLE ZONE AIR HANDLING UNIT WITH HUMIDITY CONTROL

The air handling unit provides conditioned air as required to satisfy space temperature and humidity.

The air handling unit shall be provided with a fixed outside air intake with damper, return with damper, “V” bank filters, chilled water coil, reheat coil and humidification distribution header.

The filter bank should be “V” bank design and should be configured to accommodate 4” pleated media, disposable filters. Filters should have a minimum MERV rating of 13.

A chilled water coil, sized for the greater of the calculated space heat gain and dehumidification load shall be provided. A heating coil in the reheat position shall be provided so as to provide reheat of dehumidified cold supply air to prevent space sub cooling.

Unless it is determined by the Design Engineer that economizer cooling is beneficial when comparing the increased humidification requirement, the minimum outside air quantity shall be fixed.

Outside air shall be closed when the system is operating in the unoccupied mode of operation.

A single or multiple direct drive plenum fans shall be provided. A single direct drive plenum fan on smaller units shall be justified by the Design Engineer. Larger units shall have multiple fans, configured in a fan array. The fans shall be designed, as much as is practicable, so that total required air flow is achieved should one of the fan/motor assemblies be taken out of service. Air handling unit fans shall be provided with either backdraft dampers or blank off plates to allow for the servicing of a motor or fan of fan in the fan array.

Each fan motor in the fan array shall be controlled by an independent variable speed motor controller.

UVc lighting shall be provided in the chilled water coil section so as to mitigate the propagation of mold on a wet cooling coil.

A humidifier shall be provided in the discharge ductwork. A section of stainless steel duct shall be provided, the bottom of which should be designed and constructed as a drain. The bottom of this section of duct shall be provided with a cross break and a trapped drain shall be connected to the low point of the duct that discharges water to a local floor drain. This section of duct shall not be lined, but shall be insulated using external duct insulation.

The humidification distribution header shall be designed for the shortest practical absorption distance.

A DI water system shall be provided to supply water to the humidifier if district steam is not utilized.

Energy recovery units, if determined by the Design Engineer to be beneficial, shall be provided to recover energy from the air that is exhausted from the building. Note that if the volume of exhaust air is less than the required outside air volume, then the difference shall be exhausted from the occupied space. The energy recovery device should be positioned between the filters and the cooling coil.

Upon a drop in space temperature, the control valve on the chilled water coil shall modulate to the closed position the control valve on the reheat coil shall modulate to maintain the desired space temperature.

Upon a rise in space temperature, the control valve the control valve on the chilled water cooling coil shall modulate so as to maintain desired space temperature. The control valve on the reheat coil shall remain closed.

Upon a rise in humidity of the space above a predetermined (adjustable) set point, initially set at 35%, the control valve on the chilled water coil shall modulate to the full open position, or as required to achieve a maximum 55 deg. F. Leaving air temperature and the control valve on the hot water re-heat coil shall modulate so as to maintain the desired space temperature setpoint.

During occupied time periods, the air handling unit fan shall operate continually so as to provide constant air flow.

During unoccupied time periods, the air handling unit fan shall be deenergized. The fan shall be started should the space temperature drop below or rise above a predetermined space unoccupied temperature setpoints. If humidity control is critical during unoccupied times, the unit shall be started upon a rise or drop in space humidity above or below a predetermined value.

MISCELLANEOUS AIR HANDLING UNIT CONTROL

FILTER BANKS

A differential pressure transmitter shall be provided to monitor the status of each of the filter banks. A trouble signal shall be registered at the automatic temperature control system head end when the predetermined filter pressure drop associated with the dirty filter is registered.

LOW MIXED AIR TEMPERATURE

STAGE ONE LOW TEMPERATURE

A serpentine averaging type air temperature sensor shall be provided in the air handling unit ahead of the chilled water coil. If the temperature ahead of the chilled water coil drops below 40 deg. F. (adjustable), a trouble signal shall be registered at the automatic temperature control system head end. The outside air damper shall be closed and the return air damper shall be fully opened. The control valve on the chilled water coil shall be modulated to 100% open and the control valve on the heating coil shall continue to modulate to maintain space temperature. The unit shall continue to operate in this condition until the temperature ahead of the chilled water coil elevates up to 55 deg. F. For a minimum of 15 min. (adjustable). The unit shall then be released to normal operation.

STAGE TWO LOW TEMPERATURE

A serpentine averaging type air temperature sensor shall be provided in the air handling unit ahead of the chilled water coil. If the temperature ahead of the chilled water coil drops below 35 deg. F. (adjustable) and the space temperature drops more than 5 deg. F. (adjustable) below the desired space air temperature setpoint, the air handling unit fan shall be deenergized and an alarm signal shall be registered at the automatic temperature control system head end.

FIRE ALARM INTERFACE

An in-duct smoke detector shall be provided for each air handling unit that is sized to deliver an air flow of 2,000 cfm or greater. For air handling units that deliver less than 15,000 cfm, the detector shall be in the outside air duct upstream of filters. For units that deliver in excess of 15,000 cfm, a second in duct detector shall be provided in the supply duct. Should smoke be sensed by the in duct smoke detector, the air handling unit fans shall be shut off, the outside air damper shall be closed. A trouble signal shall be generated at the control system head end and a supervisory signal shall be generated at the fire alarm panel.

HEATING AND COOLING FAN COIL UNITS

Single Zone Fan Coil units shall be premanufactured and shall be provided with either one coil for heating only or for cooling only applications or two coils to enable both heating and cooling. Each unit shall be provided with a 1" throw pleated media filter.

Sequence of Operation

The occupied / unoccupied mode of operation shall be determined by a time-of-day schedule that resides on the central control system computer.

The fan coil unit shall be a single zone heating and cooling unit with a constant volume fan and 1" pleated media filter. The unit shall be provided for spot heating and cooling.

Fan coil unit shall be provided with a chilled water cooling coil and/or a hot water heating coil. Each coil shall be provided with a control valve. The heating coil shall be positioned in the pre-heat position.

A temperature sensor shall be provided in each control zone. The location of the zones sensors shall be determined by the design engineer.

In the occupied mode of operation, the fan coil unit fan shall operate so as to provide continuous constant volume air flow to the spaces served.

The control valve on the respective coil shall be modulated as required to adjust flow through the coil so as to satisfy the space temperature setpoint. Note that a 2 deg. F. (adjustable) dead band shall be maintained.

In the unoccupied mode of operation, the fan coil unit fan shall cycled in order to maintain a setback or setup temperature.

Should any space temperature drop below the pre-determined unoccupied heating temperature or rise above the pre-determined unoccupied cooling temperature. The fan in the fan coil unit serving that zone shall be energized. The control valve on the respective coil should be fully open to flow through the coil. The fan coil unit shall continue to operate in this condition for a minimum of 15 min. after the space temperature elevates to above the unoccupied heating temperature or drops below the unoccupied cooling temperature.

EXHAUST FAN OPERATION

The exhaust fans shall operate continually during the "occupied mode of operation". Unless specifically required, and as approved during design be KSU Facilities, the exhaust fan shall be deenergized during unoccupied time periods.

TYPICAL TROUBLE AND ALARM SIGNALS

Trouble Signals:
Commanded pump fail to start or run

Chilled water supply temperature above setpoint

Heating hot supply water temperature below setpoint

First stage low mixed air temperature
High filter pressure drop
High space temperature
Low space temperature

High space humidity
Low space humidity
In duct smoke detector initiation

Alarm signals:

Stand-by pump fail to start or run – loss of flow

Fan status – differs from requirement
note that status of each fan shall be monitored

Second stage low mixed air temperature

High duct static pressure

High Zone CO2

APPENDIX 8B: SCHEDULES

APPENDIX 8B.1---PIPING MATERIAL SCHEDULES

PIPING MATERIAL SCHEDULE											
SYSTEM	PIPING					FITTINGS		MAXIMUM WORKING		MAXIMUM WORKING	
	SIZE	TYPE	SCHEDULE	MATERIAL	ASTM	MATERIAL	TYPE	PRESSURE (PSI)	TEMP (°F)	HYDRO STATIC PRESSURE (PSI)	TIME
DOMESTIC HOT WATER	1/2"— 2"	L	—	CU	B-88	CP	SJ OR PP	125	50 TO 140	175	1 HR
DOMESTIC HOT WATER	2-1/2" AND ABOVE	L	—	CU	B-88	CP	FL / B	125	50 TO 140	175	1 HR
DOMESTIC COLD WATER	1/2"— 2 "	L	—	CU	B-88	CP	SJ OR PP	125	50 TO 85	175	1 HR
DOMESTIC COLD WATER	2-1/2" & ABOVE	L	—	CU	B-88	CP	FL / B	125	45 TO 85	175	1 HR
DOMESTIC COLD WATER	1/2"— 1-1/2"	PEX									
DRAIN WASTE AND VENT BELOW GRADE	ALL	DWV	40	PVC	D2665	PVC	SW	30	60-85	10' ABOVE HIGHEST CONNECTION	1 HR
ROOF DRAIN ABOVE GRADE	ALL	DWV	SERV	CI	A-74	CI	NH	30	60-85	10' ABOVE HIGHEST CONNECTION	1 HR
ROOF DRAIN BELOW GRADE	ALL	DWV	40	PVC	D2665	PVC	SW	30	60-85	10' ABOVE HIGHEST CONNECTION	1 HR
CHILLED WATER	1/2"— 2 "	L	—	CU	B-88	CP	SJ OR PP	150	40 TO 85	175	1 HR
CHILLED WATER	2-1/2" & ABOVE	ERW	40	CS/BLK	A-53	CS	W OR PC	150	40 TO 85	175	1 HR
HOT WATER	1/2 — 2"	L	--	CU		CP	SJ OR PP	150	200	175	1 HR
HOT WATER	2-1/2" & ABOVE	ERW	40	CS/BLK	A-53	CS	W OR PC	150	200	175	1 HR
TEMPORARY CONNECTIONS AT COILS	1/2"— 1"	PEX	ONLY ALLOWED FOR TEMPORARY CONNECTIOS TO COILS IN HYDRONIC SYSTEMS								
REFRIGERATION	ALL	ACR	L	--	CU	CP	B	**	**	**	**
HIGH PRESSURE STEAM	1/2 — 2"	SL	40	CS/BLK	A-106	CS	T	125	400	200	1 HR
HIGH PRESSURE STEAM	2 1/2" & ABOVE	ERW	40	CS/BLK	A-53	CS	FL / W	125	400	200	1 HR
LOW PRESSURE STEAM	1/2 — 2"	SL	40	CS/BLK	A-106	MI	T	15	250	30	1 HR
LOW PRESSURE STEAM	2 1/2" & ABOVE	ERW	40	CS/BLK	A-53	CS	FL / W	15	250	30	1 HR
STEAM RELIEF	1/2 — 2"	ERW	40	CS/BLK	A-53	MI	T	15	200	75	1 HR
STEAM RELIEF	2 1/2" & ABOVE	ERW	40	CS/BLK	A-53	CS	FL /W	15	200	75	1 HR

APPENDIX 8B.1---PIPING MATERIAL SCHEDULES- CONTINUED

PIPING MATERIAL SCHEDULE											
SYSTEM	PIPING					FITTINGS		MAXIMUM WORKING		MAXIMUM WORKING	
	SIZE	TYPE	SCHEDULE	MATERIAL	ASTM	MATERIAL	TYPE	PRESSURE (PSI)	TEMP (°F)	HYDRO STATIC PRESSURE (PSI)	TIME
STEAM CONDENSATE RETURN	1/2 — 2"	ERW	80	CS/BLK	A-53	CI	T	75	200	150	1 HR
STEAM CONDENSATE RETURN	2 1/2" & ABOVE	ERW	80	CS/BLK	A-53	CS	FL / W	75	200	150	1 HR
COMPRESSED AIR	2" AND SMALLER	L	—	CU	B-88	CP	SJ OR PP	125	50 TO 85	175	1 HR
CHEMICAL FEED	ALL			STAINLESS STEEL				60	50 TO 85	90	1 HR
CHEMICAL FEED FINAL CONNECTIONS	ALL	--	—	POLY TUBE	--	NA	NA	60	50 TO 85	90	1 HR
LABORATORY GAS	1" AND SMALLER		—	STAINLESS STEEL				125	50 TO 85	150	1 HR
AIR CONDITIONING CONDENSATE DRAIN	ALL	L/DWV	—	CU	B-88	CP	SJ OR PP	2	40 TO 85	10 FT	1 HR
NATURAL GAS	1/2 — 2"	SL	40	CS/BLK	A-106	MI	T	5	75	75 *	1 HR
NATURAL GAS	2 1/2" & ABOVE	ERW	40	CS/BLK	A-53	CS	W	5	75	75 *	1 HR

ABBREVIATIONS:

BLK — BLACK	ERW — ELECTRIC RESISTANT WELD	PC — ROLLED GROOVED PIPE COUPLING	SL — SEAMLESS
CI — CAST IRON	F — FUSION WELD	S — SOCKET JOINT	SS — SILVER SOLDER
CP — COPPER	GLV — GALVANIZED	SJ — SOLDER JOINT 95-5	T — THREADED
CS — CARBON STEEL	MECH — MECHANICAL	TIN—ANTIMONY	W — WELDED
DWV-DRAIN WASTE AND VENT	MI — MALLEABLE IRON	SW- SOLVENT WELD	B - BRAZED
PVC - POLYVINYL CHLORIDE	MJ — MECHANICAL JOINT	FL - FLANGED	NH - HEAVY DUTY 4 BAND NO HUB COUPLING
PEX - CROSS LINKED POLYETHYLENE			
ACR - AIR CONODITIONING AND REFRIGERATION			

NOTES:

* TESTING OF NATURAL GAS PIPING SHALL FOLLOW SPECIFICATION REQUIREMENTS

** EVACUATION AND TESTING OF REFRIGERANT PIPING SHALL FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS

1. "T" DRILL COPPER "TEES" WILL NOT BE PERMITTED.
2. ."WELD —O—LETS" AND "THREAD —O—LETS" CAN BE USED FOR PIPING TAKE OFFS PROVIDED THE BRANCH LINE FOR WHICH EACH IS USED IS A MAXIMUM SIZE OF 1 PIPE SIZE SMALLER THAN 1/2 OF THE MAIN SIZE OF WHICH IT CONNECTS.
3. ALL PIPING SHALL PASS PRESSURE TESTING PRIOR TO THE INSTALLATION OF INSULATION.
4. ALL FLANGES IN COPPER PIPING SYSTEMS SHALL BE RATED MINIMUM 150 PSI, NORMAL WORKING PRESSURE.
5. PIPE FLANGE GASKETS
   a. GASKETS FOR HYDRONIC HEATING HOT WATER AND COOLING CHILLED WATER SHALL BE INORGANIC FLEXIBLE GASKET RECOMMENDED FOR INTENDED SERVICE.
   b. GASLETS FOR STEAM AND STEAM CONDENSATE APPLICATIONS SHALL BE SPIRAL WOUND STEEL, RECOMMENDED FOR INTENDED SERVICE.
6. ALL PIPE NIPPLES IN STEEL PIPING SHALL BE SCHEDULE 80 STEEL.

