14 00 00. CONVEYING SYSTEMS

.1 The program statement for the project shall outline the preliminary requirements for conveying system. New and Modernized elevators shall be Open Market technology. New machine rooms, hoistways, and pits shall be designed to accept all manufacturer's non-Machine-Room-Less (MRL) elevators. Select equipment with regard to function and proper size to avoid excessive wear and provide long cable life. Locate hoisting machine and sheaves to avoid reverse bends in hoist cables. Hoist machine shall use stranded steel wire rope for suspension and counterbalance, be a non-proprietary product, available for purchase and installation by any licensed elevator contractor, and shall be interchangeable with a minimum of two other elevator manufacturers' hoist machines, readily available in the elevator industry.

.1.1 CODES and STANDARDS

A. Architect/Engineer (A/E) shall use most current codes and standards unless superseded by this Building Design Standard. The following is a partial list of applicable codes and standards:

1. Ohio Building Code (OBC)
2. Ohio Mechanical Code (OMC)
3. Ohio Plumbing Code (OPC)
4. National Electrical Code (NEC)
5. American Society of Mechanical Engineers (ASME A17.1) Safety Code for Elevators and Escalators
6. Accessibility (ICC/ ANSI A117.1)
7. National Fire Protection Association (NFPA 72)

14 20 00. ELEVATORS

.1 PLANNING CONFERENCE: The A/E and Elevator Consultant shall arrange with the University Project Manager for a meeting to discuss elevator requirements with the Department's Elevator Manager. The Elevator Consultant selection and their scope of work shall be approved by the University Architect ~~(UA)~~, University Engineer ~~(UE)~~, and the Department's Elevator Manager.

.1.1 PRE-DESIGN ANALYSIS: For each individual project and system, the A/E and Elevator Consultant shall submit the proposed design intent, including but not limited to, providing traffic analysis for all buildings. Identify the type, size and capacities of proposed elevator(s) to the University Architect ~~(UA)~~, University Engineer ~~(UE)~~/Technical Services Group ~~(TSG)~~, and the Department's Elevator Manager. Detailed plans and information of the intent must be sent to the project team early in the design phase. Designer The A/E and Elevator Consultant shall ensure that the multiple building systems that interface with the elevator are identified and code compliant.

.2 USE OF EXISTING ELEVATORS (DURING CONSTRUCTION OR RENOVATION shall Refer to Division 01): If university permission is granted to use existing elevators, the contractor shall protect all equipment and be alerted that elevators will be inspected by the Department's Elevator Manager before and after construction to appraise any damage caused by this use. The General Contractor shall be required to arrange and pay for maintenance during this period, and to restore elevator equipment to pre-construction condition before the final project payment is authorized. The Department's Elevator Manager and the A/E shall designate the appropriate elevator for use.

Wexner Medical Center: Elevators deemed acceptable to use will be inspected by OSUWMC Facilities Operations personnel before and after construction to appraise any damage caused by the use. Pending approval by OSUWMC Facilities Operations, the A/E shall designate the appropriate elevator for use.

14 20 01. GENERAL REQUIREMENTS:

.1 PRIMARY INTENT:

a. Provide acceptable levels of elevator design and service as it relates to the Average Interval and handling capacity based upon building's needs.
b. Provide safe and convenient transport of passengers and materials.
c. Provide systems that give the highest level of accessibility for people with disabilities.
d. The A/E shall incorporate specific standardized parts for easy maintenance, quick repair or replacement.
e. Provide design for safety and, reliability that achieves desired lifecycle service and cost effectiveness.
f. Installation of non-open market controller(s) and machine(s) are prohibited.

.2 CONTRACT: Except as otherwise approved by the university, elevators shall be included in the general contract. Specify that all wiring installed by the elevator contractor shall comply with Division 26 of the specifications.

.3 PROVISIONS FOR SERVICING: The elevator contractor shall provide evidence that they have a staffed service office with sufficient field mechanics that are able to respond to service calls within 30 minutes. Staff shall also include sufficient supervision and adjusters to meet all maintenance requirements and installations. Common wear parts shall be stocked locally and available the same day to make repairs. Other parts must be available to arrive on campus the next business day. Acceptable companies will have a history of more than five years of continuous elevator construction, modernization, service, repair and maintenance experience. Maintenance and callback service shall be provided for one year from date of university acceptance.

.4 MAINTENANCE BY ELEVATOR CONTRACTOR: Beginning on the date of notice to proceed, furnish service and maintenance on all elevators in the common machine

room and or building, depending on project, for a minimum of one year following overall project completion. Call back service shall be in accordance with the current university maintenance specification. Service shall include scheduled regular examinations and record keeping per the Electronic Maintenance Control Program (EMCP) for all the equipment:

- All Safety Test
- Emergency communication devices - monthly.
- Automatic Elevator Rescue units - monthly
- Every elevator service shall be maintained in accordance with the EMCP.
- Phone and fire service testing - monthly

Service shall be completed during regular work hours 6am to 6 pm by competent trained employees of the Elevator Contractor. The maintenance during modernization and warranty shall be code compliant and in accordance with unierrsity's maintenance agreement (provided by Department's Elevator Manager at time of project). Provide the Department's Elevator Manager with copies of the maintenance history, program maintenance and repairs performed.

Wexner Medical Center: The contractor shall respond to entrapment calls within 30 minutes after notification, including evenings, weekends, and holidays. The contractor shall respond to maintenance callbacks within 45 minutes after notification, including evenings, weekends, and holidays.

.4.1 INSTRUCTIONS FOR MAINTENANCE PERSONNEL: The Contractor will furnish electronic and two three hard copies of: final wiring diagrams, technical manuals for all parts and tools. Equipment using diagnostic or adjusting tools are not permitted. Provide repair parts, the most up to date edition of catalogs, instruction manuals, lubrication charts, and required written instructions to the Department's Elevator Manager to allow maintenance following the commencement of the warranty period.

.4.2 SPARE PARTS: Elevator Contractor/Manufacturer shall confirm that spare parts are available for purchase by any party on a non - exchange basis on installed elevator unit in the University Facilities and Campuses. Spare parts purchases shall be at cost plus applicable parts mark-up as designated by current university elevator maintenance agreement.

.5 WARRANTY:

a. Prior to placing the elevator into service, the A/E shall schedule a final inspection of equipment. The final inspection shall include the Elevator Contractor, A/E, Elevator Consultant, General Contractor, University Project Manager and the Department's Elevator Manager.

b. The warranty shall include all labor to meet the EMCP requirements, and materials for period of 12 months after the university acceptance and the State of Ohio operating permit is issued.
c. Emergency Service requests will be initiated by Service Facilities.

.5.1 INSPECTIONS AND WORK PERFORMED DURING WARRANTY PERIOD:

a. The Elevator Contractor shall provide service in accordance with the EMCP requirements during the warranty period. The installing Contractor shall submit the report record using the EMCP application including call backs of all work performed on the relevant elevator(s) which shall include improvements, repairs, and modifications to the Department's Elevator Manager. The report(s) submittal shall be through the following methods:

   All work may be reported via the Department's Elevator Manager, Facilities Operation and Development's (FOD's) work order System and Service2Facilities call center, using the current Computerized Maintenance Management System (CMMS) as well as the EMCP application.

   - Copies of all service reports, repairs, maintenance records, oil logs, and Department of Commerce Elevator Violation notices received, originated or maintained by the Contractor shall be furnished through electronic transmission to the Department's Elevator Manager for inclusions in the CMMS Data Base.
   - Monthly testing of the fire service, alarm and emergency communication devices shall be provided. Provide EMCP record with copies of all service records and testing performed.

b. At the 10th-month anniversary date, after State Elevator and University acceptance date, the A/E and Elevator Consultant shall contact the Elevator Contractor to arrange an inspection of the elevator equipment. The A/E, Elevator Consultant, University Project Manager and the Department's Elevator Manager shall verify that all elevator component parts are operating as designed. The A/E and the Elevator Consultant shall make certain that all deficiencies found are corrected prior to the warranty expiration and the elevator is re-inspected. The A/E and Elevator Consultant shall submit the final report of deficiencies and corrections in writing to the University Project Manager and the Department's Elevator Manager.

.6 PERMITS: Elevator Contractor shall obtain and pay for all State of Ohio elevator permits and inspections, including callback inspections required for a final State Acceptance of the entire installation for new and modernization projects. Proof of Permit Application shall be furnished to the University Project Manager and the Department's Elevator Manager.

.6.1 Combine permits and certificates of operation shall be obtained by the Elevator Contractor within 48 hours of State Acceptance and shall be provided to the University.

14 20 02. REQUIREMENTS:

Elevator Design and Installation shall comply with the current Ohio Elevator and Escalator Codes and all referenced national codes and Standards.

.1 Access and Machine room: During Design, it is common practice for Design Consultants to need access to elevator machine rooms for field verification. All Consultants shall be escorted by the Elevator Contractor currently on contract or being utilized by the Department's Elevator Manager for maintenance. The University Project Manager and Department's Elevator Manager shall be contacted in advance for coordination.

.1.1 HOISTWAY and MACHINE ROOM: New elevator hoistways and machine rooms shall be sized in compliance with the National Elevator Industry, Inc. Vertical Transportation Standards, latest edition, and each hoistway and machine room shall be sized to accept all manufacturers' non-MRL equipment.

.1.1.1 Show Pit Ladder, Hoistway Sump Pump as required and other equipment on the Floor Plan of the Elevator pit.

.1.2 A/E shall detail locations of all support beams required in Hoistway. Indicate beams on building sections and details. For multiple Elevators in the same Hoistway, provide divider beams for guiderail support brackets.

.1.3 The Pit Floor shall be epoxy painted, including the Sump pump pit and up to first floor landing, color: light gray.

.2 Sump pumps or drains in the pit maybe required. If a sump pump is installed on a hydraulic elevator, it must pump into an oil separator/collector sized for worst case scenario; check current edition of the Ohio Plumbing Code (OPC). Provide removable flush grate covers on sump pump holes.

.3 HYDRAULIC ELEVATORS:

.3.1 For Hydraulic Elevator, installation may also be provided with Sump Pump with integral oil sensor or other Alarm Notification means so that Pump will not operate if hydraulic fluid is contaminating the water (Products are available from SEEWATER, INC., (www.seewater.com), 1-888- 733-9283 and other Manufacturers).

.3.2 Provide a high water alarm to detect pit water and move elevator to upper floor and remove from service and connect it to the building's energy

Management system and as an emergency alert to Service2Facilities call center. This applies to all elevator pits and sumps.

.4 HOISTWAY VENTING:

.4.1 Hoistway ventilation is not required by code.

.5 MACHINE ROOM

.5.1 Elevator machine and controller shall be installed in a code compliant elevator machine room. Machine space does not constitute an elevator machine room. Machine room shall provide full body entry. Provide an ample elevator machine room with heating and cooling of elevator machinery spaces. Design a machine room with an air conditioning and/or heating unit to eliminate the effects of temperature and humidity on the electronic components. The elevator machine room temperature must be maintained between 60□ and 90□ Fahrenheit and 40% to 75% relative humidity. The air conditioner cannot be located directly over the elevator controller. There must be at least 7' headroom. A means to collect and drain condensation shall be provided. Drain cannot be hooked up directly into the sewers. Provide a safe way to service air conditioners in machine room. All exposed drives must be guarded. The Elevator Machine room ventilation equipment is a vital part of the elevator operation, it is therefore, required that the Elevator Machine Room's ventilation equipment be connected to standby power or emergency generator, if available, for reliability.

.5.1.1 Provide drawing plans and sections for the elevator machine room and all equipment, sprinklers where required, HVAC, electrical, etc. Show machine room on elevations and roof top plans as relevant to all elevators.

.5.1.2 Only equipment required for elevator operation is permitted in elevator equipment spaces. No extraneous piping, ductwork, conduits, etc. will be permitted in elevator equipment spaces. Elevator machine room must be equipped with a light and duplex receptacle with GFCI. It must be on a separate circuit from the control equipment. Lights shall not be connected to the load side of a GFCI device.

.5.1.3 Elevator controller software updates shall be provided and installed immediately upon notification of such updates.

.6 WIRING and LIGHTING:

a. Elevator machine room must be equipped with a light and GFCI type duplex receptacles on each wall of the machine room. It must be on a separate circuit from the control equipment.

b. Provide properly sized primary or main line disconnect switch for each elevator to be mounted adjacent to the machine room door. In line of sight of the machine(s) and controller(s).
c. Use only rigid steel conduit in the elevator machine room for main power equipment. EMT may be used for low voltage control wiring.
d. Specify adequate and energy efficient lighting including LEDs that are interference free with controller and around equipment. Locate lighting to avoid conflict with repair, maintenance, installation of equipment such as motors and full removal of electrical cables.
e. Elevator car lighting fixtures will be wall sconces with full battery backup.

.6.1 Provide the following dedicated travel cable data lines for each elevator:

- 1 Camera
- 1 Monitoring System
- 2 Spares

. 6.1.1 Provide a hoistway lighting system for every elevator as follows:

a. Install a light at the top of the hoistway.
b. Provide light on top of the car approximately 24" above the car.
c. Locate lights at Pit Level, the corner of back wall of hoistway, where clearance allows.
d. If there is more than one elevator in the hoistway, provide lights between elevators near the divider beams, at Pit Level.
e. Provide 4-way light switches at the elevator pit, at the top of the hoistway, and in the elevator machine room.
f. Locate pit light switch next to pit ladder and above lobby floor level. Location of pit light switch shall be code compliant.
g. Provide ~~13 w fluorescent lamps (or LED) with integral ballasts and lamp base with cage~~ LED fixture, lensed with wire guard.

.6.1.2 When fire fighter's emergency operation is active, the entire height of the hoistway shall be illuminated at not less than 1 foot – candle (11 lux) as measured from top of the car of each fire access elevator.

.6.2 Provide OBC approved stairs for access to elevator machine rooms. Ship's ladders and alternating tread stairs are prohibited.

.6.3 FIRE PROTECTION: Elevator Hoistways and Machine Rooms may be exempted from the requirements for Automatic Fire Protection Sprinkler heads in fully sprinkled buildings when in compliance with the requirements of OBC, NFPA and the following:

a. An approved automatic fire detection systems that will respond to visible or invisible particles of combination connected to building fire alarm system.

b. Generator and Transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire resistance rating of not less than 2 hours.

.6.3.1 A/E shall provide a note on the construction drawings prohibiting Fire Suppression in elevator Hoistways and Machine rooms when in compliance with OBC, OFC, and NFPA.

.6.3.2 SOUND CONTROL: If elevator machine room is adjacent to an occupied space, the A/E shall be responsible for determining if additional sound absorbing materials are required inside of the elevator machine room to comply with program of requirements.

.6.3.3 SHUNT TRIP: Comply with NFPA 72.

.7 Provide proper separation between machine room and hoistway. Sound deadening material and fluid smell control systems is required for Hydraulic elevator machine rooms that are located next to classrooms, offices, student rooms, and occupied rooms.

Wexner Medical Center: Hydraulic elevator machine rooms should not be located next to patient care rooms, conference rooms, or offices without sound deadening material. Provide the minimum acceptable SCT rating.

.8 Provide a tank heater or viscosity alarm monitoring control system for hydraulic elevator oil systems. Oil tank heaters shall be large enough to maintain freely flowing oil in the coldest seasonal conditions.

.9 All elevators shall be designed with emergency power or a feature to lower the elevator to the closest available floor landing in case of a power failure, with an Emergency Return Unit (ERU).

.10 Provide a well casing with a plugged bottom sleeved with scheduled 40 PVC or HDPE with an end cap for further protection for all hydraulic elevators, except holeless hydraulic elevators. In addition to the sleeved well casing, the cylinder shall be wrapped with Mylar tape or coated with an asphaltic application.

.11 Provide Emergency Signs for Fire Fighters' operation at designated fire floor and emergency signs at each floor. Provide occupants signage at each floor with an etched graphic with the hall call station that says "Do Not Use Elevator In Case Of Fire" per elevator code. Signs shall be integral with each Hall Call Station with engraved / etched graphic.

Wexner Medical Center: Provide signs for firefighters' operation at designated fire floor, etched with the hall call station. Provide occupants signage at each floor

with an etched graphic with the hall call station that says “Do Not Use Elevator In Case Of Fire” per elevator code.