APPENDIX 8B.2---PIPING INSULATION SCHEDULE

PIPING INSULATION SCHEDULE					
SYSTEM	SIZE	TYPE	THICKNESS	JACKET	REMARKS
DOMESTIC COLD WATER	1/2" THRU 1-1/4"	PHC	1/2"	ASJ	2
DOMESTIC COLD WATER	1-1/2" AND ABOVE	PHC	1"	ASJ	2
DOMESTIC HOT WATER	1/2" THRU 1-1/4"	PHC	1"	ASJ	1, 2
DOMESTIC HOT WATER	1-1/2" AND ABOVE	PHC	1-1/2"	ASJ	1, 2
DOMESTIC COLD WATER VALVES	ALL	EC	1/2"	WL	4
CHILLED WATER COOLING	1/2" THRU 1-1/4"	PHC	1"	ASJ	2
CHILLED WATER COOLING	1-1/2" AND ABOVE	PHC	2"	ASJ	2
REFRIGERANT HOT GAS	ALL	PHC	1"	ASJ	3
REFRIGERANT LIQUID	ALL	PHC	1/2"	ASJ	3
HOT WATER HEATING	1/2" THRU 1-1/4"	PHC	1-1/2"	ASJ	1, 2
HOT WATER HEATING	1-1/2" AND ABOVE	PHC	2"	ASJ	1, 2
HIGH PRESSURE STEAM	1/2" AND 3/4"	PHC	3"	ASJ	1, 2
HIGH PRESSURE STEAM	1" THRU 1-1/4"	PHC	4"	ASJ	1, 2
HIGH PRESSURE STEAM	1-1/2" AND ABOVE	PHC	4-1/2"	ASJ	1, 2
LOW PRESSURE STEAM	1/2" THRU 3"	PHC	2-1/2"	ASJ	1, 2
LOW PRESSURE STEAM	4" AND ABOVE	PHC	3"	ASJ	1, 2
STEAM CONDENSATE	1/2" THRU 3"	PHC	2-1/2"	ASJ	1, 2
STEAM CONDENSATE	4" AND ABOVE	PHC	3"	ASJ	1, 2
CONDENSATE PUMP DISCHARGE	1/2" THRU 1-1/4"	PHC	1-1/2"	ASJ	1, 2
CONDENSATE PUMP DISCHARGE	1-1/2" AND ABOVE	PHC	2"	ASJ	1, 2
CHILLED WATER VALVES	ALL	EC	1/2"	WL	4
CHILLED WATER PUMPS	ALL	EC	1/2"	WL	4

ABBREVIATIONS
PHC: PRE-MOLDED FIBERGLASS PIPE INSULATION
ASJ: ALL SERVICE JACKET
EC: FLEXIBLE CELLULAR FOAM
WL: WHITE LAQUER FINISH

REMARKS:
1. TAPER INSULATION AND SEAL RAW INSULATION EDGES AT ALL VALVES, UNIONS ETC ON ALL HOT PIPING SYSTEMS TO ALLOW ACTUATION AND/OR REMOVAL WITHOUT
2. PROVIDE PVC JACKET OVER ALL PIPE INSULATION THAT IS EXPOSED BELOW AN ELEVATION OF 8' ABOVE FINISHED FLOOR.
3. PROVIDE PVC JACKET OVER ALL PIPE INSULATION THAT IS EXPOSED ON THE EXTERIOR OF ANY BUILDING.
4. SEAL ALL SEAMS AND JOINTS IN THE INSULATION THROUGH THE FULL THICKNESS OF THE INSULATION

APPENDIX 8B.3---STRAINER SCHEDULE

STRAINER SCHEDULE							
SYSTEM CHECK VALVES	TYPE	SIZE	BODY MATERIAL	CAP DESIGN	MESH	PRESSURE RATING	REMARKS
DOMESTIC HOT AND COLD WATER	"Y" PATTERN	1/2" THRU 2"	CAST BRONZE	THREADED WITH BLOW DOWN VALVE		400 PSI	THREADED CERTIFIED LEAD FREE
DOMESTIC HOT AND COLD WATER	"Y" PATTERN	2-1/2" TO 6"	DUCTILE IRON	BOLTED WITH BLOW DOWN VALVE		200 PSI	FLANGED OR WAFER CERTIFIED LEAD FREE
CHILLED AND HOT WATER	"Y" PATTERN	1/2" THRU 2"	CAST BRONZE	THREADED WITH BLOW DOWN VALVE		400 PSI	THREADED
CHILLED AND HOT WATER	"Y" PATTERN	2-1/2" TO 6"	CAST IRON	BOLTED WITH BLOW DOWN VALVE		200 PSI	FLANGED
HIGH PRESSURE STEAM	"Y" PATTERN	1/2" TO 2"	CAST STEEL	THREADED WITH BLOW DOWN VALVE		300 PSIG	THREADED
HIGH PRESSURE STEAM	"Y" PATTERN	2-1/2" & ABOVE	CAST CARBON STEEL	BOLTED WITH BLOW DOWN VALVE		200 PSI	FLANGED
LOW PRESSURE STEAM	"Y" PATTERN	1/2" TO 2"	CAST IRON	THREADED WITH BLOW DOWN VALVE		250 PSIG	THREADED
LOW PRESSURE STEAM	"Y" PATTERN	2-1/2" & ABOVE	CAST CARBON STEEL	THREADED WITH BLOW DOWN VALVE		200 PSI	FLANGED
STEAM CONDENSATE RETURN	"Y" PATTERN	1/2" TO 2"	CAST IRON	THREADED WITH BLOW DOWN VALVE		400 PSIG	THREADED
STEAM CONDENSATE RETURN	"Y" PATTERN	2-1/2" & ABOVE	CAST IRON	THREADED WITH BLOW DOWN VALVE		200 PSI	FLANGED

APPENDIX 8B.4---VALVE SCHEDULES

BALANCE VALVE SCHEDULE									
SYSTEM STOP VALVE	TYPE	SIZE	BODY MATERIAL	BONNET/ PACKING GLAND DESIGN	DISC/BALL MATERIAL	STEM MATERIAL	PACKING MATERIAL AND SEATS	PRESSURE RATING	REMARKS
DOMESTIC WATER	GLOBE WITH TEST PORTS	1/2" TO 2"	BRASS	THREADED BONNET	BRASS	BRASS	EPDM O-RING	250 PSI NON-SHOCK CWP	PROVIDE THREADED OR SOLDERED ENDS AS REQUIRED BY PIPING SYSTEM CERTIFIED LEAD FREE,
DOMESTIC WATER	ANGLE PATTERN GLOBE VALVE WITH TEST PORTS	2-1/2" AND ABOVE	CAST IRON	BOLTED BONNET WITH GLASS AND CARBON FILLED TFE SEAT RINGS	BRASS WITH EPDM INSERT	STAINLESS STEEL	EPDM	175 PSIG	FLANGED CERTRIFIED LEAD FREE
HOT AND CHILLED WATER	CONTROL VALVE	ALL	PRESSURE INDEPENDENT CONTROL VALVES ARE REQUIRED ON ALL COILS. BALANCE VALVES ARE NOT REQUIRED.						

CHECK VALVE SCHEDULE							
SYSTEM CHECK VALVES	TYPE	SIZE	BODY MATERIAL	CAP DESIGN	DISC MATERIAL	PRESSURE RATING AT 350°F	REMARKS
DOMESTIC HOT AND COLD WATER	"Y" PATTERN SWING CHECK	1/2" THRU 2"	BRONZE, B-62 BRONZE	THREADED	BRONZE		THREADED OR SWEAT ENDS AS REQUIRED
DOMESTIC HOT AND COLD WATER	IN-LINE SPRING CHECK	2-1/2" TO 6"	CAST OR DUCTILE IRON	NA	NICKEL PLATED IRON		FLANGED OR WAFER CERTIFIED LEAD FREE
CHILLED AND HOT WATER	"Y" PATTERN SWING CHECK	1/2" THRU 2"	BRONZE, B-62 BRONZE	THREADED	BRONZE		THREADED OR SWEAT ENDS AS REQUIRED
CHILLED AND HOT WATER	IN LINE SPRING CHECK	2-1/2" TO 6"	CAST OR DUCTILE IRON	NA	NICKEL PLATED IRON		FLANGED OR WAFER
HIGH PRESSURE STEAM	IN-LINE SPRING CHECK	1/2" TO 2"	CAST STAINLESS STEEL	NA	STAINLESS STEEL	300 PSIG	THREADED ENDS STAINLESS STEEL SEAT
HIGH PRESSURE STEAM	"Y" PATTERN SWING CHECK	2-1/2" & ABOVE	CAST STEEL	BOLTED	CHROME, COBALT	200 PSI	FLANGED
LOW PRESSURE STEAM	IN LINE SPRING CHECK	1/2" TO 2"	CAST STAINLESS STEEL	NA	STAINLESS STEEL	300 PSIG	THREADED ENDS STAINLESS STEEL SEAT
LOW PRESSURE STEAM	IN-LINE SPRING CHECK	2-1/2" & ABOVE	CAST STEEL	BOLTED	CHROME, COBALT	200 PSI	FLANGED
STEAM CONDENSATE RETURN	IN-LINE SPRING CHECK	1/2" TO 2"	CAST STAINLESS STEEL	NA	STAINLESS STEEL	230 PSIG	THREADED ENDS FLOUORINE RESIN SEAT
STEAM CONDENSATE RETURN	IN LINE SPRING CHECK	2-1/2" & ABOVE	CAST STEEL	BOLTED	CHROME, COBALT	200 PSI	FLANGED

STOP VALVE SCHEDULE									
SYSTEM STOP VALVE	TYPE	SIZE	BODY MATERIAL	BONNET/ PACKING GLAND DESIGN	DISC/BALL MATERIAL	STEM MATERIAL	PACKING MATERIAL AND SEATS	PRESSURE RATING	REMARKS
DOMESTIC WATER	BALL, FULL PORT	1/2" TO 2"	BRONZE, 8-584 OR B-62 BRONZE	ADJUSTABLE WITHOUT REMOVAL OF HANDLE	STAINLESS STEEL	STAINLESS STEEL	REINFORCED TEFLON	600 PSI CWP	PROVIDE THREADED OR SOLDERED ENDS AS REQUIRED BY PIPING SYSTEM CERTIFIED LEAD FREE
DOMESTIC WATER	BUTTERFLY	2-1/2" AND ABOVE	DUCTILE IRON	STAINLESS STEEL SHAFT WITH ALUMINUM BRONZE DISC	ALUMINUM BRONZE	STAINLESS STEEL	EPDM	200 PSI WOG	PROVIDE FULL LUG BODY CERTRIFIED LEAD FREE
COMPRESSED AIR	BALL, FULL PORT	ALL	BRASS	ADJUSTABLE WITHOUT REMOVAL OF HANDLE	STAINLESS STEEL	STAINLESS STEEL	GLASS FILLED REINFORCED TEFLON	600 PSI CWP	PROVIDE THREADED OR SOLDERED ENDS AS REQUIRED BY PIPING SYSTEM
HOT AND CHILLED WATER	BALL, FULL PORT	1/2" TO 2"	BRONZE, 8-584 OR B-62 BRONZE	ADJUSTABLE WITHOUT REMOVAL OF HANDLE	STAINLESS STEEL	STAINLESS STEEL	REINFORCED TEFLON	600 PSI CWP	PROVIDE THREADED OR SOLDERED ENDS AS REQUIRED BY PIPING SYSTEM
HOT AND CHILLED WATER	BUTTERFLY	2-1/2" AND ABOVE	DUCTILE IRON	STAINLESS STEEL SHAFT WITH ALUMINUM BRONZE DISC	ALUMINUM BRONZE	STAINLESS STEEL	EPDM	200 PSI WOG	PROVIDE FULL LUG BODY
HIGH PRESSURE STEAM	BALL, FULL PORT	1/2" TO 2"	CARBON STEEL WITH SCREWED ENDS	BOLTED THREE PIECE DESIGN	STAINLESS STEEL	STAINLESS STEEL	PTFE AND GRAPHITE	400 PSIG AT 300 DEG. F.	PROVIDE THREADED ENDS
HIGH PRESSURE STEAM	OS&Y GATE	2-1/2" AND ABOVE	STEEL	BOLTED BONNET	STEEL WEDGE GROUND FACE	STEEL	FLEXIBLE SPLIT WEDGE	ANSI CLASS 150	PROVIDE FLANGED / RAISED FACE ENDS
LOW PRESSURE STEAM	BALL, FULL PORT	1/2" TO 2"	CARBON STEEL WITH SCREWED ENDS	BOLTED THREE PIECE DESIGN	STAINLESS STEEL	STAINLESS STEEL	PTFE AND GRAPHITE	400 PSIG AT 300 DEG. F.	PROVIDE THREADED ENDS
LOW PRESSURE STEAM	GATE	2-1/2" AND ABOVE	STEEL	BOLTED BONNET	STEEL WEDGE GROUND FACE	STEEL	FLEXIBLE SPLIT WEDGE	ANSI CLASS 150	PROVIDE FLANGED / RAISED FACE ENDS
STEAM CONDENSATE RETURN	BALL, FULL PORT	1/2" TO 2"	CARBON STEEL WITH SCREWED ENDS	BOLTED THREE PIECE BODY	STAINLESS STEEL	STAINLESS STEEL	PTFE AND GRAPHITE	400 PSIG AT 300 DEG. F.	PROVIDE THREADED ENDS
STEAM CONDENSATE RETURN	BALL, FULL PORT	2 1/2" AND ABOVE	STEEL	BOLTED BONNET	STEEL WEDGE GROUND FACE	STEEL	FLEXIBLE SPLIT WEDGE	ANSI CLASS 150	PROVIDE FLANGED / RAISED FACE ENDS
NATURAL GAS	BALL, FULL PORT	1/2" TO 2"	BRASS	ADJUSTABLE WITHOUT REMOVAL OF HANDLE	CP BRASS	BRASS	PTFE	175 PSI GAS	PROVIDE THREADED ENDS
NATURAL GAS	LUBRICATED PLUG	2 1/2" AND ABOVE	CAST IRON	BOLTED BONNET	STEEL WEDGE GROUND FACE	STEEL	REINFORCED TEFLON	ANSI CLASS 125	PROVIDE FLANGED / RAISED FACE ENDS

NOTES:
1. HANDLES ON ALL BALL VALVES SHALL BE PROVIDED WITH EXTENSIONS, WHERE REQUIRED, TO ALLOW FOR THICKNESS OF INSULATION AS LISTED IN THE INSULATION SCHEDULE.
2. GATE VALVES, LOCATED ON EXPOSED PIPING SYSTEMS, IN SIZES 2-1/2" AND ABOVE, THAT ARE MORE THAN 8' ABOVE THE FINISHED FLOOR SHALL BE PROVIDED WITH CHAIN OPERATORS.

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CHAPTER 9 – ELECTRIC SYSTEM

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CHAPTER 9---ELECTRICAL SYSTEMS

Section 9.0 Codes

9.0.1 Codes listed below are applicable to the following standards within this document. Designers and Contractors shall be responsible for adhering to all applicable codes adopted at time of project design and construction.

9.0.2 Codes as applicable to MEP are as follows:

2018 International Building Code (IBC)
2018 International Existing Building Code (IEBC)
2018 International Mechanical Code (IMC)
2018 International Plumbing Code (IPC)
2018 international Energy Conservation Code
2018 International Fire Code (IFC)

9.0.3 Fire Prevention

Kansas Fire Prevention Code
2017 NFPA 70, National Electric Code (NEC)
2017 NFPA 96, Ventilation Control and Fire Protection for Commercial Cooking Operations
2016 NFPA 110, Emergency and Standby Power Systems

9.0.4 Miscellaneous Codes

Current Edition, ASME A17.1 / CSA B44 Safety Code for Elevators and Escalators
2010 Edition K.S.A. 58-1301 et seq ADA Standards for Accessible Design

Section 9.1 General Requirements

9.1.1 When installing or changing equipment, the designer shall evaluate available fault currents and size the ampere interruption capacity accordingly.

9.1.2 Electrical Systems shall be designed to meet the NEC codes. The respective code edition shall be as identified in the “list of applicable codes”.