.12 Design the elevator main floor entrance with room for passengers to wait for the elevator out of the building’s traffic flow. If the Elevators open into Fire resistance rated corridor (egress path) there shall be a lobby that completely separates elevators from the corridor by fire/smoke barriers and opening protection.

.13 Design temperature and humidity conditioned airflow in front of the elevator doors.

.14 Design adequate space between the elevator and the outside to allow moisture and dirt walk-off prior to elevator entry.

.15 Design at least one elevator in each building to serve the mechanical equipment floor(s) and all other floors of the building.

Wexner Medical Center: The designated elevator shall be large enough to handle major pieces of equipment of the equipment room.

.16 All elevators shall be numbered with a university customer number in addition to the State number. Customer number shall be supplied by Department’s Elevator Manager.

.17 ELEVATOR SELECTIVE COORDINATION REQUIREMENTS**:**

The following requirements take precedence over the requirements of “overcurrent protection” in Division 26 of BDS, for Low Voltage Distribution Systems.

a. Where more than one driving machine disconnecting means is fed by a single feeder, the overcurrent protective devices in each disconnecting means shall be selectively coordinated.

b. The A/E Engineer shall design main feeder, sub-feeder and branch circuit protective devices that are selectively coordinated for all values of overloads and short-circuits.

c. Elevator Circuits and disconnecting means shall have the following characteristics:

1. Be a listed device.
2. Capable of being locked in the open position.
3. Fusible switch or Circuit breaker.
4. Have Shunt Trip capabilities.

d. Prohibited Elevator Circuit Application: There shall be no running of multiple circuits to the Elevator Machine room, in an effort to bypass the selective coordination required by this standard.

Commentary: *Selective coordination for elevator overcurrent protective devices is a critical electrical circuit. The A/E shall not shift the responsibility of designing this circuit to the installing contractor with any other supply side overcurrent protective devices.*

e. ~~.17.1~~ Elevator Overcurrent Protection shall be designed and be protected against overload and machine motors shall be rated as intermittent duty.

.18 Car HVAC Equipment Disconnect.

14 20 03. GENERAL DESIGN AND PLANNING:

.1 All components of the elevator system shall be manufactured by elevator manufacturers who are regularly engaged in the manufacture of elevator components; and all installations of elevator components shall be performed by Firms regularly engaged in installation, repair and maintenance of conveying systems.

.2 ELEVATORS TYPE PREFERENCE: Electric overhead traction type elevators are preferred. Hydraulic, Holeless Hydraulic, <u>in ground oil filled components shall comply with 14 20 02.10,</u> and basement traction elevators may be considered for specific applications. ~~Machine – Room – Less (MRL) Elevator, roped hydraulic, telescoping, or inverted plunger assemblies shall not be permitted.~~ The type of elevator required for a particular project shall be determined at the planning conference in consultation with the Department's Elevator Manager.

2.1 <u>PROHIBITED ELEVATORS TYPES: Machine-Room-Less (MRL) Elevator, roped hydraulic, telescoping, or inverted plunger assemblies shall not be permitted.</u>

.2.2 HYDRAULIC and ELECTRIC TRACTION ELEVATORS. The controllers shall utilize microprocessor based logic with control parameters fully field adjustable. Programmable chips shall be permanently programmed and shall not be affected by the loss of power or by spikes in the power system. The controller shall control the motor speed throughout the acceleration and deceleration to provide good floor approach and consistent stopping accuracy within gap limit allowed by the elevator codes. Controller shall control the high speed of the motor such that the performance time for up and down direction shall be similar. The controller's design shall be capable of controlling existing AC motors and/or new AC motors to provide the required RPM for the specified speed of the elevator. Controller shall maximize the use of solid state devices for reliability. Controller shall also provide for motor overload and overcurrent protection. The controllers shall be non-proprietary open market technology. Controllers shall have on board diagnostics with an integrated human interface system including monitor and keyboard.

Controller manufacturers shall have ongoing and regular comprehensive factory training available to any licensed elevator mechanic and elevator contractor, to perform maintenance, repair and modernization of the equipment, and a full time, staffed call center for tech support. All replacement material must be supplied on a non-exchange basis. Controllers that require special diagnostic or adjusting tools/devices are prohibited.

.2.2.1 Arrange equipment to provide ample room for servicing, repair, removal and maintenance.

.2.2.2 Design hydraulic elevator machine room off a public area or maintenance room. The hydraulic machine room should not share a common wall with classrooms or offices. Design traction machine room to be accessible from a public corridor or maintenance room. The entrance should not be accessed through an office or restroom.

Wexner Medical Center: The hydraulic mechanical room should not share a common wall with patient care rooms, conference rooms, or offices. The entrance should not be accessed through a patient care room or area, conference room, or office.

.3 PROVISIONS FOR ADDITIONAL ELEVATORS WITHIN THE CURRENT STRUCTURE: Where multiple elevators are planned and some units are for future installation, or are specified as an alternate, group units together that are included in the base contract, with no vacant spaces between units. Provide hoisting beam in base contract for all future or alternate elevators.

.4 DESIGN FOR MAXIMUM EFFICIENCY:

Wexner Medical Center: The hydraulic mechanical room should not share a common wall with patient care rooms, conference rooms, or offices. The entrance should not be accessed through a patient care room or area, conference room, or office.

.4.1 Basement Traction Machine: Applications with heavy loads both weight and traffic count, which require a low building profile and minimized elevator overhead heights.

.4.2 Overhead Traction Machine: Applications over four stops. Rise, speed, and heavy weight/traffic count, will dictate geared or gearless applications.

.4.3 Provide the fastest speed/capacity as determined by the building structure.

.5 EQUIPMENT SPECIFICATIONS: Including the following:

a. Motors shall be AC by Imperial or Reuland.
b. Hostway doors, Car doors, and Cabs acceptable Manufacturers are: Gunderlin, Tyler, and H & B.

c. Load weighing device shall be a rope mounted strain gauge with audible and visual signals compatible with elevator controller.

d. Engrave: "WHEN FLASHING, CAR IS OVERLOADED". The flashing light would be emanating from an overload sensing light or indicator mounted on the car control panel.

e. Isolation transformer shall be installed for each elevator.

f. Fixtures shall be GAL. Mfg. VPMC Series, vandal resistant. Hall Stations shall have engraved signage. Hall position indicators shall be installed at each floor and a Fire Command/Emergency power panel installed in the lobby/vestibule by the fire alarm remote annunciator. Department's Elevator Manager will provide and approve templates for fixtures prior to fabrication.

g. Items to be sole-sourced are: Governors, Safeties, and Rope Grippers shall be Hollister Whitney. All roped elevators shall have a Hollister Whitney rope gripper installed, regardless of dual sheave brakes. Machine/Brakes, and sheaves shall be by Hollister Whitney or Imperial – Geared or Gearless. Ropes shall be Bethlehem.

.5.1 ACCESS TO OVERHEAD SHEAVES for the lubrication and servicing. Specify cable self-oilers for traction elevators.

.5.2 All rotating equipment must be mounted on isolation pads.

.5.3 INSTALL ELECTRIC FEEDER PROTECTION including line filters with elevator controls.

.5.4 EMERGENCY OPERATION shall be specified per NFPA 72. All elevators in a bank should be sequenced to return to the main lobby, park with doors open. The next car would do the same automatically until the last car is landed at the lobby. A secondary landing shall be designated by the fire alarm system in case of fire at the lobby level.

Wexner Medical Center: An elevator consultant shall provide a recommendation on the number of elevators in each bank necessary to be on emergency power. The number of elevators in each bank on emergency power shall be a minimum of one.

.5.5 SEPARATE ELECTRIC SERVICE TO CONTROL SYSTEM by fused disconnect. Elevator lights and accessories will be on a separate fused disconnect and readily available to inside the door of the mechanical room.

.5.6 STUDS AND PROTECTIVE PADS: Provide pad studs in all elevator cabs and one set of typical protective pads per project. Pads shall have rubber grommets.

.5.7 For both new and remodeling installations, premium quality heavy duty door operators and track assemblies shall be specified to provide high performance operation.

.5.8 Door equipment shall be GAL Mfg. Heavy Duty MOVFR with double spring sill closers.

.5.9 Door panels shall be sandwich construction with 2 gibs per panel plus1 fire gib.

.5.10 TRACKS AND ROLLER GUIDES: All tracks shall be steel. All roller guides shall consist of three sound reducing wheels and shall be bearing steel with Dura bond LFX70 polyurethane tires. Precision type Roller guides shall be held in contact with the rail by means of adjustable devices. Roller guides shall run on dry unlubricated guide rails. Car rollers shall be a minimum of six inches in diameter. Counterweight rollers shall be a minimum of three inches in diameter.

.5.10.1 GUIDE RAILS: Use 'T' type guide rails for all car and counterweight guide rails.

.5.10.2 Roller Guides shall be Elsco Heavy Duty Model A for cars guides and Model C for counterweight guides.

.5.11 Elevator car doors are to be protected by full door infrared reversal devices with multiple beams that cover at least every six inch area of the opening.

.5.11.1 Door Reversal Device shall be Janus Panachrome.

.5.12 GUARDS FOR TOP OF CAR: Where there is more than 12" of space between the car and the hoistway wall a 42" car top guard rail and a midtrial at 21" are required.

.5.13 STAINLESS STEEL CAR DOOR and frames.

.5.14 CEILING PANELS: May or may not be required depending on location, if required for any location it will be determined during planning conferences in consultation with Department's Elevator Manager.

.5.15 FACTORY FINISHED HALL DOORS AND FRAMES: Color shall be stainless steel or as selected by the Architect/Engineer and approved by the University Architect.

.5.16 HOISTWAY AND CAR SILLS: Sills shall be nickel silver. Install car sill extension to be flush with front returns.

.5.17 FLOORING:

- Sub Flooring: Car sub floors shall have a metal pan lining with ¾" APA Sanded Plywood Grade, APA A-C Plugged, Group 1, and fire retardant treated.
- In general, elevator flooring shall comply with requirements found in Division 09, with the following additional requirements:

1. Flooring materials shall be slip resistant compliant in accordance with OSHA and ADA Standards.
2. Flooring material shall be a “no wax” material.
3. All seams shall be “heat” or “cold” welded seams in accordance with manufacturing recommendations for warranty and durability compliance.
4. Installed flooring material shall have a minimum of ten (10) year warranty for wear and durability.
5. Installers shall be factory trained in installation, repair, and maintenance of said flooring material.
6. A/E shall provide samples of the proposed flooring material to the Project Manager for approval by the Department’s Elevator Manager prior to installation. (Examples of currently approved passenger elevator car flooring material should be similar to Norament Grano and Norament Round, by Nora System, Inc. and diamond plate for service / freight elevator cars.)
7. The use of specialty flooring materials such as tile, marble, or carpet is discouraged. Proposed specifications for installation of these materials must be approved in advanced by the Department’s Elevator Manager on a case by case basis only.

.5.18 TELEPHONE SYSTEM: Furnish a vandal resistant telephone integral with car operating panel. Phone must be single button operation with ring down circuit. No phone cabinets will be allowed. The phone wire to the elevator machine room will be a part of the travel cable. It is required that each car shall be equipped with an independent phone line. Phone shall be line powered only not capable of being programed nor be equipped with timers or Batteries.

Commentary: *Preferred Manufacturers are: Wurtec, EMS and Viking phones.*

Wexner Medical Center: Connect to the OSUWMC telephone system for a fully functional system. Follow OSUWMC IS guidelines to make the final termination.

.5.18.1 Conduit and wiring from the Elevator Controller to the telephone backboard and Dual Wall Jacks for interfacing all other elevator equipment from the Controller shall be installed by the Electrical Contractor. Show location on drawings.

.5.18.2 Final connections to the elevator controller shall include pulling elevator wiring to remote junction box for final hook up in the Controller by the Elevator Contractor.

.5.18.3 Connect to the Campus telephone system with coordination with Office of the Chief Communication Office (OCIO), Wexner Medical

Center-IT for a fully functional system. Follow (OCIO) guidelines to make the final termination to the telephone backboard. The travel cable shall have the necessary make-up and quantity for elevator operation plus 20% spares, plus 6 spare twisted, shielded communications wires (typically 20 awg). An additional separate (fire alarm) travel cable shall be installed and contain 8 pair twisted shielded 14 awg.

Wiring: The fire alarm wiring system shall be stranded copper, 75 degree C insulation, FPLP rated or Fiber Optic in some approved cases.

.5.19 **Wexner Medical Center** ELEVATOR FINISHES:

ELEVATOR CABS: All stainless steel finishes to be No. 4 satin.

Doors: Stainless steel.

Door Frames: Stainless steel.

Floor Finish: Carpet tile, see Interior Finish Schedule for approved manufacturer, type, and color.

Side and Rear Walls: Metal laminate.

Ceiling: Stainless steel with recessed LED downlights.

Base: Baked enamel on steel, recessed.

Front Return Panel: Same construction as doors.

Car Operating Panel: Integral with wall front return, one per car.

Hand Rail: Stainless steel, rear wall, continuous.

Door Threshold: Extruded aluminum.

HOISTWAY ENTRANCES: All stainless steel finishes to be No. 4 satin.

Frames: Stainless steel.

Doors: Stainless steel.

Sills: Extruded aluminum.

.5.20 The following requirements shall be covered in The Elevator's Specifications:

.5.20.1 Interior car finishes (Walls, Handrails, Kick Plates, etc.)

.5.20.2 In Car Lighting (Normal and Emergency)

.5.20.3 Pit Lighting

.5.20.4 Machine Room Lighting

.5.20.5 Fixture Finishes (Stainless Steel, Vandal-Proof)

.5.20.6 Operating Panel Requirements. The in car operating panel requirements shall be engraved with the building name, elevator number, elevator capacity, and fire fighter operation information for all University elevators.

.5.20.7 Posting of Operating Certificate. The certificate shall be delivered to the Department's Elevator Manager. No certificate frames are to be provided.

.5.20.8 Emergency Battery Type

.5.20.9 Car Top Inspection Station

.5.20.10 Car Ventilation

.5.20.11 Install Fire Alarm speaker, provided by others, in elevator car, wired on a separate circuit.

.5.20.12 **Wexner Medical Center**: Consideration shall be given to the type and frequency of traffic on each elevator for heavy-duty car sills.

.6 OPERATION:

.6.1 CONTROLS FOR PERSONS WITH DISABILITIES: refer to Ohio Building Code, Chapter 11, ICC A117.1 and 2010 ADA Standard for Accessible Design, for specific requirements.

.6.2 INDEPENDENT KEY CONTROL: Where elevators require key control, surface mount key switches are preferred. Security issues should be addressed thru programmable software. Cylinders for key operated devices shall be specified in the section entitled FINISH HARDWARE. Final keying will be determined by the University.

.6.2.1 Car Operating Panel-key switch hardware shall be Stanley Security Solutions Cylinder IE7 series and Stanley Security Solutions small format 7- pin interchangeable core for floor functions and Gem type FEOK1 for fire fighters' functions. Panel key switches may vary with user group.

.6.3 Controllers shall be GAL Galaxy.

.6.4 SPECIAL REQUIREMENT:

.6.4.1 Specify as SAFETY MEASURE FOR TRACTION ELEVATORS, to be part of controller package, a circuit installed to detect the failure of the brake to lift. Detection of this failure shall be by means of mechanical switch and shall take the elevator out of service at the next stop and shall remain out of service until the condition is rectified.

.6.5 FIRE MARSHAL REQUIREMENTS:

a. When emergency power is provided, the elevator(s) shall be tested under a full load on the generator. This shall include all emergency lighting and other emergency loads connected to the generator.
b. Fireman's service shall be under emergency power condition.
c. When Firemen's Service is provided, the Department's Elevator Manager and TSG shall be consulted as to which floors shall become priority 1 and priority 2 for emergency return situations.
d. Provide the University's standard key security box near the entry used by first responders. The A/E, Consultant or Elevator Contractor shall provide elevator keys to the University's Department of Public Safety for placement in the key security box. Keys shall also be provided to the Department's Elevator Manager.

.6.6 Design solid state devices (SCR) Drive to reduce harmonic distortion to an acceptable level as described below.

.6.6.1 Silicon Controlled Rectifiers (SCR) Drive shall limit the total harmonic distortion (THD), especially THD reflected back into the power system at motor speed of 50 to 100 percent (%) without substantial harmonic distortion anywhere in the system.

.6.6.2 Solid state devices or Silicon Controlled Rectifiers (SCR) Drive input voltage wave form or voltage distortion limits shall be less than 3% THD.

.6.6.3 Wave form distortion of the fundamental cycle can come from many sources (i.e. rotating machines, etc.). Therefore, it is required that the contractor measure reflected third harmonics (THD) after the startup of the system. Contractor shall provide all the necessary instruments or tools required to accomplish this measurement without any additional cost to the University. This measurement shall be done in the presence of Ohio State Representative(s) from the Department's Elevator Manager.

.6.7 ELECTRICAL MAGNETIC FIELD INTERFERENCE (EMF) SHIELDING:

.6.7.1 GENERAL: Whenever elevator machine rooms/control rooms are adjacent to sensitive electrical equipment rooms (i.e. computer centers/rooms, elevator electronic control rooms) it is required that adjacent walls, floors or ceilings shall be shielded per Section 26 10 00 of this standard.

14 20 04. DESIGN FOR SPECIFIC INSTALLATIONS:

.1 Freight Elevator Design/Selection: If the elevator shall be used for carrying passengers and general freight, it shall be designed as a passenger elevator.

.1.1 ELEVATORS FOR PARKING RAMPS AND OTHER OPEN STRUCTURES: Elevators shall be designed in a sheltered area where rain and snow cannot reach any of the entrances directly. The elevator design shall provide for a protected area in front of the elevator doors to shelter people waiting for the elevator in inclement weather. Outdoor seasonal elevators shall be designed to provide removable exterior doors that will protect the elevator entrances and shaft from the penetration of water and snow. Outside doors will also eliminate off-season vandalism and increase safety from falls into the elevator shaft. Exclusion from the elevator by fencing or other method is preferred. Elevator shall be provided with:

.1.2 HEAT AND AIR CONDITIONING IN EQUIPMENT ROOMS to accommodate equipment. Provide heat and air conditioning to maintain adequate conditions per manufacturer requirements. Provide electrical heaters in hoistways to prevent condensation in the limit switches and ice in the door tracks.

.1.3 HEAT IN ELEVATOR CAB shall be in accordance with elevator code requirements.

.1.4 AN EMERGENCY CALL BELL switch shall operate a bell in an occupied space. In some instance (i.e., parking ramp) a remote bell in another building may be required.

1.5 GLASS OBSERVATION ELEVATORS must have emergency power to operate a fan. Battery back-up shall be provided to maintain a minimum of four hours of exhaust fan operation.

.2 ELEVATORS FOR MULTI-STORY BUILDINGS: In buildings requiring the use of automatic elevators, provide at least one elevator sized for evacuating people and for delivering firemen and equipment to a fire:

.2.1 The elevator car minimum clear dimensions shall be per 2010 ADA Standards for Accessible Design, Figure 407.4.1 Elevator Car Dimensions (a) and ASME A17.1 Standards. Elevator door shall be horizontal, sliding type to

accommodate wheelchairs or an ambulance stretcher in its horizontal position.

.3 The Architect/Engineer shall notify the University's Project Manager by letter prior to submission of schematic design documents for any of the following elevator types:

a. Glass walled observation elevators

b. Outside elevators

c. Outside seasonal elevators

d. Open air hoist ways

e. Escalator

f. Dumb Waiters

.4 PROJECT COMPLETION: Project is complete when all specification items are completed to the satisfaction of the Department's Elevator Manager, and when the Elevator Contractor through the A/E has provided three hard copies and one electronic copy of all "As-Built" Drawings and One-Line-Diagrams of mechanical and electrical drawings to the FOD Elevator Support Assistant Director Department's Elevator Manager. The "As-Built" Drawings and One-Line-Diagrams furnished shall present a clear view for use in maintaining proper operation and troubleshooting and repairs as needed. Final Acceptance by the university shall be done in coordination with the University Project Manager, manufacturer, consultant and end users.

.4.1 PROJECT CLOSE OUT: At the completion of the elevator project(s) A/E and Elevator Contractor shall provide the followings in conjunction with the university requirements and Standards:

a. Training for Daily Operation shall include specifically one-half day (4hrs.) of on-site instruction for the operation of the equipment. The training shall be attended by the university's designated personal of the Department's Elevator Manager on the proper operation and maintenance of installed equipment prior to the university acceptance of elevator project as completed.

b. Provide two (2) sets of hard copy and electronic media format of maintenance instructions, checklists, recommended lubricants, parts manuals, etc. to permit maintenance of newly installed equipment.

c. Provide recommended lists of spare Parts, including specific items needed to support the new microprocessors and solid state speed control units.

d. Provide wiring diagrams, technical manuals, and any diagnostic tools including operating and access codes incidental to the installation shall become the sole property of The Ohio State University and shall not be subject to any Manufacturer's restrictions.

14 92 00. PNEUMATIC TUBE SYSTEMS:

Wexner Medical Center: SYSTEM ARCHITECTURE: The existing system consists of a 4" Swisslog CASIII System extended throughout the Doan, Rhodes, and James Cancer complex. In addition, there is a separate Swisslog CTS 6" TL 2005 System that extends throughout Ross Heart Hospital with branches to the Rhodes/Doan Hall labs and Emergency Department. Both front ends for the existing systems reside in Doan 009.

Wexner Medical Center: CASIII SYSTEM: Any addition or modification to the existing 4" system shall utilize latest release of electronics and communicate with he existing CASIII front end. Most of the devices on the 4" system utilize emergency power. In order to strive for full functionality in an emergency situation, it is recommended that any new devices requiring an electric service utilize emergency power.

Wexner Medical Center: CTS 6" TL 2005 SYSTEM: All devices on this system are fed from emergency power enabling operation in emergency situations. In order to maintain consistency, any additions to the existing system shall utilize emergency power if an electrical service is required. Any extension of the existing 6" system shall be the Swisslog CTS 6" TL 2005 System. Any new system shall be Swisslog and communicate with the exiting front end.

END OF DIVISION 14 – CONVEYING SYSTEMS

21 00 00. FIRE SUPPRESSION

21 00 03. GENERAL PROVISIONS

.1 PREPARATION AND COORDINATION OF CONTRACT DOCUMENTS

.1.1 PLUMBING CONTRACT: Include work related to Fire ~~Protection~~ Suppression within the scope of the Plumbing Contract. The Architect/Engineer shall consult with the ~~Ohio State University's Division of Emergency Management and Fire Prevention~~ The Ohio State University Department of Public Safety (DPS) and Facilities Design and Construction Technical Services Group during the early planning phase and prior to any meetings with the Authority Having Jurisdiction.

.1.1.1 Specify that the contractor performing the fire ~~protection~~ suppression work shall be licensed and certified by the Department of Commerce Division of State Fire Marshal to perform work on the fire ~~protection~~ suppression system.

.1.1.2 CUTTING AND PATCHING: Division 01 should contain the article covering this item of work; however, mention should be made of special items of work that are not adequately covered in the General Conditions. Clearly indicate that responsibility and cost is to be borne by the fire suppression contractor.

.1.1.3 UTILITY CONNECTIONS: Include the following instructions in the specifications:

"Procedure for making connections to existing utilities shall be planned at least two weeks in advance of the work and the work shall be executed in a manner to provide reasonably continuous service throughout the construction period. **Connections shall be made only at times approved by the University Construction Manager.** For interruption of service in major utility systems, the Contractor must submit to the A/E an impairment plan with step-by-step sequence of operations planned to accomplish the work. Outline must show tentative dates and times of day for shut-off and restoration of services." Contractor to arrange and pay for temporary utilities if required by project conditions. Submit drawing of proposed temporary connections for approval.

The A/E will review the information given with the University Construction Manager, who, upon approval of the planned operations, will make arrangements with appropriate University personnel for interruption of services. Refer to Division 01 of the Building Design Standards. The A/E shall also specify and refer to the university Utility Outage Procedure found on Facility Operations

and Development's (FOD's) website under the Vendor Resources, Utilities tabs with the following link: http://fod.osu.edu/resources.

Caution to Bidders: Bidders are cautioned that the University will probably schedule interruption of services at times other than the contractors' normal working hours and that only designated University personnel are authorized to interrupt services. Frequently, outages are scheduled between semesters to reduce disruption of classes."

.1.1.3.1 PERMANENT UTILITY CONNECTIONS: On projects where connections to existing utilities (i.e., fire suppression lines) are proposed, the A/E shall contact Facilities Operations and Development (FOD) (through the University Project Manager) to ascertain the actual operating conditions and limitations of such systems to confirm that ample capacity, both present and future, will be available for project loads. The A/E shall also complete and submit for approval the Utilities Request Form found on the FOD website at http://fod.osu.edu/resources. The A/E shall submit proposed modifications to the University's utility connection requirements to the University Engineer through University Project Manager for prior approval. This is mandatory in order to obtain approval for connection and/or extension of any utilities. Instructions in the specifications must be provided to insure proper bidding, planning, coordination and minimal utility outages. Also see Division 33, Utilities.

.1.1.3.2 Fire suppression piping shall not be run under buildings.

.1.1.4 CONCRETE PADS, BASES, AND CURBS: Concrete pads, bases, and curbs are provided in Division 03; however, the Fire Suppression Contractor shall furnish and install sleeves, anchors, and other items which require embedment in concrete. These installations must be coordinated with the work specified to be performed by the General Contractor.

.1.1.4.1 CURBS: Pipe shafts and similar openings in slabs shall be curbed in HVAC equipment rooms, pump rooms, kitchens, and other areas which are subject to flooding. Curbs shall be not less than 4 inches high. The General Contract drawings shall show required curbs.

.1.1.5 PENETRATION OF FLOORS AND OF FIRE RATED WALLS by fire suppression piping and related equipment is prohibited, unless openings are appropriately fire-stopped by sealing of voids with fireproof materials. Fire-rated walls or floors must not have the rating reduced by penetrations or reduction of thickness. Precautions must be used by contractors when coring or making

penetrations to ensure that the cored material does not drop to the floor below and cause an accident or injury. See Division 07 for requirements.

.1.1.6 SLEEVES:

.1.1.6.1 PROTECTION FOR INSULATED PIPES: When insulated pipes penetrate floors that will be covered with finish flooring, specify that a sheet metal protective covering be installed around the insulation jacket. Sheet metal jacket shall extend through and above the pipe sleeve far enough to protect the insulation from bumping by floor polishing machines and vacuum sweepers. Space between the pipe sleeve and the sheet metal must be sealed. Where insulated pipes pass through wall sleeves, cover insulation with sheet metal and seal both ends of the space between the sleeve and sheet metal with non-combustible packing.

.1.1.6.2 CLEARANCE: Provide not less than 1/4 inch clearance on all sides for both insulated and non-insulated pipes which penetrate walls and slabs.

.1.1.6.3 LENGTHS: Except where greater lengths are required for penetrations through floors, sleeves shall be fabricated to a length equal to the thickness of construction through which they pass. See below.

.1.1.6.3.1 SLEEVES THROUGH WATERPROOFED FLOORS shall project a minimum of 4-inches above the floor.

.1.1.6.3.2 SLEEVES IN HVAC AND PLUMBING EQUIPMENT ROOMS shall extend no less than 1-1/4 inches above the curbs.

.1.1.6.3.3 SLEEVES IN ALL OTHER FLOORS shall extend 3/4 inch above the finish material on the floor.

.1.1.6.3.4 SEALS: Special wall sleeve fittings with soft rubber seals shall be specified for water service piping. In other installations, the void between pipe and sleeve shall be sealed with mineral wool or other non-combustible material to prevent passage of flame and smoke. In locations exposed to public view, the packing materials shall be concealed with sheet metal cover plates or split type, chromium plated brass escutcheons.

.1.1.6.4 FIRE-STOPPING: Specify and show fire stopping at all penetrations of fire-rated assemblies.

.1.1.6.5 Sleeves for copper pipe shall be fabricated of copper pipe for up to 4 inches in diameter.

.1.1.7 STRUCTURAL SYSTEMS: Lintels for openings to accommodate fire suppression installations should be provided in Division 05. Refer to paragraph 05 50 00. Any other structural steel required for support of equipment can be specified by making reference to applicable portions of Division 05.

.1.1.8 ANCHORAGES AND SUSPENSION SYSTEMS: Each utility system, including fire suppression piping, and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure. Where interference occurs, provide trapeze type hangers or other suitable supports for each system. Locate hangers and supports where they will not interfere with access to mixing boxes, fire dampers, valves, and other appurtenances requiring servicing. Attention to this prohibition must be included in every section when there is the possibility that other than the independent suspensions systems would be used, together with prohibitions against use of perforated steel strap, power actuated anchors and plug anchorage (using wood, lead or plastic).

.1.1.9 ROOF MOUNTED EQUIPMENT, FLASHING AND ROOF PENETRATIONS: Specifications should alert the Fire Suppression Contractor that installation must be coordinated with work specified to be performed by the roofer. Refer to paragraphs 07 50 10.3 and 07 60 10.4. All roof mounted equipment shall be provided with pre-fabricated mounting curbs at least 12-inches high. Curb shall be fabricated of double dipped galvanized steel, copper or stainless steel. Any installation design must facilitate roof repair and maintenance. Protrusions through roof (standpipe hose connection piping, etc.) shall be located go as not to disrupt flow of water to roof drain. Maintain a minimum clearance of 6-feet from parapet walls or change in elevation and from roof sumps or drains. Note that pitch pans or pitch pockets are prohibited. Additionally, establish architectural acceptability with only projections approved by the Project Manager.

.1.1.10 PAINTING: Cleaning and painting Fire Suppression and equipment exposed to view should be specified in Division 09. If concealed installations require painting before being concealed, list the installations and specify that materials and application be as specified in Division 09. Do not specify painting of the same surface

under more than one Division except shop prime coats, where protection is needed, color banding and flow arrows. See 09 91 23.1. USE OF INK MARKING PENS ON ANY SURFACE IS PROHIBITED. Marks bleed through paint or other finishes.

.1.1.10.1 COLOR CODING OF PIPING: Specify that, after piping has been finish painted, the installer of the piping identify the type of service lines and direction of flow with pre-printed, color-coded self-adhesive or pre-coiled plastic pipe labels. Lettering shall be at least 1-1/2 inches high. Specify that indicators be applied at connections to pumps and other equipment; at entrances to spaces; adjacent to valves; near access doors to pipe spaces; and at 30-foot maximum intervals on long pipe runs. Specify that letters be positioned to be easily read from a normal standing position.

.1.1.10.2 Use ASME A13.1 color schedule and identify piping service using the same designations or abbreviations as used on the Drawings.

.1.1.11 PIPING: Since the Fire Suppression contract is required to be separate from the Plumbing and HVAC contracts, provide independent and complete documents for each contract. The documents shall clearly indicate the scope of work included in each contract and shall call attention to areas of work that require coordination between contractors. For those common areas where the two contractors meet, on each document state which contractor is responsible for which work. Do not use the words 'Not in Contract', and do not use the acronym 'N.I.C.' If related work is required, then show and state the contractor by Division (i.e., Plumbing, or HVAC, etc.).

To avoid duplicate costs for identical work, these notations are necessary. Be sure to indicate the extent of related work and which contractor makes the interconnection.

.1.1.11.1 PIPING DETAILS, which are applicable to any or all of these three Divisions of the work, follow; details, which are applicable only to particular divisions, are stipulated in the guides for the particular division.

.1.1.11.2 SUPPORTING DEVICES: Perforated strap hangers are prohibited.

.1.1.11.2.1 HANGERS: Trapeze hangers and other hangers permitted by NFPA 13 are acceptable.

.1.1.11.3 THREADING cast iron or ductile iron pipe is prohibited.

.1.1.12 MOTORIZED EQUIPMENT: Basic requirements for electrical work and equipment are covered in Division 26 of these standards. The requirements included herein cover specific items that have been troublesome in the past and require that the specifications incorporate adequate provisions for electrical work and equipment furnished by the Fire Suppression Contractor. The A/E shall specify motors, drives, and equipment to meet all operating requirements for the installation. Consideration for motors should be for voltage, phase, frequency, frame size, temperature rise, and sufficient starting torque to start loads with high inertia. Performance requirements should include capability to make multiple starts per day to meet energy conservation control requirements. Where necessary, non-recycling shall be specified to protect the equipment from short time recycling.

.1.1.12.1 WIRING: Specifications shall clearly point out the responsibility for wiring related to fire suppression and fire alarm equipment. In general, it is required that power wiring is provided by the Electrical Contractor and control wiring is provided by Fire Suppression Contractor.