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9.1.3 Lamp Disposal

9.1.3.1 As of January 6, 2000 the Environmental Protection Agency (EPA) requires that all fluorescent, mercury vapor, and high intensity discharge (HID) lamps be disposed of properly (recycled). Lamps can no longer be disposed of as trash. The Department of Environmental Health & Safety will be responsible for accumulating and recycling all lamps on campus. For large quantities, arrangements can be made for delivery of lamps to the Hazardous Waste Facility on Kimball Ave. Pickups for smaller quantities will be made by EH&S.

9.1.3.2 Packing Tips: Lamps should be placed back into the original boxes, without the padding. Boxes of 4' fluorescent lights should be able to hold 30-36 bulbs without padding. If you have 6', 8', or U-bent bulbs treat them the same as the 4' bulbs. Please keep the boxes intact so they can be resealed. Do not wrap bare bulbs with tape. Please seal each box end with clear tape. If bulbs are broken please place them into a separate box.

Section 9.2 Distribution Systems

9.2.1 Duct bank systems (concrete encased)

9.2.1.1 It is preferred that all duct banks have a minimum of 3' of earth cover. Instances that do not allow this amount of cover must be approved in advance and in writing by the owner.

9.2.1.2 Duct shall be type DB PVC. In runs over 100', the designer shall evaluate the need for galvanized rigid steel elbows to prevent damage during cable installation.

9.2.1.3 All duct shall be installed in such a manner to prevent accumulation of water that may be subject to freezing.

9.2.1.4 Concrete shall have a minimum compressive strength of 4,000 psi. Concrete shall be died red using an approved concrete color additive.

9.2.1.4.1 Maximum aggregate size shall be ¾".

9.2.1.4.2 Premanufactured conduit spacers shall be provided with a maximum spacing of 5'shall be provided.

9.2.1.4.3 The encasement shall be reinforced with both longitudinal bars and stirrups. The sized of the reinforcing bars and stirrups and the spacing of the stirrups shall be as required by a State of Kansas licensed structural engineer; but not less than #4.

9.2.1.4.3.1 Longitudinal reinforcing bars shall be placed at each corner of the encasement and as such to maintain a maximum spacing of 6" on center around the complete perimeter of the encasement.

9.2.1.4.3.2 Minimum concrete cover over the reinforcing steel shall be 3".

9.2.1.4.4 Overall duct-bank dimension shall as required to achieve a minimum thickness of concrete over the outside of any conduit in the encasement of 6" on each side and on top and bottom.

9.2.1.4.5 The concrete shall be placed with the aid of a mechanical vibrator.

9.2.1.4.6 The sides of the concrete encasement shall be formed.

9.2.1.5 A warning tape that is a minimum of 6" wide shall be installed 18" above all duct banks.

9.2.1.6 Upon completion of the installation of the duct and prior to pulling any cable in the duct, a mandrel 1/2" smaller than the normal size of duct shall be pulled through the duct.

9.2.1.7 Duct bank penetrations into manholes shall continue completely through the wall of the manhole and shall use one larger hole rather than several small holes. If the above method is not practical, the concrete may stop outside the manhole but must be pinned to the manhole with steel pins to prevent differential settlement.

9.2.1.8 Duct bank penetrations of foundation wall shall comply with Section 2.5.2, Electrical Duct Banks.

9.2.1.9 All unused duct shall have a nylon or polypropylene pull string installed for future use.

9.2.1.9.1 The pull string shall be manufactured for the specific purpose with a minimum of 240 lbs. tensile strength and shall be rot and mildew resistant. Wire shall not be used.

9.2.2 Direct burial systems

9.2.2.1 All directly buried cable shall have a minimum of 45" of earth cover with a minimum of 3" of well graded clean washed gravel in sizes ¾" and smaller, placed both above, below and to the sides of the cable.

9.2.2.2 Two warning tapes, that are a minimum of 6" wide, shall be installed 18" and 36" above all directly buried cable.

9.2.2.3 Penetrations into manholes shall be run in Schedule 40 PVC conduit from the interior of the manhole to a point not less than 8' outside the manhole. A bell end shall be installed on each end of the conduit. The conduit shall be graded to drain any moisture away from the manhole.

9.2.2.4 Entrance into transformer pads shall be run in galvanized ridged steel conduit with long sweep 90 degree bends. The cable shall maintain the minimum 48" of depth, then turn up directly below the transformer pad. The conduit shall extend from the surface at the transformer pad to a point not less than 8' outside of the perimeter of the transformer pad. A grounding bushing shall be provided at the termination of the conduit within the pad mounted transformer.

9.2.3 Medium voltage (600 volts - 35,000 volts)

9.2.3.1 Conductors

9.2.3.1.1 Medium Voltage Conductors

9.2.3.1.1.1 Medium voltage conductors shall be UL listed compact copper with 220 mils no lead ethylene propylene rubber (NL-EPR) 133% insulation rated for 15 kV with 5 mil copper tape shield that is helically wrapped with a 25% overlap. An insulation shield consisting of strippable semi-conducting cross linked copolymer shall be provided. Conductor shield shall be semi-conducting cross-linked copolymer. An overall jacket of polyvinyl chloride shall be provided.

9.2.3.1.1.2 Medium voltage cable shall be suited for use in wet and dry areas conduits, ducts, troughs, trays, direct burial when installed with a grounding conductor in close proximity that conforms to NEC section 311.36 and d250.4(A)(5).

9.2.3.1.1.3 The Cable shall be capable of operating continuously at the conductor temperature not in excess of 105 deg. C. for normal operation, 140 deg. C. for emergency overload, and 250 deg. C. for short circuit conditions. The Cable shall be rated – 35 deg. C for cold bend.

9.2.3.1.1.4 The jacket shall have a coefficient of friction of 0.2 or less. The cable shall be able to be installed into a conduit without the aid of lubrication and shall be rated for 1000 lbs./FT. maximum sidewall pressure.

9.2.3.2 Equipment

9.2.3.2.1 Transformers

9.2.3.2.1.1 The designer shall evaluate the anticipated building harmonics to determine the K rating for each transformer installation. The K factor shall be determined as follows:

Transformer K-Factor (Harmonic rating): The transformers shall be designed to operate at full kVA rating while carrying harmonic current contents as defined by the indicated K-Factor. Harmonic current content shall be defined as odd harmonics (3rd through 15th order) which are all equal in their percentage of the fundamental (60 Hertz) frequency. K-Factor shall be defined as follows:

where hi = harmonic frequency, given as an integral multiple of the fundamental frequency and fhi = harmonic distortion, for the ith

harmonic, as percent of the unit fundamental frequency. Transformer nameplates shall be clearly marked with the transformer K-Factor rating.

9.2.3.2.1.2 Fusing of transformers shall coordinate with the owner's first upstream device.

9.2.3.2.1.3 In all transformer installations, especially retrofit or replacement, the secondary system fault current shall be analyzed.

9.2.3.2.2 Switch Gear

9.2.3.2.2.1 All pad-mounted switch gear shall be type PMU or System 2, as manufactured by S&C.

9.2.3.2.2.2 All switch gear and switch gear components must be rated for 25 KA (symm) available fault current and be tested to 25 KA (symm) by an independent testing agency.

9.2.3.2.2.3 All switch gear shall be above ground, pad mounted, type.

9.2.3.2.2.4 Circuit breakers shall be GE double high vacuum, rated to 1,000 MVA, and designed to be electrically, mechanically interchangeable with the owner's existing GE vacuum circuit breakers and work with the owner and SCADA System.

9.2.3.3 Execution

9.2.3.3.1 Cable Installation

9.2.3.3.1.1 All cable installations where the calculated pulling tension exceeds 67% of the manufacturer's recommended maximum tension shall be installed using tension measuring equipment. The owner's representative must be present to observe these installations. These cable runs shall be clearly marked on the plans.

9.2.3.3.1.2 All cable pulled through wet or damp conduit shall be sealed on the end to prevent any moisture from entering the insulation.

9.2.3.4 Testing

9.2.3.4.1 Medium Voltage Cables:

9.2.3.4.1.1 Medium Voltage Cable - Direct-current Voltage Test (D.C. HiPot): After installation and prior to being placed in service, all medium voltage cables shall be tested by use of a D.C. HiPot test.

9.2.3.4.1.1.1 Test voltages and procedures shall be in accordance with ICEA standard S-68-516/NEMA standard WC-8 (latest edition). Cable test data shall be recorded on the Medium Voltage Cable Test Data form included in the appendix of this section.

9.2.3.4.2 Transformers:

9.2.3.4.2.1 The following test shall be performed on each transformer prior to the unit being placed in service:

9.2.3.4.2.1.1 Insulation resistance tests (5000 volt MEGGER) shall be performed on high voltage and low voltage windings prior to

placing the transformer in service. This test must be approved by the transformer manufacturer prior to testing.

9.2.3.4.2.1.2 Transformer turns ratio testing shall be done on all transformers prior to energizing. Testing should be done by Contractor on the construction project and Facilities' Shops.

9.2.3.4.2.1.3 Each transformer shall be energized from the low voltage bushings, and voltages measured (phase to phase) across the high voltage bushings. All primary and secondary voltages shall be recorded and forwarded to the owner.

9.2.3.4.3 All testing shall be witnessed by the Owner's Representative.

Section 9.3 Secondary Circuits

9.3.1 General Requirements

9.3.1.1 Neutral conductors:

9.3.1.1.1 All neutral conductors shall be a minimum of full size. The designer shall evaluate the need for oversized, or doubled, neutral conductors.

9.3.1.2 Grounding:

9.3.1.2.1 The preferred method for grounding is through the use of a buried loop or, in new construction, the use of the concrete reinforcing steel. Use of the building steel for grounding shall not be allowed unless the steel was designed for this use or the grounding capability of the steel was tested and found adequate.

9.3.1.2.1.1 The requirements of NEC 250.53 "Grounding Electrode System Installation", which requires supplemental grounding electrodes as described in NEC 250.52, shall be followed.

9.3.1.3 Harmonics:

9.3.1.3.1 The designer shall evaluate anticipated building loads for potential harmonic design requirements.

9.3.1.4 Conductor Materials:

9.3.1.4.1 No aluminum conductors or busses shall be allowed. No "Stabiloy" (compact aluminum multi-conductor feeder cable with corrugated jacket) shall be allowed under any circumstances.

9.3.1.4.2 All conductors shall be copper, with THHN/THWN insulation. No exceptions shall be permitted.

9.3.1.5 Panelboards:

9.3.1.5.1 "Load Center" construction shall not be allowed.

9.3.1.5.2 The minimum level of quality is "Panelboard" or "Switchboard" construction.

9.3.1.5.3 Branch circuit panelboards shall be provided with "Bolt On" style circuit breakers.

9.3.1.6 Available Fault Currents:

9.3.1.6.1 When installing or changing equipment, the designer shall evaluate available fault currents and size the bracing capacity accordingly.

9.3.1.7 Conductor Color Coding:

9.3.1.7.1 Secondary service, feeder, and branch circuit conductors with factory applied color as follows:

Phase	208/120 Volts	480/277 Volts
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

9.3.1.7.2 Insulation on conductors in size #6 AWG and smaller shall be continuously colored. Conductors in sizes #4 AWG and larger shall be color coded using insulating electrical tape with a minimum of (4) wraps. When tape is used for color coding, the respective conductor shall be identified at each end, in each junction box and in all pull boxes.

9.3.2 Service Entrance

9.3.2.1 In new installations, it is preferred that only one disconnect be installed per service entrance. However, if multiple disconnects are installed, no more than 4 disconnects shall be installed, with space allowed for a total of 6 disconnects. Note that, when multiple disconnect switches are utilized, the disconnects shall be grouped in a common location.

9.3.2.2 At the points where conduit penetrates concrete that is in contact with soil, that conduit shall be Schedule 40 PVC conduit. This is to prevent the rusting away of metal conduit at the place where the conduit is in contact with concrete.

9.3.2.3 PVC conduit bends that are greater than 45 degrees shall be completely encased in concrete, which is required to prevent destroying the PVC bend during the wire installation.

9.3.3 Feeders

9.3.3.1 All feeders shall have a separate grounding conductor installed. In no case shall the conduit or raceway be used as the grounding conductor.

9.3.3.2 All conduit sizes and conductor numbers and sizes shall be shown on the drawings.

9.3.3.3 Feeder conduits shall be provided with a bonding bushing on the box connector at all switchboards and panelboards. The bonding bushing shall be electrically connected to the ground buss in the associated switchboard or panelboard using a grounding conductor equal in size to the grounding conductor in the feeder.

9.3.4 Panelboards

9.3.4.1 Panelboards shall be provided with copper buss bars.

9.3.4.2 Panelboards shall be provided with a hinged “door in door” cover design which allows the panel interior to be accessed without completely removing the panel cover.

9.3.4.3 All panelboards shall have separate grounding and neutral busses. All grounding and neutral wiring shall be terminated on the proper buss.

9.3.4.4 The preferred breaker is bolt-on type.

9.3.4.5 All panelboards shall be sized to allow a minimum of 20% of space for additional breakers, by count of breakers.

9.3.4.6 No piggyback breakers shall be allowed.

9.3.4.7 Breakers on all new or renovation projects will be re-labeled to actual room number before the contractor is out of the building and University takes over.

9.3.4.8 Directories, provided in each panelboard on all new or renovation projects, shall accurately identify all branch circuits. Identification shall include the room numbers within which the respective electrical devices, or lighting, is installed.

9.3.4.8.1 Panelboard directories shall be prepared using an electronic spreadsheet. A printed copy shall be installed on the inside of each panelboard door. An electronic copy of the spreadsheet shall be provided to the University as a part of the required closeout documentation.

9.3.4.9 A lighting level sufficient for maintenance activity at the panelboard shall be provided.

9.3.5 Branch Circuits

9.3.5.1 All wiring systems shall be installed using conduit.

9.3.5.1.1 Flexible wiring systems, including MC cable, shall not be used, except as follows:

9.3.5.1.1.1 Flexible wiring systems, including MC cable, may be used to connect a local junction box to a lighting luminaire. The flexible conduit, or MC cable, shall not exceed 6’ in length. A grounding conductor shall be provided in each flexible conduit or MC cable.

9.3.5.1.2 The minimum conduit size shall be 3/4", except as follows:

9.3.5.1.2.1 Conduit that is enclosed in a wall feeding a single receptacle from a junction box that is located in a accessible space or accessible plenum can be ½”.

9.3.5.1.2.2 Conduit that is enclosed in a wall feeding a single light switch from a junction box that is located in a accessible space or accessible plenum can be ½”.

9.3.5.2 A separate grounding conductor shall be installed in each branch circuit. Use of the conduit or raceway is not an acceptable grounding method.

9.3.5.3 All general-purpose power circuits shall be a minimum of 20 amps.

9.3.5.4 General purpose power circuits ~~s~~hall not have shared neutrals. Each single phase or three phase circuit shall be provided with a neutral conductor.

9.3.5.5 Conductors carrying more than 150v to ground shall not be installed in conduits with conductors carrying less than 150v to ground.

9.3.5.6 Conduit

9.3.5.6.1 Conduit shall be independently supported from the building structure. Attachment to other pipes, conduits, ductwork, etc. will not be allowed.

9.3.5.6.2 Non-metallic conduit or boxes shall not be used except in wet locations and when specifically allowed by KSU Facilities.

9.3.5.6.2.1 In cases where PVC conduit and boxes are allowed, conduit in sizes 2" and smaller shall be a minimum of Schedule 80 PVC.

9.3.5.6.3 All exposed conduit installed in a finished space shall be painted to match the background.

9.3.5.6 Plan Documentation

9.3.5.6.1 All lighting switching layouts shall be shown on the drawings.

9.3.5.6.2 All circuit numbers for each receptacle, with associated panelboard, shall be shown on the drawings.

9.3.5.6.3 Wire counts for all circuits shall be shown on the drawings.

Section 9.4 Wiring Devices

9.4.1 Receptacles and Switches

9.4.1.1 All receptacles and switches shall meet the requirements of ADA. The preferred mounting heights, above finished floor, are 48" for switches and 18" for receptacles.