.1.1.12.2 STARTERS: Specifications shall require that motor starters be provided by the Electrical Contractor. Exceptions to this requirement will require the approval of the A/E and his review is necessary to ascertain that standards stipulated in the electrical specifications are followed.

.1.1.12.3 MOTORS shall be sized in accordance with applicable NEMA standards for the operating conditions of each specific items of equipment with a 1.5 1.15 service factor. Motors must be selected to operate within nameplate HP and shall not operate on the service factor. Short shaft motors shall not be used for belt drives. In general, motors one-half horsepower or smaller shall be single phase; larger motors larger than ½ horsepower shall be three phase. Motors shall be provided with electrical overload protection to prevent burn-out under operating conditions. Single phase motors shall have internal thermal overload protection which automatically resets. Large motors shall have adequate internal overload and thermal protection in addition to the overload elements in the motor starter.

.2 NFPA: Installation must comply with all ~~current editions of the NFPA as referenced in the current edition of the Ohio Building Code (OBC)~~ applicable codes and standards, including Ohio Building Code (OBC), Ohio Fire Code (OFC) and referenced standards, including specific editions of NFPA referenced unless noted otherwise. Whenever referring to materials and installations by National Fire Protection Association (NFPA) Publications use the OBC and/or OFC referenced

editions, unless noted otherwise, and include the date of each referenced publication in the specifications.

.3 EXISTING FIRE PUMPS: In remodeling or alteration projects where an existing fire pump will be used, consult the University Architect regarding desirability to updating systems to comply with the standards stipulated herein.

.3.1 Existing fire pumps shall be flow and pressure tested by the fire protection contractor to confirm actual availability of water.

.4 The Architect/Engineer should note that the Department of Commerce Division of State Fire Marshal is the Authority Having Jurisdiction (AHJ) on the Columbus Campus.

.5 **Wexner Medical Center**: Areas under renovation not currently having sprinklers shall be added as part of the project. Floor piping shall be sized such that provisions for future extension of sprinklers to all non-sprinkled areas of the floor and/or zone can be made. Areas of renovation having any sprinkler head type but semi-recessed shall be replaced as part of the renovation by a semi-recessed sprinkler head.

.6 FIXED EQUIPMENT required by the program will be furnished by the project unless written exception is given by the University Engineer for the omission. Also, See Division 11.

.7 RELOCATING EXISTING EQUIPMENT

.7.1 Relocation of existing equipment must include disconnecting and moving to new location as well as restoration and capping utilities at the old location.

.7.2 Require the contractor to be responsible for recording existing wiring and piping to facilitate reinstallation.

.7.3 Require the contractors to replace unsalvageable piping and wiring and to furnish any new piping and wiring to complete proper reinstallation.

.8 RESTRICTED LOCATION: Operating equipment other than sump pumps shall not be located below the published 500 year FEMA floodplain elevation for hydraulically connected facilities.

Commentary: *"hydraulically connected" is intended to mean facilities that are connected to other buildings/facilities or the Olentangy River by tunnels, drainpipes, conduit, etc.*

.9 FIRE PROTECTION SYSTEM IMPAIRMENT FORM: A/E and PM shall identify how the project's scope of work will cause an impairment to existing fire protection or detection system, fire alarm system or other system designated to maintain the fire resistance of the building elements or structure is taken out of service, either wholly or in part, planned or unplanned. PM shall complete the Fire Protection System

Impairment form and e-mail the completed document to emergencymanagement@osu.edu

.9.1 Link to form: https://dps.osu.edu/sites/default/files/impairment.doc

21 00 05. SUBMITTALS

.1 GENERAL: Refer to Division 01 for the list of submittals required to insure quality control of materials and workmanship. Submittals required for specific items may be stipulated in articles in which the items are specified (as is done in these standards) or may be listed under this heading. The A/E shall stipulate additional submittals that he deems necessary for the prosecution of the work.

.2 SAMPLES AND SHOP DRAWINGS: Reference should be made to Division 01 for instructions for making these submittals.

.2.1 Submittals shall be specified to be provided within 90-days of Notification to Proceed.

.2.2 PERFORMANCE CURVES: Specify that these be submitted with shop drawings.

.3 RECORD DRAWINGS: The A/E is directly responsible for the accuracy of these records. In addition to notes made in the field by the A/E's representative, Article 11 of the General Conditions requires Division Contractors to accurately record all deviations from Contract Documents during construction and to furnish this information to the A/E. When writing specifications, avoid wording that might suggest to contractors that changes can be made without prior approval. See 01 78 39.2.

.3.1 Building Information Modeling (BIM): The Architect/Engineer, or Contractor shall meet, for projects four million dollars or greater, the BIM Project Delivery Standards (BIM PDS).

.4 WARRANTIES, OPERATION AND MAINTENANCE MANUALS: Within 60 days after (Temporary or Permanent/Final) Certificate of Occupancy, submit warranties, instruction sheets, catalog data, and final shop drawings electronically following the university's Project Closeout Standards. Also see 01 78 23. Provide full information defining all conditions, quantities, pressures, temperatures, etc. during the testing operations of each piece of equipment.

.5 POWER AND CONTROL DRAWINGS: Electrical power and control drawings for large, complex electrical equipment shall be supplied and posted at, on, or near the equipment. Provide framed clear acrylic plastic protection.

.6 DIAGRAMS AND OPERATING INSTRUCTIONS: Complete diagrams and operating instructions for all control systems shall be posted near the related equipment. Provide

framed clear acrylic plastic protection. When multiple equipment rooms exist in a building, these diagrams will be required at each piece of equipment. Additionally, a complete set of diagrams will be posted or made available in the main equipment room and shall be included in the O & M manuals submitted as part of the project closeout.

.7 SUBMITTALS: Require that shop drawings for systems be sent to the Architect/Engineer (A/E) for review and, after approval, be submitted by the (A/E) to the Department of Commerce Division of State Fire Marshal for review. Require that informational and/or operating manuals be provided for all fire protection equipment. Specify that all fire protection products and equipment must be manufactured in the USA.

.7.1 List of required submittals shall include backflow preventers, fire pump, fire pump controller, jockey pump, piping, pipe fittings, sprinkler heads, flow switches, tamper switches, any additional required submittals shall also be provided.

.7.2 A water flow test report shall be submitted based on a water test conducted in accordance with NFPA 291. The fire suppression contractor shall be responsible for conducting a new water flow test for use in his design.

.7.2.1 The water supply data used for design shall include safety factors for daily and seasonal fluctuations, which can be significant.

.7.3 Specify three unique stages of design submittals for any fire suppression system, as follows:

.7.3.1 Materials and Equipment List (Product Data): Include all materials, equipment and accessories required for the work. Include catalog ID numbers, drawings, cut sheets as necessary to define the work. If cut sheets include multiple selections, and or optional selections, then clearly label the included selections and the included options. Submit to the Architect/Engineer (A/E) for review.

.7.3.2 Preliminary Shop Drawings: Include sprinkler head locations only. Include full-size detail representation of each style of sprinkler head to be used. Submit to the Architect/Engineer (A/E) for review.

Commentary: *Preliminary shop drawings shall be prepared by the fire suppression contractor and shall be reviewed and accepted by the university in coordination with the University Project Manager prior to installation.*

.7.3.3 Detailed Shop Drawings: Drawings that conform to the "Working Plans" section of NFPA 13. Include pipe layout and sizing, sprinkler head locations coordinated onto reflected ceiling drawings, hydraulic calculations, system controls, and all equipment cut sheets, zone valves, zone drain valves, and zone test stations. Submit to the Architect/Engineer (A/E) who, after review and approval, shall submit to all required parties identified in 21 00 05, Authority Having Jurisdiction (AHJ), the Department of Commerce Division of State Fire Marshal, and the University's Office of Financial Services Insurance Administrator, for review and approval by all.

21 00 07. TESTING

.1 TESTING OF FIRE PUMPS: Include in the specifications the requirement that the contractor and the pump manufacturer perform an acceptance test of the system in the presence of the A/E and designated University personnel. Prior to the acceptance test, the fire pump will be tested for proper operation. The fire suppression contractor shall be required to protect landscaping, property, and personnel from water discharge. Water discharge is prohibited over sidewalks and parking lots where temperatures are below freezing. Scheduling and other arrangements for the demonstration shall be made through the A/E and the University Project Representative.

21 00 09. RELATED WORK IN GENERAL CONSTRUCTION

.1 FIRE EXTINGUISHERS AND NON-VALVED CABINETS: Specify these in Division 10 SPECIALTIES as part of the General Contract.

.2 FIRE CABINETS shall include fire department standpipe valve connection, fire extinguishers, and space for them. Make certain that extinguisher is specified in General Contract Division 10.

Wexner Medical Center: Fire Hose Cabinets are not required.

21 05 05. FIRE SUPPRESSION MATERIALS AND METHODS

21 05 25. VALVES

.1 GATE VALVES: Use UL ~~approved~~ listed O.S.& Y., 175 lb., except hose cabinet valves.

.1.1 2-1/2 in and smaller, brass or bronze body, trim and stem, solid wedge, rising stem, union bonnet, screwed or flanged ends.

.1.2 3 in. and larger, iron body, bronze trimmed, O.S.& Y., flanged and rigid grooved ends.

.1.3 Consider specification of minimum 250 psi valves (together with piping, sprinklers, and other components) in high rise buildings to prevent specification of pressure reducing valves.

.1.4 All post indicating valves (PIVs), where provided, ~~shall be~~ when located in areas subject to damage by vehicular traffic shall be protected by bollards. All PIV shall be installed so that the base is flush with grade or pavement.

21 10 00. WATER-BASED FIRE SUPPRESSION SYSTEMS

21 11 16. FACILITY FIRE HYDRANTS

.1 SCOPE OF WORK: The Contractor shall furnish all labor, tools, material and equipment necessary to furnish and install new fire hydrants at the locations shown on the plans or as ordered and specified.

.1.1 Architect/Engineer (A/E) shall require the Contractor to include all excavation, furnishing and installing the new fire hydrant complete with proper jointing, blocking, backfilling, and all other incidental work necessary to complete this item of work. Hydrant watch valves and 6-inch ductile iron hydrant leads are to be installed where necessary.

.1.2 Remove the existing hydrants, any shut-off (auxiliary) valves (when necessary) and associated piping. Do not remove shut-off valves that are more than five feet from the hydrants they serve, that are in roads.

.1.3 Remove the lengths of piping necessary to maintain five feet maximum depth at the auxiliary valves and hydrant bases.

.1.4 Architect/Engineer (A/E) shall require the Contractor to be responsible for backfilling to the extent required to accomplish the required testing, providing suitable barricades around openings and providing the A/E and the University Project Representative a schedule of when the various hydrants are ready for inspection, testing, and site restoration.

.1.5 **Architect/Engineer (A/E) shall require the Contractor to notify Facilities Operations and Development's (FOD's) Manager of Utility Services (614-292-6383) and DPS no less than ten working days prior to taking any fire hydrant out of service.**

.2 ALL FIRE HYDRANTS shall be post type made of cast iron and shall conform in all respects to the American Water Works Association Standard for "Fire Hydrants

for Ordinary Water Works Service", AWWA - C502-80 except as herein after specified.

.2.1 Type of Hydrant: Fire hydrants shall be Clow-Eddy model F-2640 break flange/compression type (AWWA C502-80) with 7/8-inch tapered to 1-inch operating nut (turning clockwise to open and counter-clockwise to close), rising center stem, safety coupling, compression type valve, 4-1/2 inch minimum valve opening, factory sealed drain opening, and a 4-inch pumper nozzle. Nozzle thread and finish shall comply with local fire department's standards. Hydrant shall be designed for 150 pounds working pressure and tested to 200 pounds hydrostatic pressure. Hydrants inlet connection shall be 6-inch mechanical joint type.

.2.2 Valves: Auxiliary shut-off valves shall be Clow #F-5065 with mechanical joints, cast iron body, bronze wedges; non-rising bronze stem and O-ring packing.

.2.3 Piping: Piping shall be Clow mechanical joint ductile iron (AWWA C106) 250 pounds working pressure with cement-lining, class 52 thickness bitumastic enamel coating, and rubber ring gasket.

.2.4 Valve Boxes: Auxiliary valve boxes shall be Clow #F-2450 cast iron three piece screw extension type with labeled lid as required by local code.

.2.5 Design: The design shall be such that the stresses generated by a smashing blow will be localized and concentrated at a predetermined point in the couplings, straining the metal at this point beyond its ultimate tensile strength before a similar condition develops in the adjacent sections of the standpipe and stem. This design must assure that the upper and lower sections of the hydrant will break apart cleanly without bending the stem and without damage to the working parts of the hydrant, or the abutting parts of the standpipe sections; also, that there will be no leaking or flooding. The upper section of the standpipe which carries the nozzle shall be secured to the lower section in such a manner that the upper section may be revolved, thus permitting the relocation of the nozzle to any desired direction. The hydrant shall be so designed that, if broken at the joint, repairs may be made by the use of simple tools and the minimum number of parts, and without the necessity of excavating or shutting off the water supply to the hydrant. It shall be designed so that the stem and main valve may be removed through the top of the standpipe without excavating.

.2.6 Installation: Installation and locations of fire hydrants must conform to ~~the current edition of~~ NFPA 24 and specifications of both university and governing Authorities Having Jurisdiction (AHJ). Locate one fire hydrant ~~near~~ within 100 feet of the exterior siamese pumper connection.

.2.6.1 All new fire hydrants, auxiliary valves and portion of water lines connected to them shall be a minimum of 4'-6" below grade, but not more than 5'-0" below grade, where possible.

.2.6.2 New fire hydrants and their auxiliary valves shall be placed four feet away from sidewalks and roads where possible, and the valves two feet minimum from fire hydrants. Valve box to be accessible. Where fire hydrants valves are covered with sidewalks or roads paving (unable to be located) they are to remain as is.

.2.6.3 Pipe buried in ground shall have firm bearing along entire length of undisturbed earth. Pipe on fill or loose soil shall be supported every six feet on brick or concrete piers and then firmly embedded in sand. Pipe trenches shall be evenly graded.

.2.6.4 Securely anchor each mechanical joint, tee, plug, cap, and bend using pipe clamps, tie-rods and concrete thrust blocks conforming to the requirements of ~~the current edition of~~ NFPA 24.

.2.6.5 Install fire hydrant so centerline of all hose outlets is a minimum of twelve inches above finish grade. Hydrants are to be secured with ¾" tie-rods. Use concrete thrust blocks at bases.

.2.6.6 Valve boxes are to be installed so tops are flush with grade or pavement.

.2.6.7 All fire hydrants shall be installed with Class "C" concrete backing poured against undisturbed earth, as approved by the University.

.2.6.8 When main water lines' valves have to be closed for hydrant installation due to fire hydrants valve not being located, this closing shall be coordinated with ~~The Ohio State University~~ DPS and FOD's Utility Services.

.2.7 Testing: FOD's Utility Services and ~~Division of Emergency Management & Fire Prevention~~ DPS shall witness and approve all hydrostatic pressure tests. The fire suppression contractor must use calibrated pressure gauges for all pressure tests and present the calibration certificate to university personnel prior to testing.

.2.7.1 Test at 200 PSIG for two hours.

.2.7.2 Provide Contractor's Material and Test Certificate according to requirements of NFPA 13.

.2.7.3 The trench shall be backfilled between joints after inspection and before testing to prevent movement of pipe.

.2.7.4 Hydrostatic tests shall be made before the joints are covered in order that any leaks may be detected.

.2.7.5 Thrust blocks shall be sufficiently hardened before hydrostatic testing is begun.

.2.7.6 Flush lines prior to testing.

.2.8 Painting: University Fire Hydrants and valve box lids are to be RED with the hydrant caps painted GRAY, similar to existing university fire hydrants.

.2.8.1 Factory painted fire hydrants which have been damaged shall be cleaned, primed, and repainted to comply with these standards.

.2.8.2 Gray fire hydrant caps and Red valve box lids are to be painted after the fire hydrants and valve boxes are installed.

.2.9 Inspection: Backfilling will not be permitted until hydrant drain holes are plugged and ~~The Ohio State University Division of Emergency Management & Fire Prevention~~ DPS, and FOD Utility Services has inspected the installation and found it acceptable. Note that existing water lines supplying new hydrants shall be modified by the contractor to bring water line up.

.3 Refer to Division 33 for Coordination of Underground Utilities Recording during Construction.

21 12 00. FIRE-SUPPRESSION STANDPIPES

.1 DESIGN, INSTALLATION, AND TESTING: Comply with the Ohio Building Code (OBC), the Ohio Fire Code (OFC), Ohio Administrative Code (OAC) - Fire Protection Systems, the Authority Having Jurisdiction (AHJ) Department of Commerce Division of State Fire Marshal, and the applicable edition referenced by OBC and OFC of NFPA 14, STANDARD FOR INSTALLATION OF STANDPIPE AND HOSE SYSTEMS. Wherever standpipes are installed, siamese pumper connections shall be provided as required.

.1.1 At the start of design, the design Architect/Engineer remains responsible to perform a flow test and pressure test, to be performed by a service agency licensed and certified by the AHJ to perform such tests. Water flow test data used for design shall be less than 12 months old. Provide a copy of the flow and pressure test to the University's Project Representative and FOD's Utility Services.

.1.2 When the OAC for Fire Protection Systems requires standpipe hose connections at the roof level the Architect/Engineer shall coordinate the requirements of the roof access and fall protection system with the Fire Protection System.

.1.3 The Architect/Engineer shall coordinate the specified metal finish of the standpipe's exterior drain pipes with the building's finish materials.

.2 STANDPIPES: In buildings where standpipes are installed, all fire department (2-1/2 in.) valves shall be in a stairwell. Where pressure reducing type hose valves are installed, the drain riser shall be a minimum of 3 inches and include connections for testing pressure reducing type hose valves.

21 12 20. FIRE STANDPIPE CABINETS AND ACCESSORIES:

Wexner Medical Center: FIRE HOSE CABINETS are not required.

.1 STANDPIPE CABINETS shall be painted steel, flanged, flush mounted type (similar to extinguisher cabinets), large enough to accommodate a fire extinguisher. Each fire extinguisher and fire valve cabinet may have a break-glass type door with full flat glass in the door. A break-glass tool must be provided attached to cabinet.

.2 ORIFICES: Whenever necessary to ensure that hose pressure does not exceed the ~~60 psig~~ pressure limitation required by applicable codes and standards or the local fire department, orifices shall be required on hose cabinet valve-discharges. The orifices shall be the adjustable type and shall be properly adjusted by the contractor on the job so that hose pressure does not exceed the ~~60 psig~~ pressure limitation of applicable codes and standards or local fire department. The Columbus Division of Fire, Fire Prevention Bureau should be consulted on the proper pressure reducing devices. The Architect/Engineer (A/E) is to contact the University's ~~Division of Emergency Management & Fire Prevention~~ DPS prior to contacting the Columbus Division of Fire.

.3 LOCATIONS: Standpipe and valve cabinets shall be located so that the centerline of the hose valve is in accordance with NFPA 14 recommendations. The full fire rating and acoustical rating of the walls shall be maintained.

.4 HOSE CONNECTION: Where possible, all valves and fittings for fire department connections shall be rotated approximately 22-1/2° down from vertical to facilitate easy hose connection. Within the City of Columbus, threads shall be Columbus fire threads.

.5 External to the City of Columbus, threads must be compatible with the equipment of the local fire department.

.6 RENOVATION PROJECTS: Require that the FOD's Operations and/or Wexner Medical Center Facilities Operations Fire System Shop be advised to take possession, before construction begins, of existing fire extinguishers for safe keeping.

21 13 00. FIRE-SUPPRESSION SPRINKLER SYSTEMS

.1 SPRINKLER SYSTEMS shall be automatic systems designed, installed, and tested according to the Ohio Building Code (OBC), Ohio Fire Code (OFC), the Authority Having Jurisdiction (AHJ): Department of Commerce Division of State Fire Marshal, and the requirements of the applicable edition of NFPA 13, STANDARD FOR THE INSTALLATION OF SPRINKLER SYSTEMS, as referenced by OBC and OFC.

.2 SPECIAL INSTALLATIONS: Suppression systems for electrical equipment rooms, elevator equipment rooms, computer equipment rooms or similar spaces shall be designed so as not to present a hazard to occupants or equipment. Sprinkler piping shall not be routed over electrical equipment.

.2.1 Alternate fire protection systems permitted for these rooms are: (Note: A variance may be required for plan approval by the State of Ohio, Division of Industrial Compliance.)

.2.1.1 Foam, NFPA 11.
.2.1.2 Carbon Dioxide, NFPA 12.
.2.1.3 Water Spray, current edition of NFPA 15.
.2.1.4 Dry Chemical, NFPA 17.
.2.1.5 Clean Agent Fire Extinguishing Systems, NFPA 2001.
.2.1.6 Installation of new NFPA 12A – HALON 1301 FIRE EXTINGUISHING SYSTEMS are prohibited.

***COMMENTARY**: Existing University HALON 1301 FIRE EXTINGUISHING SYSTEMS are recommended to be removed in lieu of upgrading the equipment, because other substitutes are available for the same uses that pose lower risk overall to human health and the environment. As described in the signed September 16, 1987 Montreal Protocol on Substances That Deplete the Ozone Layer.*

.3 ALTERNATE CONSTRUCTION: If occupancy permits, a firewall separation may be provided. If this construction is used, sprinklers are not required, but a smoke detector connected to the building fire alarm system must be provided.

.4 DRY SPRINKLER SYSTEMS: Provide a high-low-pressure switch on all systems to detect a gradual loss of air pressure. Connect switch to fire alarm system as a distinct zone. Dry sprinkler systems shall be specified for areas susceptible to freezing temperatures, including but not limited to; dock areas, garage connectors, overhead building connectors, building overhangs/canopies, etc.

.4.1 Air Compressor with air dryer or nitrogen generator shall be specified for dry systems and shall be on a dedicated electrical circuit. Air compressor shall be a dedicated tank for fire protection service and include an air maintenance device.
.4.2 The electrical switch shall be secured by a common keyed padlock.

.5 INSPECTOR TEST VALVES: Test valves shall be as remote as possible for each zone, have piped-in drainage to allow for testing without the use of hoses or special adapters, be located in stairwells or some common, easily accessible location and contain a sight glass for visual inspection of the flow. Each sprinkler zone shall include one drain and one test station. The locations shall be coordinated with the Architect/Engineer and DPS ~~the University's Division of Emergency Management and Fire Prevention~~ Drains near an exterior wall shall be piped to building exterior within 12 inches of grade over a splash block at locations to prevent damage to property, including landscaping, and hazards to circulation paths. Interior drains shall be terminated near a floor drain sized to handle the maximum flow of the drain.

.6 ZONING (ZONE VALVE ASSEMBLIES): A minimum of one zone shall be provided per floor. Drains shall be routed to an exterior wall and shall be piped to building exterior within 12 inches of grade over a splash block at locations to prevent damage to property, including landscaping, and hazards to circulation paths.

6.1 No zone shall be dependent upon another zone. Each zone shall be capable of being drained and filled without draining another zone or the remainder of the sprinkler riser to facilitate repairs, etc.

.7 All actual devices for low suction pressure, fire pump interruption, tamper switches, and pump room flow switches shall be wired into the main fire alarm panel, by the ~~Electrical~~ Fire Alarm Contractor, as distinct zone annunciation. Specify and show which devices are to be furnished and installed by the Fire Protection Contractor.

.7.1 Cord type tamper switches are prohibited. Weatherproof tamper switches shall be installed in wet or humid locations, including pits.

.8 All pressure switches, pumps, valves and similar devices shall be installed with isolating valves to facilitate replacement of devices.

.9 All piping shall be painted red or permanently banded red. See Division 07 for painting requirements.

.10 **Wexner *Medical Center*:** SPRINKLERS: Sprinklers shall be semi-recessed, polished chrome with matching escutcheon and be installed center-of-tile in finished ceiling areas. Concealed heads are not permitted, unless otherwise approved by Wexner Medical Center Facilities Operations. Areas of renovation not having semi-recessed heads shall have the heads replaced to semi-recessed as part of the project.

.10.1 Manufacturers: Tyco, Reliable, Viking

.10.2 UL listed guards shall be provided on all exposed sprinklers subject to damage, including, but not limited to, gymnasiums, electrical rooms, mechanical rooms, storage rooms, and all sprinklers less than 7 feet 6 inches above finished floor.

10.3 Stainless steel sprinklers and escutcheons shall be installed in all areas subject to corrosion, including, but not limited to, swimming pools, storage areas with corrosive materials, and all outdoor areas.

.11 System shall include back flow protection on the domestic water line as required to be consistent with the requirements of the local water department.

.12 The fire suppression system piping requirement shall meet or exceed NFPA 13 Standard for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use and be not less than schedule 40.

.12.1 Externally galvanized piping shall be considered for areas subject to corrosion and outdoor areas only.

.13 **Wexter Medical Center:** Operating rooms shall be suppressed with a pre-action fire suppression system.

Commentary: *Consider a nontoxic antimicrobial water additive to the fire sprinklers system to prevent microbiologically influenced corrosion (MIC).*

.14 Fittings Materials and Dimensions: Cast Iron Threaded Fittings, Class 125 and 250 ASME B16.4;
Malleable Iron Treaded Fittings, Class 300 ASME B16.3;
Malleable Iron Threaded Pipe Unions, Class 250 ASME B16.39

.15 Braided and welded stainless steel flexible fire sprinkler drop hose that are UL Listed/FM Approved are allowed. Limit the number of bends and bend radius to the limitations in the manufacturer's technical data.

21 30 00. FIRE PUMPS

.1 CENTRIFUGAL TYPE PUMPS shall be provided; turbine vane pumps are prohibited. Installation shall comply with applicable codes and standards, including the Ohio Building Code (OBC), Ohio Fire Code (OFC) and the applicable edition of NFPA 20, STANDARD FOR THE INSTALLATION OF STATIONARY PUMPS for FIRE PROTECTION.

.2 CONTROLLER: Specify the following, all factory prewired and enclosed with integral transfer switch in a NEMA II floor mounted enclosure: One excess pressure controller containing magnetic starter, disconnect switch, dual pressure switch, three position selector switch, and an alarm bell to sound when the pressure drops below the second control point of the dual pressure switch.

.2.1 Coordination of Electrical Connections: Stipulate that the pump supplier coordinates the electrical connection lugs with the cable size being

provided by the electrical contractor or provide junction boxes and terminal strips to match wire sizes indicated in the motor schedule on the electrical drawings.

.2.2 All electric fire pumps shall be connected to a reliable source of power per the local municipality and NFPA 70.

.3 BEARINGS: Wherever practical, equipment shall be furnished with sealed ball or roller bearings. Specify that the contractor shall not lubricate sealed bearings.

.4 RELIEF VALVE AND DRAIN: The fire pump shall have a temperature relief valve integral with the casing. A valved discharge line to a test header located outside the building shall be provided for demonstration and operating tests. Provide an automatic ball check and drain line, piped to drain from the discharge line and test header system

.5 FIRE PUMP TEST CONNECTIONS: The test connection cluster, with 2-1/2 in. valves; shall be located on the building exterior adjacent to the fire department siamese connection for the purpose of performing proper testing of the fire pump for initial acceptance and annual testing. Include piped drainage. Test valves shall have piped in drainage. The Architect/Engineer shall coordinate the site requirements for the test vehicle/trailer and water discharge to prevent damage to the landscape and building.

.5.1 All Fire Department Siamese Connections (FDC) shall require locking caps that accept KNOX key wrench.

.6 WATER SUPPLY: Design shall be based on a water flow test within 12 months of design and shall consider daily and seasonal fluctuations in the water supply when sizing and selecting pumps. Specify that the installing contractor conduct another water supply test prior to ordering fire pumps as part of shop drawing submittal process.

21 31 00 SIGNAGE

.1 The Architect/Engineer (A/E) shall specify the SIGNAGE REQUIREMENTS PER OHIO FIRE CODE. A/E shall also review ~~APPENDIX S of the Building Design Standards~~ and list the signage requirements in Division 10 Signage as part of the General Contract.

.2 FIRE DEPARTMENT CONNECTION: The location of the fire department connection shall be indicated by the permanent installation of a readily visible sign. Such sign shall have the letters “FDC” at least 6 inches (152 mm) high and words in letters at least 2 inches (51mm) high or an arrow to indicate the location. The color of the letters is to contrast with the background color, e.g., white letters on red background. The Architect/Engineer shall coordinate the location of the sign with ~~the University Project Representative and the Division of Emergency Management and Fire Prevention~~ DPS and the AHJ.

.3 STANDPIPE CONNECTION CABINETS: The location of the fire department standpipe connection cabinets shall be identified with a permanently installed sign with letters at least 1 inch high in a color that contrasts with the background color, to read “Standpipes”.

.4 FIRE EXTINGUISHERS: The location of installed fire extinguishers within a cabinet shall be properly identified by the labeling above the cabinet with dimensional signage using proper wording and/or pictorials.

.5 FIRE PUMP ROOM: Fire protection equipment shall be identified in an approved manner. Rooms containing controls for fire suppression pumps shall be identified for the use of the fire department. Signage shall be constructed of durable materials permanently installed and readily visible to read, “FIRE PUMP”.

.6 SPRINKLER RISERS AND VALVES ROOM: Fire protection equipment shall be identified in an approved manner. Rooms containing controls for all fire suppression sprinkler risers and valves, including dry and pre-action suppression systems shall be identified for the use of the fire department. Signage shall be constructed of durable materials permanently installed and readily visible to read, “SPRINKLER ROOM”.

21 32 00 TRAINING

The following training shall be provided:

.1 The sufficient number of hours of training as determined by AE, University Project Manager and the affected university department to train the university staff. The training shall be strictly provided by the OEM (Original Equipment Manufacturer). Training shall be provided independent of and in addition to "start up and check out" of installed systems and equipment. Training shall be provided on-site during normal working hours and scheduled through the university, Facilities Operations and Development Training Coordinator at (614) 688-3289 or other university department as appropriate.

.2 Each OEM shall provide hourly rates to be used for miscellaneous support. The OEM shall provide this additional support during the warranty term.

.3 Contractor and/or OEM shall provide all necessary training materials, including, but not limited to: books, brochures, pamphlets, audio and video tapes, on-site support manuals, logging sheets, and system documentation materials.

END OF DIVISION 21 – FIRE SUPPRESSION

Published January 1, 2006; Revised June 28, 2019

22 00 00. PLUMBING

22 00 03. GENERAL PROVISIONS

.1 ALTERNATES OR ALTERNATIVES: Refer to Division 01 for instructions regarding use of the word "Alternate".

.2 ALTERNATE MATERIALS FOR ACID WASTE SYSTEMS: Refer to 22 10 00 for pipe and pipe fittings. One of the acceptable materials shall be specified as the base bid and one or more of the others shall be specified as an alternate. Acid dilution tanks, which are a part of acid waste systems, should be located in such a way that they are easily accessible for servicing.

.3 CODES: All materials and installations shall be compliant with the current Ohio Building Code, the current Ohio Plumbing Code, and the current versions of ASHRAE 90.1 and the International Fuel Gas Code adopted by Ohio.

Wexner Medical Center: All materials and installation shall also be compliant with the current FGI ~~AIA~~ Guidelines for Design and Construction of Health Care Facilities.

.4 SEWER AND WATER TAPS: City of Columbus Sanitary Sewer Tap Fees and System Capacity Charges shall be paid by the contractor doing the work. Costs of and arrangements for sewer and water taps, including capacity charges, must be resolved with the University Engineer before preparation of final documents. Also see Division 33 – Utilities Site Utilities.

22 00 04 MOTORIZED EQUIPMENT

Basic requirements for electrical work and equipment are covered in Division 26 of these standards. The requirements included herein cover specific items that have been troublesome in the past and require that the specifications incorporate adequate provisions for electrical work and equipment furnished by the Plumbing, HVAC, and Fire Protection Contractors. The A/E shall specify motors, drives, and equipment to meet all operating requirements for the installation. Consideration for motors should be for voltage, phase, frequency, frame size, temperature rise, and sufficient starting torque to start loads with high inertia. Performance requirements should include capability to make multiple starts per day to meet energy conservation control requirements. Where necessary, non-recycling shall be specified to protect the equipment from short time recycling.

.1 WIRING: Specifications shall clearly point out the responsibility for wiring related to Plumbing, HVAC, Fire Suppression and Fire Alarm equipment. In general, it is required that power wiring is provided by the Electrical Contractor and control wiring is provided by the Plumbing, HVAC and Fire Suppression Contractor. Also see Communications Wiring Standard in Appendix.