9.4.1.2 All receptacles and switches shall have a minimum rating of 20 amps and shall be heavy duty specification grade.

9.4.1.2.1 The preferred color for receptacles and switches is ~~brown~~ gray with metal face plates.

9.4.1.3 In areas that are required to have ground fault interrupting capability, it is preferred that GFI receptacles be used rather than GFI breakers.

9.4.1.3.1 Each restroom must have at least one receptacle and it must be a GFI receptacle.

9.4.1.3.1.1 The receptacle shall be mounted above the lavatory.

9.4.1.4 Cover-plates in finished spaces shall be brushed stainless steel, unless specifically allowed by KSU facilities. Galvanized steel cover-plates may be used in mechanical spaces.

Section 9.5 Safety Switches and Fuses

9.5.1 Safety Switches

9.5.1.1 All safety switches shall be heavy-duty grade, within reach of devices and controls.

9.5.1.2 All safety switches shall have a durable label permanently attached to the ~~inside~~ outside of the cover that describes the fuse size, type, current-limiting ability and devices controlled.

9.5.1.3 Fuse holders in all safety switches intended for use on circuits where current-limiting fuses are required shall be specified with rejection clips designed to permit only the installation of Class R fuses ~~only~~.

9.5.1.4 A ground bus shall be provided in every safety switch.

9.5.1.5 Safety switches shall be provided with a method of opening the cover without shutting power off at the switch.

9.5.1.6 Safety switches in mechanical rooms shall have NEMA 3R enclosures unless the environment or usage requires a different, more protective, enclosure.

9.5.2 Fuses

9.5.2.1 All fuses shall be time delay, current limiting, type. RK-1, or fast-acting fuses, shall be used for providing maximum protection against short circuits and ground faults. RK-5 fuses shall be utilized for motor loads in order to provide some tolerance for inrush and starting currents.

9.5.2.1.1 Where “R” class fuses are utilized, rejection clips shall be provided in the fuse holders.

9.5.2.2 Renewable fuses shall not be used.

9.5.2.3 Each project shall supply one set of three spare fuses for each type and size fuse installed.

9.5.2.3.1 Where fuses are provided on a project, a box for storage of the spare fuses shall be provided. The box shall be of metal construction designed to store fuses and mounted in a highly visible, Facilities' controlled, location and labeled appropriately. The location shall be determined by KSU Facilities.

Section 9.6 Motors

9.6.1 All motors shall meet ASHRAE 90.1 and EMO Energy Conservation Policy #060 (Appendix 2) and shall have a minimum service factor of 1.15.

9.6.2 Motors with an electrical characteristic of 480 v 3 phase shall be used whenever possible.

9.6.2.1 Where 480-volt power distribution is not available, motors shall be configured for 208 volt 3 phase or 240-volt 3 phase electrical distribution systems as appropriate depending on the electrical characteristics in the building into which the motor is to be provided.

9.6.3 Motors shall not be designed to operate into the service factor.

9.6.3.1 Soft starting of motors shall be utilized whenever appropriate.

Section 9.7 Communications and Alarm Systems

9.7.1 Telephone and Data Systems

9.7.1.1 General Guidelines

9.7.1.1.1 In wall back boxes and any required conduit, with pull strings shall be indicated in all design / construction documents.

9.7.1.1.2 KSU Telecommunications will install all wiring and termination devices.

9.7.1.1.2.1 If a specific project includes the installation of any wiring, to be completed as a part of the contract, the full cable specification shall be obtained from KSU Telecommunications.

9.7.1.1.3 A minimum of one voice and one data cable shall be installed for every 100 sf. of office area.

9.7.1.1.4 The design of all communications systems shall be coordinated with KSU Telecommunications and Facilities Planning.

9.7.1.1.5 Service entrance conduit requirements:

9.7.1.1.5.1 (2) 4-inch conduits per 200,000 square feet of usable office space. One spare conduit for each 2 conduits to be used. No more than 2 - 90°

bends between pulling points. All ends of metallic conduit must be reamed and brushed. All conduits shall have a pull string installed. Metal sleeves through foundation walls must extend a minimum 20' beyond the wall.

9.7.1.2 Telecommunications Closets

9.7.1.2.1 All telecommunications closets should be considered as potential locations for ancillary electrical equipment as well as the basic termination of Cable/Wire/Fiber. As such, the following are EIA basic standards for such spaces:

9.7.1.2.1.1 Minimum size requirements – 5’ by 6’ with door opening out or 5’ by 8’ with door opening into the room. Minimum ceiling height shall be 8’-0”. Minimum entry door measurement shall be 3’ wide by 6’-8" high. The door measurements do not include a door sill or center post.

9.7.1.2.1.2 Floors of telecommunications closets shall be finished with vinyl tile or sealed concrete.

9.7.1.2.1.3 Each closet must have a minimum of two 120V AC duplex outlets. Each outlet must be a 20-amp rated NEMA 5-20R grounding receptacle fed from a dedicated non-switched, 20-amp 1 phase circuit that is protected by a 20-amp circuit breaker or a 20-amp fuse.

9.7.1.2.1.4 Each closet shall be provided with lighting providing an even level of illumination equal to or greater than 60 footcandles at a point 4’ above the floor.

9.7.1.2.1.5 When closets are stacked in a multi-story building a minimum of (2) 4 inch cores, each equipped with a fire rated cable penetration sleeve extending a minimum of 1 inch above the finished floor, shall be provided between closets. Two additional 4" cores each with sleeve shall be provided for each additional 10,000 square feet per floor.

9.7.1.2.1.6 Telecommunication closets shall be provided with individual HVAC equipment capable of maintaining the room at a temperature between 65 deg. F. and 95 deg F. and relative humidity of between 20% and 60%. The equipment anticipated to be installed within the closet shall be analyzed and the HVAC equipment sized accordingly.

9.7.1.2.2 A minimum of one telecommunications closet shall be located on each floor of a building**.** Distance limitations or other considerations may require more than one closet on each floor of a building. Closets should be located as close to the core of the structure as possible and should be stacked one above the other in multiple floor buildings. One closet should be allocated for every 10,000 sq. ft. Average cable runs should be 150 horizontal feet with no single cable run exceeding 295 feet.

9.7.1.3 Telecommunications Interior Pathways

9.7.1.3.1 Pathways must support cables and provide protection. Pathways should be planned to facilitate the original installation of voice/data cabling as well as ongoing maintenance, additions, and relocations.

9.7.1.3.1.1 Where possible, cable trays or conduit for horizontal distribution shall be installed in corridors.

9.7.1.3.1.2 In renovations of existing facilities, existing conduits or other pathways may be used, provided they meet the current requirements of interior pathways.

9.7.1.3.2 Sections of conduit shall be no longer than 100' and shall not have more than 2 bends between pull points or pull boxes with individual bends not to exceed 90°. Inside bending radius must be at least six (6) times the inside conduit diameter for conduit 2" or less and at least 10 times the conduit diameter for conduit greater than 2". Pull boxes should be placed directly after a bend or sized accordingly if the pull box is located at the bend.

9.7.1.3.3 The types of cable specified, or planned, shall be approved by KSU Telecommunications. Minimum conduit bending radius shall conform to type of cable used.

9.7.1.3.4 The conduit shall be sized to avoid exceeding 40% fill, or the following cable fill maximums, whichever is less**:**

3" conduit - 50 cables maximum
2" conduit - 22 maximum
1" conduit - 7 cables maximum
3/4" conduit - 4 cables maximum

9.7.1.3.5 Telecommunications terminal back boxes shall be standard electrical boxes; 2" x 4" x 2" mounted flush with the wall surface in new construction. In existing buildings, the terminal back boxes may be surface-mounted. Surface-mounted boxes shall be single gang deep switch and receptacle boxes, 4 5/8" x 2 7/8" x 2 1/4"; “Wiremold” 5744S or approved equal.

9.7.2 Fire Alarm Systems

9.7.2.1 All new buildings and major renovations shall include a central, addressable fire alarm system that communicates with the Campus Safety and Security Office and is ADA compliant.

9.7.2.1.1 Fire alarm systems shall provide for both voice notification and mass notification.

9.7.2.1.2 The fire alarm system shall be designed by a fire protection engineer, licensed in the state of Kansas.All design and construction documents shall be sealed by the design professional, who is responsible for the design of the system.

9.7.2.1.3 If a security system is available in the building where a new fire alarm panel is being installed, the fire alarm panel shall be connected to the security system to allow reporting of a fire alarm to the Campus Police through the security system. All fire alarm panels shall be capable of reporting through the security system or other external system.

9.7.2.1.4 If an Energy Management Controls System (EMS) is available in the building where a new fire alarm panel is being installed, the fire alarm panel shall be connected to the EMS.

9.7.2.1.5 Wiring

9.7.2.1.5.1 Fire alarm cabling shall be installed in conduit.

9.7.2.1.5.1.1 Conduit used for fire alarm systems shall be red.

9.7.2.1.5.2 All wiring for fire alarm systems shall be either Type FPLM, plenum rated cable or an acceptable cabling in conduit.

9.7.2.2 Drawings for fire alarm systems shall show all initiation and notification device locations, and all panel and annunciator locations.

9.7.2.2.1 Design documents shall indicate all wiring both in plan view and in a system riser diagram. The documents shall include all voltage drop calculations and battery capacity requirements. Connection details for all devices shall be included in the fire alarm system drawings.

9.7.2.2.2 Fire alarm upgrades, if for only a portion of an existing building, must be designed to provide a complete and fully functional fire alarm system for the entire building at a future date without requiring upgrades to the central fire alarm panel.

9.7.2.2.3 When fire alarm systems are installed in buildings with elevators, provisions shall be included for alternate floor controls.

9.7.2.3 Fire Alarm Panels

9.7.2.3.1 All new fire alarm panels must be expandable.

9.7.2.3.2 All fire alarm panels shall be equipped with a “walk test” feature, which allows each activating device to be tested without the need to reset the panel after each device is activated.

9.7.2.3.3 All fire alarm panels shall be equipped with a “building evacuate” switch.

9.7.2.3.4 All fire alarm panels shall be located at the main entrance of the building or shall have a remote annunciator located at the main entrance.

9.7.2.4 Fire Alarm Initiation, Notification Appliances and Door Holders

9.7.2.4.1 Pull stations

9.7.2.4.1.1 Pull stations shall be located at all building and floor entrances.

9.7.2.4.1.1 All pull stations shall be key operated, keyed the same as the building fire alarm panel. All keying shall be coordinated with the KSU Public Safety.

9.7.2.4.2 Smoke Detectors

9.7.2.4.2.1 All smoke detectors or other activating devices shall be installed in locations that are readily accessible for maintenance.

9.7.2.4.2.2 Beam detectors shall be used in atriums or other high ceiling areas.

9.7.2.4.2.3 Ionization type smoke detectors shall not be installed in mechanical rooms.

9.7.2.4.3 Door Holders

9.7.2.4.3.1 Door holders shall be wall-mounted, magnetic type with proper mounting blocking in the wall.

9.7.2.4.3.2 Combination door closer/hold-opens shall not be used.

9.7.2.5 Acceptable Manufacturers

9.7.2.5.1 Simplex is the preferred system to match current University systems.

~~9.7.2.5.2 Faraday, Honeywell, Notifier, FCI, and Powertronics are also acceptable, provided a complete interface with existing University fire alarm systems is achieved.~~

9.7.2.5.2 Honeywell and CSC are acceptable, provided a complete interface with existing University fire alarm systems is achieved.

9.7.2.5.3 The vendor for fire alarms systems must show the ability to respond to requests for service within 24 hours and the ability to supply replacement parts for the system within 48 hours.

9.7.3 Security Systems

9.7.3.1 The Kansas State University Police Department, in coordination with project management, shall conduct a formal security review for all building installations, remodels, and new construction involving access control and camera systems. Architecture and Engineering consultants are responsible for obtaining this review and incorporating all specified University-approved devices, pathways, and infrastructure into the design. These requirements must be clearly documented and included in the construction bid documents.

9.7.3.2 Standardized equipment shall be used across campus to ensure consistency, reliability, and ease of maintenance:

- Cameras: Verkada
- Access Controls: Gallagher

9.7.3.3 Installation of all camera and access control systems shall be performed by the designated Kansas State University vendor. The selected vendor is responsible for ensuring proper integration with existing campus infrastructure, compliance with University Police specifications, and coordination with IT Services for secure network deployment. The vendor's scope shall include device installation, system configuration, testing, and documentation of all installed components.

Section 9.8 Lighting Systems

9.8.1 General Guidelines

9.8.1.1 International Energy Conservation Code (IECC) and ASHRAE Standard 90.1 conformance.

9.8.1.1.1 The IECC and ASHRAE Standard 90.1 shall be adhered to in the design of all lighting and lighting control system designs. This includes lighting levels, automatic shutoff and light reduction controls and daylight-responsive controls. Dictated maximum lighting power density requirements shall be adhered to.

9.8.1.1.1.1 Occupancy sensors shall be provided. Where possible, utilize the occupancy sensor as a vacancy sensor requiring lighting to be manually turned on and then automatically turned off after a pre-determined time period, during which occupancy is not detected. Occupancy sensors shall be dual technology consisting of infrared and ultrasonic technology.

9.8.1.1.1.1.1 When the HVAC system is variable air volume, or when it consists of zoned equipment, a contact closure from the occupancy sensor that provides a binary input to the automatic temperature control system or unitary equipment controller shall be provided.

9.8.1.1.1.2 Time switches shall be utilized for display or plant growth lighting to limit the time that this lighting is energized to only that required.

9.8.1.1.1.3 Daylight-responsive controls shall be provided where the space design allows.

9.8.1.1.1.4 Lighting controls shall provide zoning so as to facilitate presentation in classroom, lecture halls, seminar rooms and any other similar spaces. Lighting systems shall be provided with dimming controls in these spaces.

9.8.1.1.1.5 Exterior lighting controls shall provide both ambient and time of day control so as to allow for illumination only during certain time periods when ambient light levels are below a predetermined minimum.

9.8.1.2 Lamps and lighting luminaires

9.8.1.2.1 Light-emitting diode (LED) technology shall be utilized for all lighting systems unless specific requirements require an alternative light source. Alternative lighting sources shall be approved by KSU Facilities, during the design of a lighting system.

9.8.1.2.2 Lighting fixtures (luminaires) shall be provided with 1-10 volt dimming drivers capable of a minimum lighting level of 10%. Where specific requirements dictate, as approved by KSU Facilities during design, dimming to 1% shall be provided.

9.8.1.2.3 Lighting fixtures (luminaires) shall be provided a color rendering index (CRI) of 80. Where specific requirements dictate, as approved by KSU Facilities during design, CRI of 90 shall be provided.

9.8.1.2.4 Lamps in lighting fixtures (luminaires) shall be provided with a minimum color temperature of 4000 deg. K. Where specific requirements dictate, and as approved by KSU Facilities during design, lamps with a warmer color temperature (lower than 4000 deg. K.) may be provided.

9.8.1.2.5 Lighting fixtures (luminaires), where recessed into an acoustic grid ceiling, shall be nominal 2’ x 4’. The use of nominal 2’x 2’ luminaires is discouraged.