.2 STARTERS: Specifications shall require that motor starters be provided by the Electrical Contractor. Exceptions to this requirement will require the approval of the A/E and his review is necessary to ascertain that standards stipulated in the electrical specifications are followed. Variable Frequency Drives (VFD's) shall be specified by the A/E and furnished by the Mechanical Contractor as part of the AHU or pump package.

.3 MOTORS shall be sized in accordance with applicable NEMA standards for the operating conditions of each specific items of equipment with a 1.5 1.15 service factor. Motors must be selected to operate within nameplate HP and shall not operate on the service factor. Short shaft motors shall not be used for belt drives. In general, motors one-half horsepower or smaller shall be single phase; larger motors larger than ½ horsepower shall be three phase. Motors shall be provided with electrical overload protection to prevent burn-out under operating conditions. Large motors shall have adequate internal overload and thermal protection in addition to the overload elements in the motor starter. Definite purpose inverter fed motors shall be specified for use with VFD's.

22 00 05. SUBMITTALS:

.1 STATE INSPECTION CERTIFICATE: Soil, waste, and vent piping shall be approved by the State of Ohio Department of Health. Work shall be inspected by the State Plumbing Inspector and a copy of the final inspection certificate shall be delivered to the University Project Manager.

.1.1 Fees: Specify that inspection fees shall be a part of the contractor's job cost.

.2 TEST REPORTS: Submit reports of all tests required by 22 00 07.

22 00 07. TESTING

.1 Underground Water Service Piping: See Division 33 Section 33 11 13 Site Water Distribution.

.2 Interior Water Piping: Test with water, at 125 psig pressure, for a period of not less than 6 consecutive hours.

Student Life: prior to water testing interior water piping, test with air where it is permissible with Ohio Plumbing Code.

.3 Domestic Water Supply Piping: Flush and sterilize under the supervision of a qualified consultant. Provide the University Project Manager with written certification of sterility and confirm that the piping system is clean and safe to transmit water for human consumption. The sterilization method to be followed shall be that prescribed by the health authority having jurisdiction or water purveyor having jurisdiction, or in the absence of a prescribed method, the procedure described in either AWWA C651 or AWWA C652 or their successors, or as described in the Ohio Building Code, Ohio Plumbing Code Section 610.1, whichever is the more stringent.

.4 Interior Gas Piping: Test with nitrogen for a period of 24 consecutive hours in conformance with the rules and regulations of the local gas supplier. Submit test report to University Project Manager through A/E.

.4.1 A minimum of 48-hour notice shall be given in writing to the University Project Manager prior to the purging of lines. Purging shall be performed in conformance with recommendations of and under supervision of the local gas supplier. Venting during purging operations shall be to the outside of buildings at a safe location.

.5 Exterior Storm and Sanitary Sewers: Test according to the requirements of the City of Columbus Section 901.10 of the Construction and Material Specifications, or to the Ohio Building Code, Ohio Plumbing Code, or to the Authority Having Jurisdiction, whichever is the most stringent.

.6 Compressed Air Piping (regular pressure): Test to 125 psig for 6 hours.

.7 LP Gas Systems: Should be purged and tested in accordance with the latest edition of NFPA 58. Submit test report.

.8 Oxygen and/or Surgical or Miscellaneous Gas Lines: Test as recommended by National Cylinder Gas and NFPA. Consult the University Engineer for any special testing or purging requirements.

Wexner Medical Center: Medical gas systems: Test as recommended by current editions of National Cylinder Gas Codes and NFPA 55, 99C. Systems shall be certified by a third party certifier with ASSE 6001 certification. Certifier shall be hired by the Architect/Engineer.

.9 Recording Line Charts shall be specified for all gaseous pressure testing.

10 Compressed air and laboratory gases above 150 psig shall be inspected, examined, and tested per the requirements of Chapter VI of ASME B31.3. A third-party inspector shall be hired by the A/E (Criteria A/E for design-build) and subject to approval by the University.

11 Commissioning: Refer to Owner's Project Requirements (OPR) for systems to be commissioned.

22 00 09. RELATED WORK IN GENERAL CONSTRUCTION:

.1 WATER SUPPLY PIPING INSTALLATION:

.1.1 Provide a minimum of 48 inches cover over pipe to prevent freezing.

.1.2 Provide concrete anchors and steel yokes on all fittings with over 1/16 bend. Details shall be shown on drawings.

.1.3 A 2 feet wide by 1 foot thick reinforced concrete bridge beam shall be keyed into the foundation wall immediately under any water service line to the

building. This beam will be carried out from the building wall to firm support beyond the excavation for the building wall.

.2 GAS PIPING BACKFILL: Specify that no backfill operations be performed until piping installation has been tested and approved.

.2.1 Sand: Use only clean sand, free of rubble and rocks of 1- 1/2 inch diameter or greater.

.2.2 Backfilling: Deposit sand to a depth of 3 inches above and below piping. Caution the contractor to exercise care to prevent breaking of wires and displacement of anodes. Remainder of backfill shall be made with clean excavated material free of rubble, rocks, bricks, wood or debris placed and compacted in accordance with requirements stated in Division 2 of these guides. Grits are prohibited.

.3 CLEANING AND PAINTING: Cleaning of fixtures and equipment shall be included in the Plumbing Contract. Painting may be a divided responsibility of the General Contractor and the Plumbing Contractor. The A/E shall coordinate the specifications to clearly indicate each contractor's responsibilities in order to avoid double costs for identical work or total omission of the work. See Section 09 90 00. Color for the exterior exposed gas pipes should be consulted and approved by University landscape Architect and University Utilities.

22 05 05. PLUMBING MATERIALS AND METHODS

22 05 07. SLEEVES:

Sleeves shall be provided for piping through all walls and floors. ~~See Facility Services 3.12 through 3.12.3.4.~~ All penetrations shall maintain existing wall fire and/or smoke rating

.1 PROTECTION FOR INSULATED PIPES: When insulated pipes penetrate floors that will be covered with finish flooring, specify that a sheet metal protective covering be installed around the insulation jacket. Sheet metal jacket shall extend through and above the pipe sleeve far enough to protect the insulation from bumping by floor polishing machines and vacuum sweepers. Space between the pipe sleeve and the sheet metal must be sealed. Where insulated pipes pass through wall sleeves, cover insulation with sheet metal and seal both ends of the space between the sleeve and sheet metal with non-combustible packing.

.2 CLEARANCE: Provide not less than 1/4 inch clearance on all sides for both insulated and non-insulated pipes which penetrate walls and slabs.

.3 LENGTHS: Except where greater lengths are required for penetrations through floors, sleeves shall be fabricated to a length equal to the thickness of construction through which they pass. See below.

.4 SLEEVES THROUGH WATERPROOFED FLOORS shall project a minimum of 4-inches above the floor.

.5 SLEEVES IN HVAC AND PLUMBING EQUIPMENT ROOMS shall extend no less than 1-1/4 inches above the curbs.

.6 SLEEVES IN ALL OTHER FLOORS shall extend 3/4 inch above the finish material on the floor.

.7 SEALS: Special wall sleeve fittings with soft rubber seals shall be specified for water service piping. In other installations, the void between pipe and sleeve shall be sealed with mineral wool or other non-combustible material to prevent passage of flame and smoke. In locations exposed to public view, the packing materials shall be concealed with sheet metal cover plates or split type, chromium plated brass escutcheons.

.8 FIRE-STOPPING: Specify and show fire stopping at all penetrations of fire-rated assemblies.

.9 Sleeves for copper pipe shall be fabricated of copper pipe for up to 4 inches in diameter.

22 05 20. GAUGES AND THERMOMETERS

.1 METERS: Permanent utility services to each building require permanent metering.

Student Life: requires metering and submetering for each individual building. Meters must also be accessible remotely.

.2 GAUGES:

.2.1 Gauges shall be 4-1/2 inches in diameter single spring type with recalibration adjustment in the dial face and with gate valve shut-off. Tailor the range to the application. Gauges shall not be positioned over 6 feet above the floor; install remote sensing gauges as required to conform with this restriction.

Wexner Medical Center: Gauges shall have ball valve shut-off.

.2.2 Water supply: Locate a pressure gauge at the water service entrance and elsewhere as needed to properly identify pressure within the piping system.

.2.3 Domestic hot water: Locate pressure gauges on suction and discharge sides of pumps and elsewhere as needed to properly identify pressure within the piping system. When hot water is supplied by the power plant, provide gauges on both supply and return.

.2.4 Gas service: Locate pressure gauges at the service entrance and upstream and downstream of pressure regulators.

.2.5 Other piped systems: Locate vacuum or pressure gauges as required to properly identify pressure within each system. Provide pressure gauges at entrance and exit locations for steam supply, condensate return, hot water supply and hot water return.

.3 THERMOMETERS:

.3.1 Thermometers shall be digital or mercury-free, red or blue-reading-in-glass type with 9-inch magnified column, Fahrenheit scale, recalibration feature, and adjustable head. Tailor the range to the application. Installation shall be in brass or stainless steel pressure tight separable well with heat transfer paste. Thermometers shall not be positioned over 6-feet above the floor; install remote head type of thermometers as required to conform with this restriction. Provide a building automation sensor well adjacent to thermometers at major plumbing system equipment (e.g. domestic hot water heaters, central distribution mixing valves, etc.)

.3.2 Piped systems and storage tanks: Locate thermometers as required an all systems or tanks where temperature should be identifiable for operation and maintenance. Provide at building entrance and exit locations for domestic hot water supply and return.

Wexner Medical Center: Additionally, thermometers are required at the inlet and outlet of all pressure reducing stations, domestic hot water pumps and master mixing valves.

22 05 25. VALVES

.1 GENERAL REQUIREMENTS

.1.1 Each valve-type (e.g. flush valves, ball valves, balance valves, etc.) provided for a single project shall be products of a single manufacturer. Specify three (3) equivalent manufacturers, approved by University Engineer, for the contractor to select from.

.1.2 Valve tags: Specify that each valve in each piping system be tagged with a brass tag numbered consecutively for each system and attached to the valve with a brass chain. Valve tags shall have stamped abbreviations of the system in addition to the valve number. Valves tags shall be tagged with Ohio State nomenclature as: service-building ID (2 letter designation)-floor-valve number. For example, a domestic cold water valve on the 2nd floor of Rhodes would be tagged DCW-RH-2-34.

.1.3 Valve chart: The A/E shall determine the location for installation of a valve chart and shall specify that a typewritten directory of all valve numbers (by system, describing location) be furnished, framed under glass, and installed in the equipment room where indicated. A copy of the valve directory shall be bound in a hard fiber binder, along with an electronic copy, and delivered to the A/E for forwarding to the University's Project Manager.

Student Life: The A/E shall provide an additional electronic copy of the valve chart to Student Life's Office of Facility Management & Logistics for the project.

Wexner Medical Center: Concealed valve locations shall be indicated by color coded tags adhered to the ceiling T-bars. Colors shall match pipe labeling color specification.

.1.4 Design requirements:

.1.4.1 Shut-off valves shall be provided on all branches off main water lines and ahead of dielectric unions. Branches shall be provided with drain valves to facilitate drainage of branches. Shut-off valves shall be located as necessary to allow maintenance/repair of system components with no disruption to building services. Required locations for shut-off valves include, but are not limited to, the inlet and outlet of all pieces of equipment, at each floor branch from the riser, and at each branch off the main floor distribution piping.

.1.4.2 Fixture Stops: Each fixture and piece of equipment shall be provided with a fixture stop. Groups of fixtures shall be valved separately. Stops for flush valves shall be screwdriver stops with protective caps; all other shall be quarter turn ball valves. Handwheel stops are prohibited.

.1.4.3 Unions and Fittings: A union or bolted flange fitting shall be provided downstream of, and within approximately 12 in. of each valve, and adjacent to both inlet and outlet of pumps and other equipment.

Student Life: This rule only applies to valves three inches or larger.

Wexner Medical Center: Unions and Fittings: A union or bolted flange fitting shall be provided downstream of, and within approximately 12 in. or at least 3 pipe diameters, and adjacent to both inlet and outlet of pumps and other equipment. Unions should be independent devices. Combination valves/unions are not acceptable.

.1.4.4 Flush Valves: Expose for easier maintenance.

Wexner Medical Center: Flush Valves: Expose for easier maintenance except in high security areas where enclosure would be required (prisoner holding or psychiatric population as examples).

.2 GATE VALVES:

.2.1 2-1/2 inches and smaller, brass or bronze body, trim and stem, solid wedge, rising stem, union bonnet, 125 pounds screwed ends.

Wexner Medical Center: Gate valves 2-1/2 inches and smaller are prohibited.

.2.2 3 inches and larger, iron body, bronze trimmed, O.S. & Y. 125 pounds flanged, (conforming to the City of Columbus Item 802).

.2.3 All gate valves shall be full port.

.3 VALVE BOXES: Valve boxes shall be furnished on all valves of water service piping. Boxes shall be extended to final grade or pavement. The word "WATER" shall be cast in the cover. A 3 inches galvanized steel pipe shall be installed in each valve box to prevent misalignment. Liners shall be removed as the last item of work at the installation.

.4 GAS COCKS:

.4.1 1-1/2 inches and smaller, screwed, all brass 150 lb. WOG.

.4.2 2 inches and larger, lubricated types, 175 pounds WOG.

.4.3 Valves shall be labeled as required to be compliant with all requirements of the International Fuel Gas Code (IFGC), as referenced within the Ohio Building Code.

.5 GLOBE AND ANGLE VALVES:

.5.1 2-1/2 inches and smaller, brass or bronze body, trim and stem, union bonnet, 125 pounds screwed ends.

.5.2 3 inches and larger, iron body, bronze trimmed, 125 pounds flanged.

.5.3 All globe and angle valves shall be full port.

Wexner Medical Center: Globe and angle valves are prohibited.

.6 CHECK VALVES:

.6.1 2-1/2 inches and smaller, swing check type, brass or bronze, renewable, disc, 125 pounds screwed ends.

.6.2 3 inches and larger, swing check type, iron body, bronze trimmed, bolted cap, 125 pounds flanged ends.

.6.3 Spring loaded check valves, flanged silent center guide, 250 lb. semi-steel body, bronze stem, 1/16 inch raised face.

Student Life: Only allows the spring loaded type check valves. Deviations from this requirement shall go through BDS variance process.

.7 BALL VALVES:

.7.1 3 inch or smaller, two or three piece bronze body, full port, screwed ends, chrome plated brass or stainless steel ball, steel stem, reinforced TFE packing and seat ring with appropriate pressure and temperature rating for specific application.

.8 BUTTERFLY VALVES:

.8.1 2 inch and larger, ductile iron body, bronze disc, extended neck, geometric drive, molded-in seat liner, stainless steel stem, EPDM rubber liner, 125 pounds. Lug or wafer style.

.9 BACKFLOW PREVENTION DEVICES: As required and specified per Ohio Building Code, Ohio Plumbing Code and all referenced ASSE standards. Provide 3/4-inch minimum size drain line to floor drain. Units must be removable and accessible for maintenance. The Ohio Environmental Protection Agency specifies those situations in which backflow prevention devices and arrangements shall be used. Code-approved air gaps are recommended and pumping units with code-approved air gaps are also recommended. Where air gaps and vacuum breakers are not acceptable, products of the following manufacturers of backflow prevention devices are approved:

Size in Inches	**Model**	**Manufacturer**
1/2” through 10”	BEECO	MIFAB, Inc Chicago, IL 60643
3/4	#80-0059	The Toro Co. San Marcos, CA 92069
1	#9- 2770	The Toro Co.
3/4; 1; 1-1/4, 1-1/2; 2; 3	#900	Watts Regulator Co. Lawrence, Mass. 01842
3/4	BF-075	Richwell Valve Co. Santa Anna, CA 92707
1	BF-100	Richwell Valve Co.

Wexner Medical Center requirements:

.10 BALANCE VALVES: Install balance valves in domestic hot water return systems as necessary. Provide separate shut-off valves and balance valves. Applies to all building at The Ohio State University

22 05 50. VIBRATION AND SEISMIC CONTROLS

.1 DESIGN REQUIREMENTS: Refer to PART ONE (Division 0). Specify sound emission and transmission controls as required to meet standards indicated in the

Table entitled, "Ranges of Design Limits for Sound Control" in the Appendix, or when applicable, to meet Federal standards.

.2 WATER SUPPLY PIPING: Shock absorbers shall be provided in accordance with the Plumbing and Drainage Institute Standard PDI-WH201. Shock absorbers shall have stainless steel air chamber and brass, bronze, or stainless steel body.

.3 COMPRESSED AIR SYSTEMS: Vibration isolators or inertia pads shall be provided under air compressors. Flexible connectors shall be provided on discharge line of compressor.

.4 DOMESTIC HOT WATER SYSTEMS: Branch connections to hot water risers shall be designed with adequate provision for movement.

Wexner Medical Center: Collaborate with Medical Center Facilities Engineering to provide a domestic hot water system that meets their waterborne pathogens program.

.5 VACUUM PUMPS: Shock absorbers shall be provided similar to those for Water Supply Piping.

22 07 00. PLUMBING INSULATION

22 07 16. PLUMBING EQUIPMENT INSULATION

.1 STORAGE TANK INSULATION: Insulation for hot water and cold water storage tanks shall comply with Federal Specifications HH-I-530A or its successor.

.1.1 For domestic hot water storage tanks: Recommended thickness 2 inch, density 6 pounds/cubic foot, compressive strength 300 psi at 10% deformation, thermal conductivity .32 Btu/(hour) (square foot) (F degrees/inch) at 175 degrees mean temperature.

Wexner Medical Center: Domestic hot water storage tanks are prohibited.

.1.2 For cold water tanks: Recommended thickness 2 inch, density 9 pound/cubic foot, compressive strength 530 psi at 10 percent deformation.

Wexner Medical Center: Domestic cold water tanks are prohibited, unless approved by OSUWMC Facilities.

.2 FLUE INSULATION: Domestic hot water heater flues shall be insulated when required for safety or for reducing heat transfer.

Student Life: Closed cell elastomeric flue insulation shall be used on all non-steam applications. The materials shall be rated for proper application temperature and code compliant fire/smoke rating.

Published January 1, 2006; Revised June 28, 2019

22 07 19. PLUMBING PIPING INSULATION

.1 PIPING INSULATION: Fibrous glass, or equal mineral fiber, molded sectional type covering. Asbestos is expressly prohibited and water-soluble treatment of insulation jacket to impede or retard flame or smoke is also prohibited. Insulation thickness and R-value shall be as required by the ~~Ohio Building Code, Ohio Plumbing Code, whichever is more energy efficient~~ current version of ASHRAE 90.1 adopted by Ohio.

.

Student Life: Closed cell elastomeric pipe insulation shall be used on all non steam applications. The materials shall be rated for proper application temperature and code compliant fire/smoke rating.

.1.1 Concealed locations: Insulation for cold water piping shall be provided with a factory-applied fire retardant vapor barrier jacket with self-sealing lap; insulation for domestic hot water piping shall be provided without vapor barrier.

.1.2 Exposed locations: Insulation for both cold and hot water piping in exposed locations shall be of 7 pound density and jacket shall have pre-sized glass cloth.

.1.3 Insulation for interior downspout piping, roof drain sumps, water cooler wastes, and chilled water wastes shall be of 7 pound density, with or without jacket as required for the location.

.1.4 Thicknesses:

.1.4.1 Insulation on cold water piping, interior downspout piping, roof drain sumps, water cooler wastes, and chilled water wastes shall be at least 1/2 inch thick. Insulation on piping 3 inch and larger shall be at least 3/4 inch thick.

.1.4.2 Insulation on domestic hot water lines 1-1/4 inch and smaller shall be 1 inch thick. Insulation on piping 1-1/2 inch and larger shall be 1-1/2 inch thick.

.1.5 Installations: Insulation shall be installed over hangers and supports and shall be carried continuous through all sleeves. In addition to the following requirements, specify any other insulation required. All of the following piping shall be insulated:

.1.5.1 Cold Water Lines.

.1.5.2 Domestic hot water lines, including recirculating lines and storage lines.

.1.5.3 Horizontal runs from roof drains and horizontal downspouts, inside buildings.

.1.5.4 Roof drain sumps, inside buildings.

.1.5.5 Exposed horizontal waste lines from water coolers and lines carrying chilled water waste.

22 10 00. PLUMBING PIPING AND PUMPS

22 10 05. PIPE AND PIPE FITTINGS

.1 PROHIBITED INSTALLATIONS:

.1.1 Water, sewer, drain, steam, condensate and gas lines shall not be designed for installation over electrical switchgear and transformers, or in elevator or electrical equipment rooms and shafts. This is not intended to prohibit sprinklers in electrical equipment rooms.

.1.2 Bullhead connections in any piping service are expressly prohibited except air, gas or cold water lines.

.1.3 Glass waste piping under slabs or underground is prohibited.

.2 STEEL PIPE: A120/A53 is acceptable in lieu of either A120 or A53 Type F, provided that all of the other restrictions governing the use of either grade are followed. If the dual graded pipe is to be used in place of A53, Type F, the vendor will provide mill certification signed by the manufacturer's chief metallurgist. Said certification shall conform to the ASTM A-53 requirements for chemistry, tensile, bending/flattening, and hydrostatic testing. It is strongly recommended that, if dual graded pipe is specified, that it be specified as domestically produced so that the University has recourse in event of non-specification compliance.

.3 UNDERGROUND WATER PIPE

.3.1 Underground Water Pipe (Exterior) See Division 33 Section 33 11 13 Site Water Distribution.

.3.2 New domestic cold water utility piping shall not be designed to be routed through campus tunnels or through campus facilities. If no other reasonable alternative exists, routing the underground domestic cold water utility through a tunnel or through a campus facility requires a design variance submitted to the University Engineer. Any exposed domestic cold water pipe must be designed with restraints to account for thrust forces. The project designing and installing the exposed domestic cold water line shall provide third party inspection on the installed water line prior to the water line being energized for testing.

.4 INTERIOR COLD WATER AND DOMESTIC HOT WATER PIPING: Branch off with valves to isolate areas of the building so that the entire water supply does not have to be shut off during repairs.

.4.1 4 inch and smaller, hard drawn type L copper tubing, with cast bronze or wrought copper class 150 lb., socket solder fittings or press fittings made out of bronze or copper conforming to ASME B16.18 or ASME B16.22 and performance requirements of IAPMO PS 117. Press fittings shall have factory-installed EPDM sealing element and leak detection feature.

.4.2 6 inch and larger, galvanized steel pipe, Schedule 40, conforming to ASTM-A53, Type E, Grade B. Fittings shall be Class 150 lb. malleable iron, galvanized, screwed pattern. Fittings, on 10 in. and larger, cast iron with Class 125 lb. flanges.

Wexner Medical Center: 5 inch and larger, hard drawn type L copper pipe with cast bronze or wrought copper class 150 lb. brazed fittings.

.5 DRIP LINES: Type L copper tubing with copper fittings.

.6 SPECIAL PIPING

.6.1 Distilled water: Schedule 80 CPVC, "Orion White Line" or Enfield "Purity Sustained" polypropylene plastic or tin-lined copper pipe with appropriate fittings may be used. If plastic is used, quality control of joint fusing is critical to performance.

Wexner Medical Center: The above piping for distilled water can be used for reverse osmosis water systems and deionized water systems also.

.6.2 Compressed air piping: Seamless hard-copper tubing, type L or K, with cast bronze or wrought copper class 150 lb. socket solder fittings. Galvanized steel piping is prohibited.

.6.3 Oxygen pipe lines: Cleaned seamless copper tubing, type K or L, or Schedule 40 brass pipe. Fittings shall be cleaned wrought copper.

Wexner Medical Center Informat: This section shall not applicable for medical oxygen.

.6.4 Other: Pipe and fittings for acid distribution, alkaline distribution, process piping, lubricating oil, high pressure, unusual gases, etc. shall be individually reviewed with the University Engineer. Also see 22 20 07.

.6.4.1 Compressed air and laboratory gases above 150 psig shall be designed, fabricated, and installed to comply with ASME B31.3. Such piping shall be inspected, examined, and tested per the requirements of Chapter VI of ASME B31.3. A third-party

inspector shall be hired by the A/E (Criteria A/E for design-build) and subject to approval by the University.

.6.5 Medical Gas piping: Medical gas designs, materials, and installations shall be compliant per Ohio Building Code, Ohio Plumbing Code, and NFPA 99C, ASME B31.1, NFPA 50, and NFPA 51.

6.6 Reverse osmosis permeate (product water) piping: Specify schedule 80 PVC, 316 stainless steel, or high purity polyvinylidene fluoride (PVDF) (complete system by SYGEF or Simtech) piping and fittings as appropriate for application. Do not specify copper.

6.7 Process cooling piping: Material selection shall be suitable for the application and compatible with laboratory equipment being served.

.7 GAS PIPING:

.7.1 Underground Natural Gas Lines (piping): See OSU BDS Division Underground Natural Gas Line 33 51 13.

.7.2 Interior piping shall be Schedule 40, A120/A53, ASTM A-120, Type F, or ASTM A53, Type F, Grade B black steel pipe. Joints in 1-1/2 inch and smaller pipe may be screwed. Fittings, class 150 lb. banded, malleable iron, black. Use of bushings is prohibited. Weld joints in pipe 2 inch and larger. Use backing rings for welding 8 inch and larger pipe.

.7.3 Specify that all steel pipe risers shall be cathodically protected from corrosion and electrically isolated from building grounds. A/E shall retain the services of a Consultant specializing in Cathodic Protection System design.

.8 PIPING FOR SOIL, WASTE, AND STORM DRAINS

.8.1 Exterior storm sewers: (Minimal pipe size shall be 8” for all piping that is not a roof leader) Acceptable materials are type PSM PVC pipe for 4 inch and 6 inch diameters conforming to ASTM D-3034, extra strength ASTM C700 vitrified clay pipe for 4 inch and larger diameters, and reinforced concrete pipe (ASTM C-76 deleting Sections 3.1.2 and 11. regarding design, concrete compression testing and production core and cylinder tests) for 6 inch and larger diameters, and corrugated polyethylene N-12 pipe conforming to ASTM-F405 and AASHSTO M252 for pipe 4" to 36" in diameter.

.8.1.1 For clay pipe, joints shall conform to ASTM C-425 Compression Joints for Vitrified Clay Bell and Spigot Pipe. For concrete pipe, joints shall conform to ASTM C-443 Type A Rubber Gasket. Also see 22 20 07.

.8.2 Exterior sanitary sewers: Acceptable materials are type PSM PVC pipe for 4 inch diameters conforming to ASTM D-3034, extra strength vitrified clay pipe for 4 inch and larger diameters and service weight cast iron pipe for 4 inch and larger diameters, and PVC SDR-26 pipe for 6" and larger diameters.

.8.3 Interior acid waste and vent: Piping above grade may be either Borosilicate glass or Duriron or polypropylene. Duriron shall be used below grade. See 22 00 03 and 22 20 07.

.8.4 Interior vents, soil, waste and storm drains except underground: Extra-heavy or service weight centrifugally cast iron soil pipe with lead, rubber gasket or "no hub" joints may be used for 1-1/2 inch diameter and larger pipe. When rubber gaskets are used, specify "Dual-Tight" or "Ty-Seal" with lubricant equal to "Lubrifast". Schedule 40 ASTM ~~A120~~ A53, type F, galvanized steel pipe, with galvanized cast iron drainage type fittings may be used for 2-1/2 inch diameter and smaller. Type L copper tubing and copper drainage fittings for waste and type M copper tubing for vents may be used for 4 in**c**h diameter and smaller. Provide structural support for large pipe and lateral restraint for all kinetic forces. PVC piping for interior vents, soil, waste and storm drains including using as sleeves shall be required prior approval from University Engineer.

Commentary: Approval from University Engineer on interior PVC piping is typically contingent upon whether the following issues have been addressed or not:

- Project manager has verified with User that noise won't be an issue to the User should PVC piping be used.
- PVC will not be used in plenum areas.
- A/E has confirmed that the waste to be discharged is compatible with the PVC material.
- A/E has specified the appropriate cement for the PVC pipe joining.
- A/E has included details for PVC piping penetrating floors and/or fire rated walls.

.8.5 Interior underground vent, soil, waste and storm drains: Extra-heavy weight centrifugally cast iron soil pipe with lead, rubber gasket or "no hub" joints may be used. When rubber gaskets are used, specify "Dual-Tight" or "Ty-Seal" with lubricant equal to "Lubrifast". Type K copper tubing and copper drainage fittings may be used for 3 inch diameter and smaller.

Wexner Medical Center: Type M copper tubing is prohibited.

.9 COPPER CONNECTIONS: Solder joints for copper water lines shall be made with no-lead solder in order to minimize the exposure to lead; water coolers must be lead-free.

.9.1 Copper joints: Copper piping less than 2 inch may be soldered using 95/5 tin/antimony solder. Copper piping 2 inch and larger shall be brazed, using a 6 percent silver alloy with a 1000°F solidus minimum and comparable to J.W. Harris Co., Dynaflow.

.9.2 Connections between copper and steel piping: Those carrying water shall be made with an approved type dielectric nipple or flange. Specify that all dielectric nipples used have at least 250°F temperature rating.

22 10 10 PUMPS

~~.10.1 Deionized water pumps~~

.10.1 Domestic water pumps: iron housing with brass impeller

Wexner Medical Center: Domestic water pumps shall be on emergency power.

22 14 00. FACILITY STORM DRAINAGE

1 ROOF DRAINAGE:

.1.1 COORDINATION: Location and depth of drains shall be carefully coordinated to assure adequate pitch of the drainage area to drain.

.1.2 DRAINS: Roof drains shall be cast iron with removable combined beehive strainer and sediment cup. Roof drains for multistory building or one-story buildings equivalent to at least two stories in height shall be provided with integral expansion joint. Roof overflow drains shall not empty onto public access areas.

.1.3 FLASHING: Drains shall be installed with lead sheet weighing not less than 6 pounds per square foot extending a minimum of 12 inches in all directions outward from the clamping ring. Lead flashing shall be placed below the roof insulation, and insulation shall be tapered down to the drain. Specifications shall call attention to the requirement for coordination with the installation of roofing.

.1.4 CONNECTIONS: Preferred approach is to drain roof drainage to storm water best management practices (BMPs) rather than direct connection to piped storm water conveyance systems.

.2 AREA DRAINAGE:

.2.1 OPEN AREA DRAINS: Where drains are subject to clogging with leaves, select drains which will avoid pooling of water.

.2.2 AREAWAY DRAINS: In areaways, at landings at the foot of exterior stairways, and similar locations, provide angular strainers at the wall and floor intersection, so vertical face acts as an overflow when the horizontal portion of the grating is obstructed.

Published January 1, 2006; Revised June 28, 2019

.2.3 WHEELCHAIR RAMPS: Where drainage is required at the base of wheelchair ramps, trench drains shall be used with slotted grating designed not to create a hazard to wheelchairs.

Wexner Medical Center: trench drains shall also be designed to not create a hazard with gurneys, in applicable areas

22 20 00. PLUMBING SYSTEMS

22 20 05. WATER SUPPLY SYSTEM

.1 Refer to (Division 0) and to paragraph 22 00 09 for particular items requiring coordination with General Construction.

.2 STERILIZATION: Specify that new and reworked domestic water piping be sterilized by a firm regularly engaged in the performance of pipe sterilization.

.3 DESIGN OF SYSTEM:

.3.1 Provisions for Expansion and Movement in piping shall be shown on the drawings.

.3.2 Unions shall be provided at the following locations:

.3.2.1 Adjacent to and downstream from all valves.

.3.2.2 At final connections to all items of equipment.

.3.2.3 At connections to all plumbing fixtures.

.3.2.4 Unions or flanged connections - where required for construction or assembling purposes.

.3.3 Water service lines shall not be caulked and leaded into a building wall; tar, rubber, or some other soft material shall be used. Special wall sleeve fittings with soft rubber seals are approved. A swing joint shall be provided on water lines just inside the building, to compensate for pipe movement. Specify that threading of cast iron or ductile iron pipe is prohibited.

.3.4 In buildings containing laboratories, water lines to drinking fountains shall be run on separate risers connected to the mains ahead of laboratory equipment lines. Vacuum breakers shall be provided at all laboratory equipment and laboratory water lines.

.3.5 Check valves shall be provided on showers, automatic washers, housekeeping closet decks and other items or equipment equipped with cold and hot water mixers. All check valves shall be easily accessible.