KANSAS STATE UNIVERSITY
MEDIUM VOLTAGE CABLE TEST DATA

Project Title and Location_____
Project #_____

Circuit Designation_____
Date_____

Name of Person Performing Test_____
Name of Contractor_____

DC TEST DATA			
TIME*	CURRENT		
	PHASE A	PHASE B	PHASE C
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Test**:** _____

Equipment**:**
Manufacturer_____
Model_____

Conditions**:**
DC Test
Voltage_____
Temperature_____
Humidity_____

Cable Data:
Installation: New_____ Used_____
Size _____ Length _____(feet)
Rated Voltage_____
Manufacturer_____
Insulation wall_____
(type and thickness)
Conductor jacket wall_____
(type and thickness)
Shield type_____
Type terminations_____
Type & location of splices_____

COMMENTS:

APPLICATION OF TEST VOLTAGE

The initially applied direct-current voltage shall not be greater than 3.0 times the rated alternating-current voltage. The rate of increase from the initially applied voltage to the specified test voltage shall be uniform and shall not be over 100% in 10 seconds nor less than 100% in 60 seconds. The duration of the direct-current voltage test shall be 15 minutes for shielded cables and 5 minutes for nonshielded cables. Test voltage for newly installed 15 KV cable with 220 MIL (133%) insulation shall be 65 KVDC in accordance with ICEA/NEMA standards.

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CHAPTER 10 – SITE WORK

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CHAPTER 10—SITE WORK

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CHAPTER 10---SITE WORK

Section 10.1 Landscaping

10.1.1 The designer is referred to the guide specification for landscaping located in Appendix 1. It is noted that this specification is only a guide and must be edited before inclusion in a project specification.

10.1.2 All site access shall be clearly shown on project drawings.

10.1.3 All construction fencing shall be shown on the project drawings, including fencing for protection of trees.

Section 10.2 Parking Lots

10.2.1 All parking lots shall comply with ADA requirements.

10.2.2 The maximum desired slope is 4%. Slopes greater than 4% must be approved by the owner.

10.2.3 All parking spaces for disabled access shall be “universal spaces.”

10.2.4 Paint colors shall be white for general lot stripping, yellow for no parking areas, and blue for disabled access spaces and areas.

10.2.5 Parking spaces shall typically be 9' in width. No compact car spaces shall be permitted.

10.2.6 Asphalt surfaced lots shall have a minimum cross section of 3" of asphalt surface, 6" of crushed stone Type 1 aggregate for base, and an underlayment of geotextile fabric.

10.2.7 Concrete surfaced lots shall have a minimum cross section for 6" of concrete and 6" of Type 1 aggregate for base. The concrete shall be Portland cement concrete with a heavy broom finish. All reinforcement shall be epoxy coated. All joints shall be shown on the plans and shall be sealed with traffic grade caulking.

10.2.8 At locations where a parking lot is adjacent to lawn areas, a mowing strip is a strip of pavement, 18"-24" in width, on the lawn side of the curb or parking bumpers that allows the lawn to be mowed while the parking spaces are occupied.

Section 10.3 Sidewalks and Ramps

10.3.1 Sidewalks shall be designed with positive drainage away from walks. Drainage of surface water shall not cross sidewalks.

10.3.2 Sidewalks and ramps shall be designed to prevent water entering a building. Overflow areas shall be provided if necessary.

10.3.3 All sidewalks shall have a minimum width of 5' and a minimum thickness of 6". Where a sidewalk is adjacent to a road or driveway, the minimum width is 9'. Walks adjacent to roads or driveways should have a grass strip between the sidewalk and the road or driveway, if space allows.

10.3.4 Lateral slope for sidewalks shall be no less than 1% and no more than 2%.

10.3.5 Curb cuts for disabled access shall use the KSU standard detail. The detectable warning area shall be a contrasting color with a warning texture.

10.3.6 Materials

10.3.6.1 The preferred material for sidewalks, ramps and other paved, exterior walking surfaces is concrete. No material shall be used for a walking surface that may become slippery when wet.

10.3.6.2 Concrete:

Minimum strength	4000 psi
Flint & Chert	1% maximum, by weight, of the coarse aggregate
Lignite	0.07% maximum, by weight, of fine aggregate
Air	6% (+/- 1%)
Reinforcing	Epoxy coated steel, minimum 6" x 6" # 1.4 x 1.4 welded wire fabric

10.3.6.2.1 Base for concrete shall be a minimum of 4" of Type 1 aggregate for base.

10.3.6.2.2 Joints

10.3.6.2.2.1 All joints shall be shown on the plans

10.3.6.2.2.2 Joints may be either tooled or sawn. If the joints are sawn, they shall be sawn within 12 hours of the placement of the concrete.

10.3.6.2.2.3 Joints shall be a minimum of 2" deep or 25% of the slab thickness, whichever is greater.

10.3.6.2.2.4 All joints shall be sealed with traffic grade, non-asphalt, non-extruding gray polyurethane sealant.

10.3.6.2.2.5 Construct control, construction and expansion joints true to line with faces perpendicular to surface plane of concrete. Construct traverse joints at right angles to the centerline, unless indicated otherwise. Existing paving – traverse joints to align with previously placed joints.

10.3.6.2.3 A medium broom finish shall be applied perpendicular to the traffic flow. ll brooming directions shall be shown on the drawings and described in the specifications.

10.3.6.2.4 Use of calcium chloride shall not be permitted.

10.3.6.2.5 Testing

10.3.6.2.5.1 The concrete shall be tested for strength, air entrainment, temperature, and slump. The specifications shall indicate allowable limits for each.

10.3.6.2.5.2 The University will retain the services of a testing firm. The contractor shall be responsible for scheduling the tests. The contractor shall be required

to notify the owner's representative a minimum of 48 hours prior to all placement of concrete.

10.3.6.2.5.3 Concrete shall be tested at the minimum rate of one test for each additional 50 CY placed. The concrete may be tested more often at the discretion of the owner's representative.

10.3.6.2.5.4 The specifications shall make clear to the contractor the responsibility to comply with the specifications.

10.3.6.2.6 Aggregates

10.3.6.2.6.1 Normal-Weight Aggregates: Concrete aggregates shall conform to the "Standard Specifications for Concrete Aggregates" (ASTM Designation: C33) and to Section 1102 of Standard Specifications for State Road and Bridge Construction Kansas Department of Transportation, Current Edition.

10.3.6.2.6.2 Coarse Aggregate shall be clean crushed stone or coarse gravel of the following quality:

Soundness, minimum……..0.90
Wear, maximum……..50%

10.3.6.2.6.2.1 Gradation for coarse aggregate shall conform to the following gradations:

Sieve Size	Percent Retained
1 inch	0
¾ inch	0-5
3/8 inch	40–60
No. 8 (0.097 inch)	95-100

10.3.6.2.6.3 Fine Aggregate shall consist of natural sand resulting from disintegration of siliceous and/or calcareous rack and shall conform to the following gradations:

Sieve Size	Percent Retained
No. 4 (0.185 inch)	0
No. 8 (0.097 inch)	0-24
No. 16 (0.049 inch)	15-50
No. 30 (0.0232 inch)	40-70
No. 50 (0.0117 inch)	70-90
No. 100 (0.0059 inch)	90-98

10.3.6.3 Paving brick

10.3.6.3.1 Brick used as paving shall not be set in a sand base if there will be any vehicle traffic on the paving. If the brick paving will be used in areas for vehicular traffic a concrete base shall be designed to carry the traffic loads required.

10.3.7 Guardrails and Handrails

10.3.7.1 This standard shall apply to all exterior guardrails and handrails that are not a significant part of a building's architecture.

10.3.7.2 All railings shall comply with the latest version of the ADAAG.

10.3.7.3 Materials

10.3.7.3.1 All guardrails and handrails shall be primarily constructed of steel pipe (or square tubing). The infill for guardrails shall be constructed of vertical balusters only. No panels shall be used for the infill.

10.3.7.3.2 Prior to installation, the bottom 18" of the railing uprights imbedded in concrete shall be dip galvanized. Any repairs or alterations shall receive a galvanizing coating prior to being painted.

10.3.7.4 All railings shall be of welded construction.

10.3.7.5 All railings shall be painted gray with a high gloss enamel paint to match the campus standard.

10.3.7.6 Installation

10.3.7.6.1 The preferred method of installation is to imbed a galvanized pipe sleeve in the concrete of the ramp, sidewalk, etc., that has an inside diameter 1" greater than the outside diameter of the railing post. This space is filled with a non-shrinking grout to secure the post in place. The grout shall fill the space completely and shall be mounded or raised adjacent to the post to drain water away from the post. No welding shall be allowed at this connection.

10.3.7.6.2 If necessary, the posts may be secured to the sidewall of the ramp, steps, etc. If this attachment is used, the design shall prevent trapping water.

Section 10.4 Storm Drainage

10.4.1 The return period to be used for the design of areas such as pedestrian malls, streets, and quadrangles shall be 25 years with a 15-minute duration.

10.4.2 The return period for areas such as parking lots, park space, and similar areas shall be 10 years with a duration of 15 minutes. Time of concentration to the utmost inlet shall be 15 minutes. If the “open” areas under consideration is indicated as a future development areas on campus master plan documents, then longer return period shall be used as directed by the owner.

10.4.3 For areas not clearly defined as stated above, the owner shall recommend the design storm. No ponding above the surface of the inlet shall be allowed based on the design storm, except in no-paved areas and only as approved by the owner.

10.4.4 The designer shall compare the above return periods with those required by the City of Manhattan. Any discrepancies shall be discussed with KSU Facilities Planning.

10.4.5 Surface detention areas should be incorporated into site designs. No detention areas will be located on paved areas unless they have received prior approval by KSU Facilities Planning.

10.4.6 The consultant, with the approval of the owner, will select an appropriate back water elevation to be used during the design of the project.

10.4.7 For buildings and other structures as directed by the owner, the site plan shall be developed such that no entry of water shall occur during a 100-year storm.

10.4.8 Site plans shall be designed by, or in collaboration with, a Civil Engineer registered in Kansas.

10.4.9 Particular attention shall be paid to bicycle and wheelchair safety in the design of storm drainage systems. Grate bars shall be placed perpendicular to the direction of traffic flow.

10.4.10 Pipe systems for storm drainage is discussed in Section 08, Mechanical Systems.

Section 10.5 Site Furnishings

10.5.1 Standards

10.5.1.1 Waste Receptacles – Victor Stanley #SC-4 LFI CC 5001 – 24 – 41 Redwood with metal sand pan (25 ½ " x 25 ½ ") – 1-800-521-2546. Receptacle should be placed 1 foot away from walk to prevent damage from snow removal equipment. Pad should be adequately sloped so as to allow for proper drainage. Pad should be concrete 3500 psi in 28 days, broom finished surface parallel to existing walk. Opening of receptacle should face direction as specified by designer.

10.5.1.2 Bench – Landscape Forms Inc. #106 S Bench 6’ or 8’ Bench LFI Forum FR 3005-BS-72 Redwood, PS Support. Post stand of bench should be welded to 8" square metal plate with 4 mounting holes, and mounted to concrete pavement with anchor bolts. Bench is to be level as possible.

10.5.1.3 Campus Light – Sterner #GS 24 RIAN 250H 208N; 24" Acrylic globe or equal / Sterner # RTS02HADN; 12’ Pole.

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CHAPTER 11 – APPENDICES

APPENDIX 1 – LANDSCAPE PLANTING

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CHAPTER 11—APPENDICES

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CHAPTER 11---APPENDICES

Appendix 1 Landscape Planting

Section 1.1 General

1.1.1 Provisions of the General Requirements, Division 1, are a part of this Division and Section.

Section 1.2 Scope of Work

1.2.1 The work to be done on this contract shall consist of furnishing all materials, labor, and equipment to execute all work for landscape planting and landscape irrigation installation in accordance with these specifications and plans. Work is to include: protection of existing trees and shrubs; finish grading, changes to existing irrigation system; installation of new irrigation, turf grass planting (seeding and/or sodding), planting of all trees, shrubs, perennials, bulbs, and groundcovers; pruning and/or removal of existing trees, shrubs, weeds, and/or stumps; maintenance of turf until acceptance date; and maintenance of all new tree, shrub, ground cover, bulb, and perennial (including ornamental grass) planting beds for one year after Partial Occupancy. (This varies from project to project.)

Section 1.3 Materials

1.3.1 Topsoil

1.3.1.1 Topsoil – a natural or cultivated surface - shall be a soil layer containing organic matter and sand, silt, and clay particles. It shall be friable, pervious, and a darker shade of brown than underlying subsoil. It shall also be reasonably free of subsoil, clay lumps, grass, weeds, brush, roots, stumps, toxic substances, litter, gravel, stones or other materials greater than 1-½" in diameter, and other deleterious material. Topsoil shall not contain plant parts of Nutsedge, Johnson Grass, Nimblewill, Bermuda Grass, Bindweed or other noxious weeds. Topsoil shall not be delivered in a muddy or frozen condition.

1.3.1.2 Soil pH should be 5.5 min., 7.0 max

1.3.2 Soil Amendments

1.3.2.1 Peat Moss – Shall be pulverized type of sphagnum peat with a pH of 3-4, and shall be 1-5% ash, 0.6 – 1.4% N.

1.3.2.2 Iron Sulfate – High Yield, 11% sulfur, 19% iron, trade name: “Copperas” produced by Fertilome.

1.3.2.3 Elemental Sulfur – 90% sulfur, disintegrating pellets, produced by Fertilome.

1.3.3 Mulch

1.3.3.1 Mulch for tree beds and tree/shrub beds shall be hardwood mulch an average of approximately 1 ½" in length, mixed in size. Mulch for ground cover beds shall be premium hardwood mulch, double ground, approximately 1" long, mixed in size. Mulch shall be fresh, clean, and free from soil, rocks, diseased material and foreign organic and non-organic matter. Samples are to be brought to the Owner for approval prior to installation.

1.3.3.2 The excelsior blanket shall consist of a machine-produced mat of curled wood excelsior of 80% six-inch or longer fiber length, with consistent thickness and the fiber evenly distributed over the entire area of the blanket. The top side of each blanket shall be covered with photodegradable extruded plastic mesh.

1.3.3.3 For turf, blown mulch shall consist of fresh, clean, and 95% weed-free prairie hay or wheat straw.

1.3.3.4 Heavy jute mesh shall be Soil Saver Type #48 with one-inch openings weighing approximately one pound per square yard or approved equal. Staples used to secure mesh shall be #11-gauge wire six inches long with a one-inch space between teeth.

1.3.4 Fertilizer

1.3.4.1 The grass starter fertilizer shall be a 10-18-22 Par Ex slow release type with a minimum of 2.7% water insoluble nitrogen (WIN) from IBDU and a minimum .6% iron. The second grass fertilizer applied shall be a 28-3-8 Par Ex slow-release type with a minimum of 8.1% WIN from IBDU, 2.5% iron, .5% magnesium, .2% manganese, and .2% zinc.

1.3.4.2 The tree, shrub, and ground cover fertilizer shall be a 14-12-14 Woodace Nursery slow release type with a minimum of 3.2% WIN from IBDU and 8.35% coated nitrogen (sulfur-coated).

1.3.4.3 Additional fertilizer for pH modified soil shall be Green Garde slow-release micronized iron.

1.3.4.4 The Contractor shall submit sample labels for approval to the Owner prior to application.

1.3.4.5 The Contractor shall notify the Owner of application time at least 24 hours in advance.

1.3.5 Plant Materials

1.3.5.1 General – All plant material shall conform to the species and cultivars specified in the plant list. No substitutions will be allowed, except where the Contractor has made written application stating the change they desire to make, any alteration in price from this change, if the completion of the project would be materially delayed by unavailability of specified material, and has obtained the written approval of the Owner. All plants in a particular planting bed or planting group shall be of the same size and form. All plants shall conform to the American Standard for Nursery Stock, ANSI Z60.1, as published by the American Association of Nurserymen.

1.3.5.2 Where plants are specified according to height or spread, the height or spread shall take precedence over the container size. No container shall be smaller than specified.

1.3.5.3 If plants of greater caliper or size are selected by the Contractor for any plants herein specified, the diameter of the ball increases proportionately.

1.3.5.4 Plants shall be sound, healthy, vigorous, free from plant diseases, insect pests or their eggs and shall have balanced, healthy, normal root systems. Plants

shall be nursery grown stock in a climate compatible with Manhattan, Kansas. Collected stock shall not be accepted.

1.3.5.5 Plants shall not be pruned prior to delivery except as authorized by the Owner. Prune only branches that are damaged, rubbing on other branches, or as directed by the Owner, retaining the natural shape of the plant. In no case shall the central leader of a deciduous or coniferous tree be cut unless specifically directed by the Owner.

1.3.5.6 All plants shall have been transplanted or root pruned at least once in the past three years. All trees shall be at least twice transplanted or root pruned and be from properly spaced blocks in the nursery. Inspection for the required root system will be made upon delivery of the plants to the site. The Contractor shall notify the Owner at least 24 hours in advance of the plant delivery time. No plant material shall be installed prior to inspection by the Owner.

1.3.5.7 Balled and burlapped plants shall be dug with firm natural balls of earth of a diameter not less than specified in the American Standard for Nursery Stock for the respective size and kind of plant material. Plants with balls cracked and broken before or during planting will not be accepted.

1.3.5.8 Balls shall be securely wrapped with burlap and tightly bound with rope or wire.

1.3.5.9 Container grown plants shall have been grown in pots or cans for a minimum of 6 months and a maximum of 2 years and shall have sufficient roots to hold the plant earth ball together when removed from the container.

1.3.5.10 Plant material shall be symmetrical, typical for the variety and species, and shall conform to the measurements specified in the plant list.

1.3.5.11 Plants used where symmetry is required shall be matched as nearly as possible. These situations include hedges, plant massing, and specimen plantings where plants indicated on the plans are of the same species and size.

1.3.5.12 Plants marked "B&B" in the Plants Schedule shall be adequately balled and burlapped with balls not less than the diameter specified in the American Standard for Nursery Stock and of sufficient depth to incorporate enough fibrous and feeding roots necessary for the full recovery of the plant. Container grown material of the same variety and size with an equivalent earth and root ball may be substituted for deciduous trees with a trunk diameter under one inch and for all shrubs and ground covers listed in the plant schedule as balled and burlapped ("B&B"), but not for coniferous and other evergreen trees. Balled and burlapped material of the same variety, size, and equivalent earth ball size may be substituted for all plants listed in the plant schedule in the construction plans as container grown. The ball size of all balled and burlapped material substitutions and container size of all container material substitutions shall conform to the American Standard for Nursery Stock.

1.3.5.13 All balled and burlapped plants that cannot be planted immediately upon delivery shall be set on the ground in the shade and the balls well covered with soil, mulch or other acceptable materials, then watered thoroughly and regularly to maintain good health and vigor, while maintaining a firm earth ball. Container grown plants shall be placed in the shade until time of planting and watered thoroughly and regularly to maintain good health and vigor.

Windy storage places shall be avoided, or adequate wind breaks and protection shall be provided by the Contractor.

1.3.5.14 Bare root deciduous shrubs and perennials, if specified, shall have a well-branched root system characteristic of the species. Root spread to height of plant ratio shall be as outlined in the American Standard for Nursery Stock.

1.3.5.15 Bare root ground cover, if specified, shall have as a minimum one, six-inch-long healthy runner and a minimum of three, four-inch-long healthy roots.

1.3.5.16 Potted ground cover shall have at least the minimum number and length of runners, for the specified pot size, as outlined in the current edition of the American Standard for Nursery Stock.

1.3.5.17 No plants with grafted root stock shall be accepted.

1.3.6 Turf Materials

1.3.6.1 Mixture for overseeding existing Bluegrass areas only: Bluegrass mixture shall contain fresh, clean, new-crop seed with a minimum purity of 98% and minimum germination of 85%. The seed mixture (by weight) shall be 100% improved Kentucky Bluegrass containing at least two varieties, in equal amounts, of acceptable varieties such as Adelphi, America, Baron, Majestic, Ram, Touchdown, or approved equal**.**

1.3.6.2 Standard mixture for new turf installations: Turf- Type Tall Fescue mixture shall contain fresh, clean, new-crop seed with a minimum purity of 98% and minimum germination of 85%. The seed mixture (by weight) shall be improved dwarf turf-type Tall Fescue containing at least two varieties, in equal amounts, of equal color and texture, containing acceptable varieties, including Barlexus, Revolution, Arid, Bonanza, Mustang, Olympic, Falcon, Jaquar, Rebel II, or approved equal.

1.3.6.3 Standard mixture for campus areas that receive extremely low maintenance: Tall Fescue mixture shall contain fresh, clean, new-crop seed with a minimum purity of 95% and minimum germination of 80%. The seed mixture (by weight) shall be 90% K31 Tall Fescue and 10% common Kentucky Bluegrass.

1.3.6.4 Sod – General

1.3.6.4.1 Sod shall be an approved, nursery grown turf type dwarf Tall Fescue sod of high quality from certified seed. Sod shall be free of noxious weeds as well as excessive amounts of other crop and weedy plants at the time of harvest. It shall also be free of objectionable grassy and broadleaf weeds. Sod shall be considered free of such weeds if less than 5 such plants are found per 100 square feet of area. Sod will not be acceptable if it contains any of the following weeds: common bermudagrass (wire grass), quackgrass, johnsongrass, poison ivy, nutsedge, nimblewill, Canadian or Russian thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel and bromegrass.

1.3.6.4.2 Sod shall be reasonably free of disease, nematodes, and soil borne insects.

1.3.6.4.3 Sod shall be free of thatch: up to ¼ inch is allowable (uncompressed).

1.3.6.4.4 The Contractor shall submit to the Owner for approval prior to delivery of sod, information as to the field location, species, and percentage of purity of the grass sod intended for use.

1.3.6.4.5 All sod shall be stripped at a uniform solid thickness of approximately 1" plus or minus ¼". Measurement for thickness shall exclude top growth and thatch and shall be determined at the time of field cutting. Sod thatch, uncompressed, shall not exceed ¼".

1.3.6.4.6 Root development shall be such that standard size pieces will support their own weight and retain their shape when suspended vertically from a firm grasp in the uppermost 10% of area, or when rolled and unrolled 3 times.

1.3.6.4.7 Before stripping, the sod shall be mowed uniformly at a height of 2 to 2 ½ ".

1.3.6.4.8 Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect survival of the sod.

1.3.6.4.9 Sod shall be harvested, delivered, and installed within a period of 36 hours. Sod not transplanted within this period shall be inspected and subject to rejection.

1.3.6.5 Bluegrass sod shall contain a mixture of 100% weight improved Kentucky Bluegrass (two certified varieties at 50% by weight each.)

1.3.6.6 Fescue sod shall be turf-type dwarf Tall Fescue sod or an approved mixture of improved turf-type Tall Fescue and improved Kentucky Bluegrass. Bluegrass content of the mixture shall not exceed 10% by weight.

1.3.7 Herbicide

1.3.7.1 The Fescue post-emergent broadleaf and grassy weed herbicide shall be Trimec Plus as manufactured by PBI/Gordon Corp. applied as required to control weeds in the grass. The pre-emergent herbicide for tree, shrub, bulb and ground cover buds is XL-2G containing Surflan and Benefin as manufactured by Helena Chemical (901) 761-0050. Contractor is to use suitable alternative herbicide for plants not labeled for XL-2G use.

1.3.7.2 All herbicides shall be applied as directed by the product labels.

1.3.7.3 The Contractor shall submit sample labels for approval to the Owner prior to application.

1..3.7.4 The Contractor shall notify the Owner of application time at least 24 hours in advance.

1.3.8 Miscellaneous Landscape Materials

1.3.8.1 Timber Landscape Edging for sign beds shall be 6" by 6" rough-cut Southern Pine, pressure treated with water-borne preservatives for ground contact use.

This preservative should be CCA .40 (Chromated Copper Arsenate), complying with AWPB LP-22. Edging shall be secured with ½", reinforcing rod stakes and wood connector strips to match edging, and constructed to sizes as shown in the Drawings. All anchoring nails shall be galvanized.

1.3.8.2 Non-Selective Herbicide shall be glyphosate- The Fescue post-emergent broadleaf and grassy weed herbicide shall be Speedzone as manufactured by PBI/Gordon Corp., applied as required to control weeds in the grass. The pre-emergent herbicide for tree, shrub, bulb and ground cover beds, is Corteva Crew. Contractor is to use suitable alternative herbicide for plants not labeled for XL – 2G use.

1.3.8.3 Antidesiccant shall be an emulsion-type, film-forming agent designed to permit transpiration and retard excessive loss of moisture from the plants, such as "Wilt-Pruf," or approved equal.

1.3.8.4 Weed Barrier Fabric, if required by project, shall be a water-permeable, black, polypropylene fabric, 4.0 to 5.0 ounces per square yard product. Fabric shall be Pro 5 Weed Barrier as manufactured by DeWitt Company, RR3, Box 338, Sikeston, Missouri 63801, (800) 888-9669, or approved equal.

1.3.8.5 Tree Wrap is required for all newly installed trees.

1.3.8.6 Tree Wrap for maples, dogwoods, and mountain ash shall be double-layered kraft paper with a tar layer between, four-inch-wide tape specifically manufactured for tree wrapping.

1.3.9 Guying and Staking Material

1.3.9.1 Tree anchors shall be made of high impact and shock resistant tenzaloy aluminum alloy. The anchor holding power for trees of three inch or less caliper shall be 300 pounds and its weight shall be one ounce. Holding power shall be 1100 pounds and anchor weight to be 4.5 ounces for trees of greater caliper than three inches.

1.3.9.2 Cable shall be 7x7 galvanized steel cable with white vinyl coating, which has a breaking strength of no less than 480 pounds for trees of three-inch caliper or less and 1700 pounds for trees of greater than three inch caliper.

1.3.9.3 Tree collars shall be 12" long, made from .5 ID x .062 wall PVC tubing with ultraviolet inhibitors.

1.3.9.4 Cable clamps shall be 1/16", zinc plated, U-bolt and clevis type.

1.3.9.5 Anchor shall be driven in with the anchor drive rod specified by the manufacturer.

1.3.9.6 Tree anchor kit for trees of three-inch caliper or less shall be Duckbill Model 40 DTS-W, and tree anchor kit for trees greater than three inch caliper shall be Duckbill Model 68 DTS-W, or approved equal.

1.3.9.7 All evergreen trees shall be staked with wood stakes. The stake shall be 2 x 2 sound hardwood and connected to the tree with two strands of twisted 12-gauge galvanized wire within a 2-ply reinforced rubber hose collar (approx. ½ " I.D.).

1.3.10 The Contractor shall install durable, expandable, long lasting polyethylene tree guards at the base of all proposed deciduous trees located in lawn areas. The guards shall be 7 to

10 inches in height and gray in color. The guards shall be the "Tree Protector" as sold by Seaberry Landscape, Inc., 3259 Terminal Drive, Eagan, Minnesota, 55121, (612) 454-9511, or approved equal.

Section 1.4 Quality of Plant Materials

1.4.1 Nursery Growing Conditions – All plant material shall be grown in conditions as closely approximating the project site climatic conditions as possible. Balled and burlapped (B & B) nursery stock shall be dug from field areas that are free from noxious weeds including Bindweed, Nutsedge, Johnson Grass, Bermuda Grass and Canadian Thistle.

1.4.2 Nursery Stock Freshness – All B & B plants shall be freshly dug nursery stock. Heeled-in stock or stock from cold storage shall not be accepted.

1.4.3 All balled and burlapped plants that cannot be planted immediately upon delivery shall be set on the ground in the shade and the balls well covered with soil, mulch or other acceptable material, then watered thoroughly and regularly to maintain good health and vigor, while maintaining a firm earth ball. Container grown plants shall be placed in the shade until time of planting and watered thoroughly and regularly to maintain good health and vigor. Windy storage places shall be avoided or adequate wind breaks and protection shall be provided by the Contractor.

1.4.4 Pruning Prior to Delivery – Plant material shall not be pruned prior to delivery except as authorized by the Owners Representative.

1.4.5 Condition of Nursery Stock – All plants shall have a normal habit of growth for the species and shall be sound, healthy and vigorous; grown at a recognized nursery in accordance with accepted horticultural practice; and free of disease, insects, eggs, larvae and defects, including knots, sun-scales, injuries, abrasions or disfigurement. All cuts over 1- ¼" shall be callused over.

1.4.6 Specimen Quality Plants – Bid prices shall permit using specimen stock, which is "better than average nursery row material," particularly for large deciduous material and evergreen trees. "Specimen quality plants" refers to the quality of the plant material, as it relates to approval of the plants along with size and branching habit.

1.4.7 Nursery Stock Measurement – Plants shall conform to the measurements indicated on the plant list. The caliber of tree trunks shall be the diameter of the trunk measured 12 inches above the natural surface of the ground.

1.4.8 Nursery Stock Inspection – The Owner reserves the right to inspect the plants at the source and/or on the site before planting for compliance with the requirements. All protective tree trunk covering shall be removed prior to inspection of plants on the site. The Contractor shall furnish the Landscape Architect with a list indicating the source (location – i.e. state, local) of each of the plant types to be supplied. This source list must be submitted within two weeks after receipt of the notice to proceed.

1.4.9 Nursery Stock Delivery – All shipments of plant stock shall comply with existing State and Federal laws and regulations governing plant disease, infection, and interstate movement of nursery stock. Protective covering during delivery shall include covering top and sides of truck to protect from wind burn. Nursery stock with loose or damaged root balls will not be accepted.

1.4.10 Nursery Stock Storage – If planting is delayed for more than six hours after delivery, set plant material in a shaded area, protected from weather and mechanical damage, and keep

roots moist by covering with mulch, burlap, or other acceptable means of retaining moisture. Contractor is responsible for watering the heeled-in nursery stock.

Section 1.5 Execution

1.5.1 Preparation

1.5.1.1 Layout – The location for all trees and outlines for all planting beds shall be staked in the ground by the Contractor and must be approved by the Landscape Architect before excavation of planting holes begins. Adjustments in planting locations shall be made by the contractor as directed by the Landscape Architect. The spacing between the center of the shrubs and the edge of the bed shall be equal to the spacing between shrubs unless otherwise noted on the drawings. *Plants shall not cover electric eyes when fully grown and should be planted 2 feet away.*

1.5.1.2 All existing turf and weed areas scheduled for planting bed development shall be sprayed with a non-selective herbicide such as Glyphosate, following manufacturer's recommended rate of application. Commencement of planting bed construction shall depend on herbicide manufacturer's recommended waiting period.

1.5.1.3 For all proposed turf areas and planting beds outside of the dripline of existing trees, subgrades soil (6" below finish grade) that has been compacted by vehicles, equipment, material storage, and in other areas designated on the drawings, shall be plowed to a depth of 12" in two directions at 90 degrees to each other by a chisel tooth plow or other suitable machine to loosen the subsurface of the soil. After plowing, the area shall be regarded to a smooth and even grade. The top 6" of subsoil shall be free of scrap lumber, trash, rocks larger than 3-inch diameter, concentrations of crushed rock, scraps of waste concrete and asphalt, and other deleterious materials prior to topsoil placement.

1.5.2 Planting Trees, Shrubs, Perennials, Bulbs, and Ground Covers

1.5.2.1 Preparation of planting areas:

1.5.2.1.1 Grasses, weeds and other debris shall be removed from all planting beds, shrub, and tree rings to prevent re-establishment of the grasses or weeds. Undesirable grasses and weeds shall be killed by using glyphosate at the manufacturer's recommended rates of application. Additional applications of Glyphosate will be required if prior applications do not kill the undesirable grasses and weeds. Remove dead plant debris prior to plant bed tilling and plant installation. All removed material shall be legally disposed of off-site away from all University property.

1.5.2.1.2 Prior to planting, till planting beds to an 8" depth. Till planting beds that require soil amendments to a 12" depth. Suitable excess soil shall be used as fill material on the site or removed from the site as directed by the Owner. Prior to planting and mulching, the edges of all planting beds shall be neatly and smoothly outlined with a spaded edge where indicated on the plans. The spaded edge shall be three inches deep in ground cover beds and four inches deep in shrub beds with soil tapered back into the planting bed. The soil surface of the bed shall be raked smooth prior to mulching. The

outline edge of all beds shall be established so as to eliminate areas difficult to mow with a riding mower as directed by the Owner. Where tree, shrub, perennial, or ground cover beds abut walks, mow strips, or other pavement, the Contractor shall remove soil along the walk or paved area to a depth of three inches in ground cover beds and four inches in shrub beds and gradually taper the soil back into the planting bed so as to hold the mulch in place. Mulch is to be placed so as to be even with the pavement surface.

1.5.2.1.**3** Unless otherwise specified by the Owner, all plants shall be set at such a level that after settlement, the crown of the plant will be at or slightly above the surrounding finished grade.

1.5.2.1.4 All tree rings shall be circular and be excavated to have sloped sides and shall be of the minimum dimensions shown in the details of the plans. Each plant to be installed in an individual pit shall be planted in the center thereof. All wire mesh from balled shrubs/trees is to be removed. Wire mesh from balled trees is to be cut vertically to the bottom of ball at four evenly spaced places around ball. The mesh is to be cut off from top one-half of ball and removed. All burlap and lashings from balled and burlapped plants shall be removed from the top one-third of shrub and tree balls after the plant has been placed in the plant pit and immediately prior to backfilling, but no rope lashing or burlap shall be pulled out from under the balls. Remove shrub balls from container grown plants by cutting the cans on two sides with an acceptable can cutter or by carefully removing shrub balls from knock-out containers. After removal from container, the roots on the outside of the shrub ball are to be cut vertically around the ball at approximately 4 inch-6 inch intervals and the root ends “fluffed” so as to encourage them to grow into the surrounding soil and not to girdle the plant. Peat pots may be used for deciduous shrubs and ground cover. Peat pot is to be removed unless the rootball of shrubs would be damaged; then, remove at least top one-third of peat pot and cut vertically around pot at approximately 4 to 6 inch intervals, as approved by the Owner on site. Great care shall be exercised so as not to loosen or break the root ball. Plants with broken balls will not be accepted.

1.5.2.1.**5** No material in a frozen condition shall be used for backfilling plant pits.

1.5.2.2 Plants shall be so handled that the roots are protected at all times, and if delivery is made in open vehicles the entire load shall be covered with canvas to prevent desiccation of material. Wind damaged plant material will not be accepted.

1.5.2.3 Plants shall be properly marked for identification with legible weatherproof labels securely attached thereto before delivery to the site. Labels are to be left on the plants for identification until the Contractor is designated by the Owner to remove them. The labels will be removed at the Partial Occupancy site visit or immediately thereafter as directed by the Owner. All labels shall be sufficiently loose so as not to cause girdling of the plants.

1.5.2.4 No plant shall be so bound with rope, wire, or coverings at any time so as to cause damage to the bark, break branches, destroy its natural shape or impair its vigor.

1.5.2.5 Damaged and unhealthy limbs of trees and shrubs shall be pruned on site. Central leaders of trees shall not be removed without prior consent of Owner.

1.5.2.6 When each plant is placed in the plant pit at the proper level, the backfill will be placed around the plant and settled by watering thoroughly. The backfill shall not be tamped or packed down by pressure. Further watering of plants is to begin two days after planting, as needed.

1.5.2.7 In the spring, apply a pre-emergent herbicide at the manufacturer's recommended rate to all tree beds and shrub, perennial, bulb, and ground cover beds after planting and mulching. The Contractor shall use a pre-emergent currently labeled for use with the plant material within the beds. The Contractor shall submit a sample label for approval by the Owner prior to application.

1.5.2.8 Mulch for the trees and shrub planting shall consist of a 3" minimum and a 4" maximum layer of hardwood double-shredded dark brown mulch. Mulch around ground cover plants shall consist of a 2" minimum and 3" maximum layer of hardwood mulch. The mulch layer thickness specified is expected after settlement.

1.5.2.9 All trees shall be braced by sound stakes or guy wires as detailed in the construction drawings, using specific materials. Trees are to be able to sway 3 to 4 inches after staking. Contractor is to remove all stakes, guy wires, and other guying material at the end of the guarantee period.

1.5.2.10 The maintenance shall begin immediately after planting. The trees, shrubs, ornamental grasses, perennial, bulb, and ground cover plantings shall be protected and maintained by watering, pruning, fertilizing, and replanting as necessary up until acceptance of the Project by the Owner at the time of Partial Occupancy so as to assure healthy plants in a vigorous growing condition. After acceptance of the Work, the Contractor shall be responsible for maintaining the newly installed plant materials and plant beds for a period of one year after date of Partial Occupancy. This work shall include watering, weeding, insect and disease control and general care of all woody plants, ground cover, ornamental grass, bulbs and perennials installed in a planting bed under this Contract.

1.5.2.11 Ground cover and shrubs in areas of greater than 10% slope are to be stabilized, if needed, after mulching and before planting with heavy jute mesh. Secure mesh to slope with 6" long wire staples. Down-channel end of roll to overlap up channel end of roll by 18" and staple 12" on center. Overlap sides of rolls 4" and staple 3' on center.

1.5.2.12 Soil pH shall be modified with twenty pounds of elemental sulfur per 1000 (one thousand) square feet, five pounds of iron sulfate per 1000 (one thousand) square feet, and three inches of peat on soil surface, all being tilled twelve inches minimum into the soil for plant materials that require soil pH to be less than 7 pH.

1.5.3 Planting of New Turf Areas – Seeding

1.5.3.1 All lawn areas disturbed by construction except tree pits and other tree, shrub and ground cover planting beds, as well as areas designated on the Drawings to be sodded, shall be seeded as specified below.

1.5.3.2 The seeding operation shall not commence until site conditions are satisfactory. Seeding shall not be done during high winds or when the ground is excessively wet, frozen, or untillable.

1.5.3.3 All areas to be seeded shall meet the specified finish grades and be free of deleterious materials, including weeds, existing grass, tree branches, oil drippings, stones greater than 1-½" diameter, concentration of crushed rock, mortar, and other loose building materials. Finish grade shall consist of a minimum 6-inch topsoil finish layer except where greater thicknesses are noted on the Drawings.

1.5.3.4 Contractor shall protect seeded areas by watering, mowing, fertilizing, applying herbicide and replanting as necessary for as long as is required to establish a uniform stand of grass to a 4-inch height and until acceptance. Seeded areas will require the application of herbicides to kill broadleaf and grassy weeds. A fertilizer application of 32-2-4 at a rate of one pound actual N per 1,000 square feet shall be applied. When this operation is completed, no heavy objects shall be moved over or placed upon these areas at any time unless protected in a manner approved by the Owner's Representative.

1.5.3.5 The turf grass seeding rates are as follows:

1.5.3.5.1 Improved Bluegrass mixture: 2 - 3 pounds per 1000 square feet.

1.5.3.5.2 Improved Turf-Type Tall Fescue mixture: 7 - 8 pounds per 1000 square feet.

1.5.3.5.3 Excaliber Tall Fescue Mixture: 6 - 8 pounds per 1000 square feet.

1.5.3.6 The turf mixture for each area shall be divided into two equal parts, each to be broadcast in a separate operation with the second seeding to be over the first and at right angles to it. Seed shall be uniformly distributed with a brilliontype," cultipacker seeder, rotary fertilizer spreader, or other approved mechanical seeding equipment. A grain seed drill shall be used. Hydroseeding will not be accepted. After placement of seed, the seedbed shall be scarified to an average depth of ¼" and raked to incorporate the seed into the soil to insure good seed/soil contact. A drill or slicer seeder is required to seed grasses – allows seed to come into contact with soil.

1.5.3.7 All slopes equal to or greater than one vertical foot to three horizontal feet, or areas of concentrated surface storm water drainage (i.e. drainage channels) shall be covered with erosion control fabric after seeding. Staple the 6" overlap of erosion control fabric at a minimum of every 24 inches. Erosion control fabric to be removed by Contractor before mowing.

1.5.4 Planting of Turf Areas – Sodding

1.5.4.1 All areas to be sodded are indicated on the Drawings.

1.5.4.2 The sodding operation shall not commence until site conditions are satisfactory. Sodding shall not be done when the ground is excessively wet, frozen or untillable.

1.5.4.3 All areas to be sodded shall meet the specified finish grades before sodding and be free of deleterious materials, including weeds, existing grasses, tree

branches, oil drippings, stones greater than 1-½" diameter, concentrations of crushed rock, mortar and other loose building materials. Finish grade shall consist of a minimum 6" layer of topsoil except where greater thicknesses are noted on the Drawings. Grades for the flow lines of swales and ditches, detailed on the Drawings, shall be carefully established at a level even with the thatch surface of the sod. Sod placement, rolling, and watering shall conform with the grades shown on the Drawings.

1.5.4.4 Prepare sod bed by applying slow-release fertilizer with ratios of approximately 18-24-12 supplemented with iron, at a rate of one pound actual P per 1,000 square feet of area to be sodded. The fertilizer shall be thoroughly incorporated into the soil by tilling to a depth of 4 to 6 inches with a mechanical tiller or other approved method. The sod bed is to be smooth, free of rocks, clods and other debris larger than one inch, and free from hollows or depressions. Sod bed shall be in a firm, but uncompacted condition with a fine texture prior to laying of sod.

1.5.4.5 Sod shall be installed in tightly abutted parallel rows with the lateral joints staggered at a minimum distance equal to the width of the sod slab. Voids between sod strips will not be accepted.

1.5.4.6 For sloping surfaces, sod shall be laid at the base of the slope with staggered joints and at right angles to the flow of water. Sod placed on 3:1 slopes or steeper, and in ditch flow lines, shall be staked with 6 stakes per square yard or roll of sod. Stakes shall be wood, with ½" of the top above sod line. Stakes should be set sufficiently in the ground to permit mowing.

1.5.4.7 The sod shall be watered immediately after installation. Prevent sod from drying during progress of work. After sodding is completed in any one section, the entire area shall be thoroughly irrigated to at least one-inch depth below the new sod pad. Subsequent watering should maintain moisture to a depth of at least 4 inches.

1.5.4.8 Maintenance shall begin immediately after planting. The sod shall be protected and maintained by watering, mowing, fertilizing and replanting for as long as it is necessary to establish a uniform stand of grass. Any sod not surviving prior to its first mowing shall be replaced with new sod from the same source. Mowing of the sod will be the responsibility of the Owner.

1.5.5 Maintenance of Turf

1.5.5.1 Seeded Turf Areas: The Contractor shall protect seeded areas replanting as necessary for as long as is required to establish a by watering, mowing, fertilizing, applying herbicide, and uniform stand of grass to a 4-inch height and until acceptance. Seeded areas will require the application of herbicides to kill broadleaf and grassy weeds. A fertilizer application of 32-2-4 at a rate of one pound actual N per 1,000 square feet shall be made in April of the following year. Scattered bare spots, (none of which are larger than one square foot) will be allowed in up to a maximum of five percent of any planted area. The Contractor is to supply water by hoses and sprinkler equipment as needed until acceptance of the seeded areas.

1.5.5.2 Sodded Turf Areas: The maintenance shall begin immediately after planting. The sod shall be protected and maintained by watering, mowing, fertilizing and replanting for a minimum of 21 days or as long as necessary to establish a uniform stand of grass. Any sod not surviving shall be replaced by new sod

from the same source. A fertilizer application of 32-2-4 at a rate of one pound actual N per 1,000 square feet of sod shall be made in April of the following year. The Contractor is to supply water by hoses and sprinkler equipment as needed until acceptance of the sodded areas.

1.5.6 Relocation of Existing Trees and Shrubs

1.5.6.1 Trees and shrubs to be relocated shall be balled and burlapped (B & B) according to accepted nursery industry standards. Plants shall be dug with firm natural balls of earth in a diameter not less than specified by "American Standard for Nursery Stock," ANSI Z60.1 and shall be securely wrapped with burlap or canvas and tightly bound with rope or wire.

1.5.6.2 Trees and shrubs shall be immediately replanted or heeled in after digging in accordance with the specifications.

1.5.7 Installation of Landscape Bed Edging (Wood Timbers)

1.5.7.1 Place Edging in areas and with dimensions indicated on the Drawings.

1.5.7.2 Installed edging shall be flush with the finish grade of the adjacent turf area and ½" above the mulched bed.

1.5.7.3 Anchor edging with reinforcing rod stakes spaced not more than 3 feet on center and driven at least 24 inches into the subgrade. Stakes shall be placed in the holes that are drilled on center with the timber edging. Four galvanized nails shall be used per wood "connector strip."

1.5.8 Plant Guarantee and Maintenance Requirements

1.5.8.1 At the end of the guarantee period, inspection will be made by the Owner upon written notice requesting such inspection submitted by the Contractor at least 10 days prior to the anticipated date. Any and all parts which prove defective in material or workmanship shall be replaced by the Contractor at their expense.

1.5.8.2 During construction time up to the date of Partial Occupancy as approved by the Owner, any plants missing due to theft or vandalism shall be replaced by the Contractor at their expense as soon as conditions permit during the normal planting season. Normal fall planting season shall be from September 1 to October 31 for seeding, sodding, shrub, perennial, bulb and groundcover planting in the Fall. Tree planting may continue until December 15, weather permitting. Normal spring planting season shall begin when weather permits or soil conditions are suitable until May 24.

1.5.8.3 Any plant material required under this Contract that is not in satisfactory vigor and growth at the end of the guarantee period for any reason except hail, flood, tornado, fire, earthquake, and/or Owner damage, as determined by the Owner, shall be removed from the site. These plants and any plants missing because of the Contractor's negligence shall be replaced by the Contractor at their expense as soon as conditions permit during the normal planting season. In case of a rejected plant, the Contractor may elect, upon agreement by the Owner, to allow such plant to remain through another complete growing season. The rejected plant, if found not to be in healthy or vigorous growing condition after another growing season, shall be replaced by the Contractor, in a larger than

specified size if necessary, to match other plants in a particular bed or planting group planted under this contract.

1.5.8.4 All replacements shall be plants of the same kind as specified in the plant list. They shall be furnished and planted as specified under planting of trees, shrubs, perennials, bulbs, and groundcovers and the cost shall be borne by the Contractor.

Section 1.6 Irrigation Standards

1.6.1 Design Criteria

1.6.1.1 General Overview

1.6.1.1.1 The irrigation system shall be a two-wire or conventional wire-controlled system, utilizing:

- WeatherTRAK controllers and decoders
- Netafim hydrometer (master valve and flow sensor)
- Shielded cable to flow sensor from controller (18-2)
- Blue and white 14-gauge wires to solenoid (master valve)
- Hunter valves – ICV w/flow commercial Valves

1.6.2 Materials

1.6.2.1 PVC and PVC Pipe Fittings

1.6.2.1.1 Mainline pipe shall be virgin, high impact, polyvinyl chloride (PVC) Schedule 40. Lateral lines shall be polyvinyl chloride (PVC) pipe Class 200, sizes 1", 1-1/2" or 2". All PVC pipe shall be continuously and permanently marked with manufacturer's name, material, size and schedule or type. Pipe shall meet ASTM D2241 specifications for PVC plastic pipe or latest revision thereof. Pipe sizes are shown on drawings as minimum allowable sizes. Larger sizes may be used by Contractor.

1.6.2.2 Flexible Swing Pipe and Joints.

1.6.2.2.1 Flexible swing pipe shall be Irritol Super Blue Flex 1/2 inch. The flexible pipe should not extend over 3 feet and should be placed to provide positive drainage to the lateral line.

1.6.2.2.2 Fittings for the flexible swing pipe shall be the 'spiral barb' type fittings and Oetiker Clamps, as specified for P.E. pipe and clamps and

1.6.2.2.3 Use a triple swing joint on lateral pipe sizes 2-1/2 inches or larger and sprinklers with 1 inch inlet.

1.6.2.2.4 Use flexible swing polyethylene pipe on laterals of sizes less than 2″ and sprinkler heads with ≤ 3/4" inlet.

1.6.2.3 Pipe and Tube Fittings

1.6.2.3.1 All PVC fittings shall be Schedule 40 and 80: ASTM D 2466.

1.6.2.3.2 Insert fittings for P.E. Pipe: Fittings shall be held in place on the pipe with screw tightened stainless steel clamps fastened around the fitting serration.

1.6.2.4 Joining Materials

1.6.2.4.1 All slip fittings shall be solvent welded with Weld-On P-70 purple primer and Weld-On 721 glue. Primer is to be a different color than cement.

1.6.2.4.2 Use Teflon tape on all threaded fittings, applied with a single wrap with 50% overlap.
- 1.6.2.4.2.1 Plastic-to-plastic: Teflon tape only.
- 1.6.2.4.2.2 Plastic-to-metal: Teflon tape and pipe dope.

1.6.2.5 Valves and valve specialties

1.6.2.5.1 Remote control valve shall be Hunter ICV Series with Schedule 80 toe nipples.

1.6.2.5.2 Master valves shall be Netafim Flow 3 Hydrometer with reed switch.

1.6.2.5.3 Flow sensor shall be integrated with master valve; alternates must be approved.

1.6.2.5.4 Low-flow valves (<10 GPM) shall be Hunter ICZ Drip Control Zone Kit with valve and pressure regulator.

1.6.2.5.5 R.C.V. valve box covers shall be Highline boxes, green in color.

1.6.2.5.6 Valve Boxes

- 1.6.2.5.6.1 All valves must be placed in a 12" standard Highline valve box.
- 1.6.2.5.6.2 All quick couplers must be placed in a 10" round box.
- 1.6 2.5.6.3 Valve boxes must be placed on 4 bricks and be level with surface grade.
- 1.6 2.5.6.4 Openings on the valve box must be covered with fabric; no dirt or debris left inside.
- 1.6.2.5.6.5 Valves must have clearance on top and bottom; valve boxes must not rest on pipes.
- 1.6.2.5.6.6 Wiring inside valve boxes must be neatly coiled together.
- 1.6.2.5.6.7 Valve box should be centered on the valve.

1.6.2.6 Valve Box Schedule

All valve boxes and extensions used on Kansas State University irrigation systems must be Highline brand and conform to the following standards:

All valve boxes and extensions used on Kansas State University irrigation systems must be Highline brand and conform to the following standards: Use	Product	Model #	Dimensions	Notes
Standard Valve Box	Highline Standard Valve Box Rectangle, Black Box / Green Lid	HIGHLINE 170106	11" x 16" x 12" H	Drop-in CV, closed mouse holes
Jumbo Valve Box	Highline Jumbo Valve Box Rectangle, Black Box / Green Lid	HIGHLINE 194502	14" x 20" x 12" H	Overlapping CV, closed mouse holes
10" Round Valve Box	Highline Valve Box Round, Black Box / Green Lid	HIGHLINE 181104	10" Diameter	Use risers as needed
10" Round Extension	Highline Valve Box Extension Round	HIGHLINE 181026	10" Diameter x 3" H	Fits model 181104
Jumbo Valve Box Extension	Highline Jumbo Valve Box Extension Rectangle	HIGHLINE 190110	14" x 20" x 6" H	Closed mouse holes
Standard Valve Box Extension	Highline Standard Valve Box Extension Rectangle, Black Box/Lid	HIGHLINE 170116	11" x 16" x 6" H	Drop-in CV, closed mouse holes
• Install extensions as needed to ensure boxes sit flush with grade.				
• Ensure boxes are securely seated and not resting on pipe or fittings.				
• All valve boxes must be level, centered, and protected during installation.				

1.6.2.7 Wiring

1.6.2.7.1 Wire to the automatic controller from the power source shall be copper conductor, No. 12 AWG Type-TW or THHN wire.

1.6.2.7.2 Electric control wires from the automatic controller to the automatic valves shall be direct burial No. 14 AWG copper, UF Type wire. The insulation shall be 60° Celsius with insulation thickness of 3/64″. The common wire shall be white and another individual color shall be dedicated to each valve. Extra wires shall be installed as shown on plan and as herein specified with ends properly water proofed with King ‘one-step’ connectors or approved equal.

1.6.2.7.3 Wires used above ground shall be encased in U.L. listed electrical metallic tubing attached to the vertical mounting surface with zinc plated clips placed two feet on center.

1.6.2.7.4 Wires beneath sidewalks or roads shall be installed in a P.V.C. sleeve.

1.6.2.8 Automatic Control System

1.6.2.8.1 Controller shall be Eicon wall or pedestal mount enclosure that is waterproof & lockable. Ground according to manufacturer's recommendations.

1.6.3 Execution

1.6.3.1 Preparation

1.6.3.1.1 Flags shall be set to identify preliminary locations of lawn sprinklers.

1.6.3.2 Trenching and Backfilling

1.6.3.2.1 Sleeves for piping and wiring shall be installed under sidewalks.

1.6.3.2.2 Piping or sleeves shall be covered to these minimums:
1.6.3.2.2.1 Lateral Pipe – 18 inches, Class 200 P.V.C.

1.6.3.2.2.2 Mainline Pipe – 28 inches, Schedule 40 P.V.C.

1.6.3.2.2.3 Sleeves – 28 inches or 18 inches, Schedule 40 P.V.C.

1.6.3.3 Piping Installation

1.6.3.3.1 Install P.V.C. pipe in dry weather at temperatures above 40 degrees Fahrenheit for 24 hours at this temperature before testing.

1.6.3.4 Automatic Control System Installation

1.6.3.4.1 Wiring should be installed in same trench with piping. To allow for expansion, loop wire at control valves and controllers and 100 foot intervals. Bundle wires every 10 feet.

1.6.3.4.2 Pipe shall be flushed free of dirt and debris before installation of sprinklers or other devices.

1.6.3.4.3 Test entire system at normal working pressure for 3 hours and demonstrate operation to Owner's maintenance personnel.

1.6.3.4.4 The specification standards listed herein are designed for potable water lawn irrigation application only. Chemical injection and reclaimed water through irrigation piping is not permitted.

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CHAPTER 11 – APPENDICES

APPENDIX 2 – STONE RESTORATION AND CLEANING

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Appendix 2 Stone Restoration and Cleaning

Part 1: General

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Part 2: Products

2.1 Manufacturers
2.2 Cleaning Materials

Part 3: Execution

3.1 Preparation
3.2 Cleaning Stone, General

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Appendix 2 Stone Restoration and Cleaning

Part 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings of Fairchild and Durland/Rathbone Halls apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Cleaning exposed stone surfaces.

B. Unit Prices: Stone restoration and cleaning to be provided under unit prices are to be quoted as a cost per square foot to add or deduct wall surfaces from the bid. The Unit Price is to include all costs associated with the work as specified herein.

1.3 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPA); 4 to 6 gpm (0.25 to 0.4 L/s)

B. Medium-Pressure Spray: 400 to 800 psi (2750 to5500 kPA); 4 to 6 gpm (0.25 to 0.4 L/s)

C. High-Pressure Spray: 800 to 1200 psi (5500 to 8250 kPA); 4 to 6 gpm (0.25 to 0.4 L/s)

1.4 SUBMITTALS

A. Product Data: For each product indicated, include recommendations for application and use. Include test reports and certifications substantiating that products comply with requirements.

1. Baking Soda, Bicarbonate of Soda (may also be known by manufacturers product name.)

B. Samples for verification.

1. Example of chemical cleaner (said Baking Soda).

C. Qualification Data: Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information detailing the extent of similar work undertaken and completed.

D. Cleaning program indicating cleaning process, including protection of surrounding materials on building and Project site, and control of runoff during operations. Describe in detail the materials, methods and equipment to be used.

1. If materials and methods other than those indicated are proposed for cleaning work, provide a written description, including evidence of successful use on other comparable projects, and a testing program.

1.5 QUALITY ASSURANCE

A. Restoration Specialist: Engage an experienced stone restoration and cleaning firm that has completed work similar in material, design, and extent to that indicated or this Project and with a record of successful in-service performance.

1. Field Supervision: Require restoration specialist firms to maintain an experienced full-time supervisor on the Project site during times that stone restoration and cleaning are in progress.

B. Chemical Manufacturer Qualifications: A company regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-trained representatives who are available for consultation and Project site inspection and assistance at no additional cost.

C. Pre-application Conference: Approximately two (2) weeks prior to the scheduled commencement of the cleaning and associated work, conduct conference at Project site. Notify participants at least 5 working days before scheduled conference.

1. Meet with Owner; Architect; testing and inspecting agency representative, cleaning firm representative and site foreman; and cleaning system manufacturer representative.

2. Review methods and procedures related to cleaning system, including manufacturer's written instructions.

3. Review governing regulations and requirements for insurance, certifications, and inspection and testing, if applicable.

4. Review protective measures to be taken for the protection of materials not to be cleaned.

5. Review provisions for temporary walks, ramps, scaffolding, shoring, bracing and other equipment required for proper progress of Work and the removal of same at the completion of Work.

6. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

7. Establish which areas on the site that will be available for use as storage and work areas, and firm's responsibility of protection and restoration of said storage and work areas to pre-construction conditions.

8. Review University parking requirements, regulation, and the procedure for the firm and its employees to obtain permits for parking during the course of the work. Any parking fees and/or fines are the responsibility of the Cleaning firm.

D. Mockups: Prepare field samples for cleaning procedures to demonstrate aesthetic effects and qualities of materials and execution. Use materials and methods proposed for completed Work and prepare samples under same weather conditions to be expected during remainder of Work.

1. Locate mockups on the building where directed by Architect.

2. Cleaning: Prepare samples approximately 25 sq. ft (2.3 sq. m) in area for each type of stone and surface condition:

a. Test cleaner and methods on samples of adjacent materials for possible adverse reaction, unless cleaners and methods are known to have a deleterious effect.

b. Allow a waiting period of not less than 7 days after completion of sample cleaning to permit a study of sample panels for negative reactions.

3. Notify Architect 7 days in advance of the dates and times when samples will be prepared.

4. Obtain Architect's approval of mockups before starting the remainder of stone cleaning.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with type and name of product and manufacturer.

B. Use air conveying/mechanical systems for bulk transfer to storage. For manual handling of bulk transfer use mechanical ventilation to remove airborne dust from railcar, ship or truck. Use approved respiratory protection when ventilation systems are not available. Selection of respirators is based on the dust cloud generated.

C. No more material should be stored at the job site than will be used within two weeks. For expected storage periods greater than two weeks, the material should be properly warehoused.

D. Store in a cool, dry area, away from acids avoiding contamination.

E. Comply with manufacturers written instructions for minimum and maximum temperature requirements for storage.

1.7 PROJECT CONDITIONS

A. Clean stone surfaces only when air temperature is 40 deg F (4 deg C) and above and will remain so for at least 7 days after completion of cleaning.

B. Protect windows, doors, and all other materials not specifically designated for cleaning within said specifications, from undesired blasting, in particular:

1. Fairchild Hall painted window frames, downspouts and fire stair. These items have been tested and were found to contain high lead levels and inadvertent cleaning should be avoided. The cleaning firm shall discuss with the Architect the methodology proposed for use to protect the painted areas of Fairchild Hall during the cleaning process.

C. The cleaning firm shall verify the location of all sources of power and ensure that such sources are compatible with the requirements of the tools for application. If the sources of appropriate power do not exist or are not available, said firm shall supply an appropriate source at the firm's expense.

1.8 SEQUENCING AND SCHEDULING

A. Perform stone restoration work in the following sequence:

1. Adjust or remove obstructing plant growth. Inform architect of the area and need for removal.

2. Proceed with stone cleaning process.

3. Recycle or dispose of waste materials into a secured landfill in accordance with all local, state and federal environmental regulations.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1. Baking Soda (Blasting Media and cleaning material for food and non-food contact surfaces)

a. SodaClean Maintenance Plus, MMLJ Inc.

b. Contam-Away Blast Media, Contam-Away

c. The Soda Works

d. Enviro-Clean

e. Evans Products Inc.

B. Should a bidder wish to incorporate, in the base proposal, brands or products other than those named in the Specifications, he shall submit written request for substitution approval to the Architect no later than ten (10) days prior to date proposals are due. Approved substitutions will be set forth in an addendum. Bidders shall not rely upon approvals made in any other manner.

C. Products submitted for request for substitution shall meet the minimum requirements as shown in section 2.2 below. Any products not meeting the above criteria will not be approved for substitution.

2.2 CLEANING MATERIALS

A. Baking Soda (Sodium Bicarbonate): CAS# 144-55-8, White, granular solid. Odorless, soluble in water and maintains an optimum pH of 8.4.

B. Potable Water for mixture with Baking Soda during blasting process.

C. Additional tools and/or machinery as prescribed by the manufacturer.

PART 3 – EXECUTION

3.1 PREPARATION

A. General: Comply with manufacturer's written instructions for protecting building surfaces against damage from exposure to their products.

1. The cleaning firm shall seal all fresh air intakes and other possible interior entries for soda dust in area of cleaning. Cleaning firm shall notify Architect prior to sealing fresh air intakes.

B. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from injury resulting from stone restoration work.

1. Prevent solutions from coming into contact with pedestrians, motor vehicles, landscaping, buildings, and other surfaces that could be injured from such contact.

2. Do not clean stone during winds of sufficient force to spread cleaning solutions to unprotected surfaces.

3. Collect all un-treatable wastes for disposal off Owner's property.

4. Dispose of runoff from cleaning operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

5. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles that must remain in operation during course of stone restoration work.

3.2 CLEANING STONE, GENERAL

A. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Work from bottom to top of the building for each scaffold drop.

B. Use only those cleaning methods indicated for each stone material and location.

1. Some areas of stone will require more attention than others. These areas will be specially noted in the drawings.

2. Use spray equipment that provides controlled application at volume and pressure indicated, measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage stonework.

a. Equip units with pressure gauges.

3. For water spray application, use a fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.

4. For high-pressure water spray application, use a fan-shaped spray tip that disperses water at an angle of at least 40 degrees.

C. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging stone surfaces.

D. Removing Plant Growth: The Contractor is responsible to completely remove plant, moss, and shrub growth from stone surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing to dry as long as possible before removal. Remove loose soil or debris from open joints to whatever depth they occur.

E. Baking Soda Applications: Apply chemical cleaners to stone surfaces to comply with chemical cleaner manufacturer's written instructions.

1. Spray Applications: Spray apply water to stone surfaces to comply with requirements indicated for location, purpose, water temperature, pressure, volume, and equipment. Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from surface of stone and apply water from side to side in overlapping bands to produce uniform coverage and an even effect.

2. Rinse any remaining residues by working upward from bottom to top of each treated area at each stage or scaffold setting.

3. Repeat cleaning procedure above where required to produce the cleaning effect established by the mockup.

END OF SECTION 04902