Student Life: check valves are not required on shower valves, however, shower valves must meet the following criteria: single handle pressure-mixing valve, with single bronze stem, housing stainless steel balancing piston sealed in stem assembly. Must hold shower temperature steady with pressure fluctuations up to 85%. Double seal packing with adjustable brass nut. Brass adjustable limit stop screw to prohibit valve handle to be turned to excessive hot discharge temperatures. All trim to be copper nickel chrome plated. Service stops to be brass and cast integral with valve body. Combination divertor and volume control to be cast integral with the valve.

22 20 06. DOMESTIC HOT WATER

.1 DESIGN OF SYSTEMS

Wexner Medical Center: Work with OSUWMC Facility Engineering team to obtain the most up to date Waterborne Pathogen Management Plan

Design Concept: Domestic hot water systems utilize steam reduced down from 70#, 400 degF steam stations. The domestic hot water is to be generated at 140 degF, with the capability of providing thermal shock up to 160degF. Domestic hot water is circulated throughout the complex to deliver 125-135 degF at the outlets. Monitoring of the domestic hot water supply and domestic hot water return shall be through the building automation system at the domestic hot water heaters and on the branch risers of each floor served. Consult with OSUWMC Facilities for other special monitoring requirements. Provide a master mixing valve with isolation valves and bypass for maintenance in lieu of individual mixing valves at each faucet. The domestic hot water system shall be on emergency power.

.1.1 Domestic hot water systems shall be designed to reasonably assure an expeditious flow of hot water at ALL outlets. When the facility is large (i.e., multistory laboratory building) or the system is large to support heavy flow (i.e., hospital or gymnasium showers) with central domestic water heating, the design
shall include recirculating line(s) and pump(s). When the total facility requirements are minimal and compact (i.e., fixture count of a small residence), or in the case of an isolated and remote minimal requirement in a large facility, the economics of space requirements and recirculating system must be calculated. An independent residential size water heater, backed up to the fixture(s) location, without recirculating system may be most appropriate. As a rough guide, domestic hot water systems shall dispense hot water after a flow of not over 1-1/2 quarts or within 10 seconds. Efficiency of hot water heaters shall meet minimum requirements of the current version of ASHRAE 90.1 adopted by Ohio.

Wexner Medical Center: The domestic hot water system shall be designed with recirculating lines and pumps, regardless of system size. Branches

greater than 20 feet from the main shall include a domestic hot water return line.

.1.2 A Recirculating Line shall be provided for all mains. Except for short runouts, lines shall be a minimum of 3/4 inch for large facilities. See paragraph 22 20 06.1.1.

.1.3 Unions or Flanged Connections shall be provided as specified in paragraph 22 20 05.3.2.

.1.4 Maximum Fouling Factor shall be used in sizing domestic hot water heaters. Factory assembled units are recommended; installation should be by the manufacturer or his approved representative.

.1.5 Domestic Hot Water Heaters: Integral heat exchangers with storage tank assemblies are prohibited. Separate heat exchangers and storage tanks or instantaneous heat exchangers are acceptable, dependent on the application. Water-to-water heat exchangers shall be double-wall construction. Refer to Owner's Project Requirements (OPR) for equipment redundancy requirements.

Wexner Medical Center: Storage tanks are prohibited. Steam fired semi-instantaneous water heaters shall be provided. Water heaters shall be designed with 100% redundancy such that if the largest water heater fails the building will continue to be fully served with domestic hot water.

.1.6 Shielding shall be specified around the packing areas of all circulating pumps.

22 20 07. SOIL AND WASTE SYSTEMS

.1 GENERAL PROVISIONS:

.1.1 Preparation of Contract Documents: Refer to (Division 00). Consult the University Project Manager regarding labor jurisdictional decisions in the area where the project is located. Sewerage from 5 feet outside building walls might become a part of the General Contract. See 22 10 05.8.1 .

.1.2 Applicable Specifications and Codes: Sanitary sewers external to a building shall conform to the requirements of local jurisdiction.

.1.3 Refer to paragraph 22 00 05 , 01 33 13 and 01 77 00 for submittals, test reports and certificates required.

.2 DESIGN OF SYSTEMS:

.2.1 Combined and Separate Systems: Combined storm and sanitary drains within the building structures are prohibited; each shall be run out of the building separately. (Part of the Columbus campus is served by a combined sewer system and part by separate sewer systems. The A/E shall obtain information from the University Project Manager relative to the sewer

arrangement for each building area.) On regional campuses, storm and sanitary systems shall be designed as separate systems.

.2.2 Storm Sewer Catch Basins and Roof Drains shall not be connected to sanitary systems except with specific permission from the University Engineer. If such permission is granted, catch basins shall be parged inside and provided with inverted elbow traps with cleanouts large enough for easy cleaning. Manholes shall not be used for catch basins or yard drains.

.2.3 Manholes shall be provided and shall be not more than 250 feet apart, except for large or very deep sewers. Lids shall be properly identified with cast-in lettering, indicating "STORM SEWER" or "SANITARY SEWER". Use the City of Columbus Construction and Material Specifications, State of Ohio Department of Transportation (ODOT) Construction and Material Specification Item 207, and/or local codes for minimum requirements.

.2.3.1 Each manhole or catch basin that meets the OSHA definition of a confined space shall have an entry opening that measures 30” or larger in diameter or 30” or more on a side.

.2.3.2 Steps or ladder rungs shall be built into manholes, catch basins, pits, and vaults as appropriate to provide foot and hand holds.

.2.4 Sewers shall be laid on a uniform grade from manhole to manhole. Double strength sewer tile shall be used when overburden is heavy or when sewer runs under roads. Sewers shall be extra heavy cast iron where buried under traffic areas with less than 3 feet of cover. Compression joints conforming to ASTM C-425 "Compression Joints for Vitrified Clay Bell and Spigot Pipe" shall be used on clay sewer pipe.

.2.5 Cleanouts shall be provided on all downspouts before they enter the ground.

.2.6 Joint Treatment: Caulked joints in soil pipe shall be caulked with white oakum and lead. The use of gaskets on joints as noted in paragraph 22 10 05.8 is acceptable. Lead shall not be used for caulking of joints in waste and vent lines where mercury might be used.

.2.7 Floor Drains: In general, floor drains shall be provided in toilet rooms and in equipment and fan rooms. These drains shall not be placed in ducts or plenums, or places of negative air pressure. (This is to avoid drying traps and pulling sewer gas into the air system.) Floor drains with sediment bucket shall be provided in trash rooms serving kitchens. In emergency shower and eyewash areas, floor drains are required unless there is an appropriate means to drain the water or permitted by University Engineer. ~~Must be discussed with University Project Manager.~~

Commentary: *Eyewashes are required to be tested weekly per ANSI standards.*

.2.8 Equipment Drains: Specify extra deep traps in locations subject to high pressure or vacuum such as fan housing, etc., to avoid loss of trap seal.

.2.9 Drip Lines from pumps, automatic traps, automatic air vents and from equipment shall be located to discharge over adjacent floor drains. Drip lines from pumps shall be connected to stuffing box drip points, not at drip base of pump. A separate drip line from drip base to over adjacent floor drain shall be provided.

.2.10 Flashing shall be provided for each vent. Flashing shall not be less than 4 lb. sheet lead and shall extend up and turn down inside top of vent. Specifications shall call attention to the requirement for coordination with the installation of roofing.

.2.11 The Manufacturer's Detailed Instructions for the installation of acid waste and vent lines shall be included in the final specification submittal.

.2.12 Acid Neutralizing Sumps: Provide as required. Locate sumps for servicing ease.

.2.13 Glass waste piping under slabs or underground is prohibited.

.2.14 Sewage ejector pumps: Where required, shall have a minimum of two (2) equally sized pumps so that a pump is available in the event of one pump failure. Pumps shall be automatically alternated on a monthly basis. Pumps shall have dual mechanical seals with a seal failure alarming to the BAS. The pump shall be designed to operate for a minimum of three minutes per cycle to prevent short cycling and premature pump failure. Sump capacity shall be designed to not exceed 12 hours of discharge load.

Wexner Medical Center: Pumps shall be on emergency power in the event of normal power failure to prevent sewage backup.

22 40 00. PLUMBING FIXTURES

.1 FIXTURES AND APPURTENANCES: Fixtures shall be of standard types and design and shall be selected on the basis of providing low flow rates of water, either by design or by the installation of flow restrictors. Principal fixture consideration should be given to showerheads and faucets.

.2 GENERAL PROVISION: Include in the specifications a statement that, during final inspection of the buildings, the contractor will be required to remove at least one randomly selected water closet in the presence of designated University personnel so that it can be checked for proper installation. If the one water closet is found to be installed in a defective manner, the contractor will be required to remove and properly reinstall all water closets.

.3 DETAILS:

.3.1 Urinals: Use siphon jet or blowout type urinals except where sound control is a problem, rated at 1.0 gallons per flush (GPF) ~~or preferably waterless urinals~~. Water closets shall be elongated design with open front seat, color as approved by the University Project Managers Office.

Water Closets: Use low flow toilets that have been tested and rated to function reliably at 1.6 GPF.

Lavatory Faucets: Use lavatory faucets with a maximum flow rate of 0.5 gallons per minute (GPM).

Kitchen Faucets: Use index-levered low-flow kitchen faucets with maximum flow rate of 2.2 GPM.

Showerheads: Use low-flow showerheads with institutional head and built-in 2.5 GPM flow control.

Dishwashers: Use dishwashers that operate on 10 gallons per cycle or less; or commercial dishwashers that use 120 gallons per hour or 1 gallon or less per rack.

Clothes Washers: Use clothes washers that meet EPA ENERGY STAR® requirements. Consider ozone laundry systems for facilities handling large quantities of textiles.

Wexner Medical Center: Bariatric water closets and private restrooms, where needed, shall be floor mounted, back outlet.

.3.2 Janitors' mop sinks' shall be precast terrazzo or molded stone (24 inch by 36 inch minimum), with a front edge stainless steel cap, on the floor.

.3.3 Individual Electric Refrigerated Water Coolers shall be provided in new buildings. Wall hung types are preferred. The Architect/Engineer shall determine the location of coolers for use by persons with disabilities and shall make adjustments in the building structures to assure accessibility to coolers by persons in wheelchairs. Water consumption shall not pass through, around or near lead of any form or sort.

.3.4 Shower Mixers shall be thermostatic mixing type.

Student Life: Require pressure balance with positive stops to be used for showers.

.3.5 Built-up Shower Pans shall be detailed in the drawings and specified.

.3.6 Traps on Lavatories and Sinks shall be not less than 1-1/4 inch by 1-1/2 inch chrome plated cast brass "P" traps with brass nut.

.3.7 Supplies to faucets, water closets, water fountains, residential dishwashers shall be copper tubing with steel handle stops, all chrome plated. Braided flexible hosing is prohibited.

Wexner Medical Center: All sinks shall have aerators removed.

22 42 05. FIXTURE CARRIERS

.1 FIXTURE CARRIERS: Lavatories, urinals, wall hung sinks, electric water coolers, and wall hung water closets shall be supported by chair carriers strongly anchored to withstand abusive eccentric loadings.

.1.1 Closet Chair or Carrier shall be selected so that the stud plate is supported by the wall back of the fixture. (It is important that this plate be against the wall to provide a rigid mounting.)

.1.2 Carriers shall be firmly anchored to the floor with maximum sized bolts that the feet will accommodate. Remember that people stand and bounce on fixtures so solid anchorage is imperative. Provide a template for bolts through the wall.

.1.3 Neoprene gaskets shall be used.

.1.4 The stud or nipple on the carrier shall be adjustable without cutting or defacing the wall and still maintain a tight joint.

Wexner Medical Center:

22 60 00 MEDICAL GAS SYSTEMS

.1 INSTALLATIONS: All medical gas piping systems shall be installed by ASSE 6010 certified installers. Documentation of certification shall be provided prior to installation and maintained on the jobsite. The installation shall be certified by a third party hired by Architect/Engineer. All installations shall conform to the latest edition of NFPA 99.

.2 MASTER ALARM PANELS are currently located in Doan 009 and in Rhodes S126. Any new master alarms shall be tied into these existing systems. If existing master alarm points are no longer available in these panels, provide a new master alarm panel adjacent to these existing panels. Coordinate number of points for new panel with OSUWMC Facilities Operations.

.3 ZONE VALVE BOXES: Existing zone valve boxes shall be replaced when renovating an area served by an existing zone valve box that does not meet the requirements of the current code. Coordinate with OSUWMC Facilities Operations. Zone valve boxes shall be labeled by the contractor with the rooms served, per NFPA 99. Zone valve boxes shall also be labeled with a unique identifier, corresponding to OSUWMC nomenclature – VB-building-floor-number – such as VB-RHH-4-3 for a zone valve box in the Ross Heart Hospital on the 4th floor. Consideration shall be given for zone valve boxes with provisions for area alarm sensor connections.

.4 MEDICAL GAS INLETS/OUTLETS: Shall be Chemetron adapter compatible. Coordinate replacement of existing medical gas inlets/outlets with OSUWMC Facilities Operations.

.5 LABELING: Ensure that all labeling required by the current NFPA 99 is specified and installed as part of the project.

22 61 00 MEDICAL AIR SYSTEMS

.1 Piping: Medical air piping shall be brazed, ASTM B819 specification hard drawn Type L copper seamless medical gas tubing. Compression fittings, flared fittings and memory-metal couplings are prohibited.

.2 Equipment: Medical air compressors shall be triplex units designed such that such that the full load of the building can be carried with the largest compressor out of service. Medical air compressors shall be single stage reciprocating type, oil free compressors, Liquid ring compressors are prohibited. Automatic alteration of compressors shall be provided to allow division of operating time. All medical air compressors shall be on emergency power. Air dryers shall be desiccant type.

22 62 00 MEDICAL VACUUM SYSTEMS

.1 Piping: Medical vacuum piping shall be brazed, ASTM B819 specification hard drawn seamless medical gas tubing. Compression fittings, flared fittings and memory-metal couplings are prohibited. Main and branch piping shall not be less than ¾" in size. Any existing medical-surgical vacuum less than ¾" in the area of renovation shall be increased in size to meet this requirement.

.2 Equipment: Medical vacuum pumps shall be triplex units designed such that the full load of the building can be carried with the largest pump out of service. Medical vacuum pumps shall be oil flooded rotary screw type. Liquid ring vacuum pumps are prohibited. Automatic alteration of pumps shall be provided to allow division of operating time. All medical vacuum pumps shall be on emergency power.

.3 Waste anesthetic gas disposal (WAGD) shall be piped individually out of each room, where required, and then ties into the medical vacuum piping. A dedicated WAGD producer shall not be provided.

22 63 00 MEDICAL GAS SYSTEMS

.1 Existing manifolds in Rhodes and Doan Hall exist for nitrous oxide, nitrogen and carbon dioxide that serve Rhodes, Doan, James and Ross Heart. Any tie-in to these existing manifolds shall include analysis into the size of the manifold, number of cylinders, frequency of change out, current code compliance, etc to ensure that the manifold can support the additional load being added.

.2 Piping: Medical gas piping shall be brazed, ASTM B819 specification hard drawn Type L copper seamless medical gas tubing. Compression fittings, flared fittings and memory-metal couplings are prohibited.

Published January 1, 2006; Revised June 28, 2019

22 70 00. SPECIAL SYSTEMS:

22 70 10. COMPRESSED AIR

.1 Refer to paragraph 22 70 10.4 for requirements for air compressors.

.2 AUTOMATIC CONDENSATE TRAPS shall be provided at all air receiver tanks and low points on compressed air line.

.3 COPPER PIPE shall be used where there is likelihood of rust or of dirt in the air.

.4 COMPRESSORS:

.4.1 Vibration isolation: Refer to paragraph 22 05 50.

.4.2 Air compressors (10 hp and under) shall be air cooled. Caution shall be exercised in locating compressors, with respect to heat producing equipment and room ambient temperature.

.4.3 Refrigerated coolers shall be used on air supply to building air control systems or equipment. If intake is extended, provide for easy maintenance.

22 70 20. AIR AND GAS PIPING SYSTEMS

.1 COMPRESSED AIR AND GAS PIPING: See 22 00 05, 22 00 09, 22 10 05.6, 22 10 05.7, 22 70 10.4, and 22 70 30.

.2 GAS BURNING EQUIPMENT: All gas burning equipment shall comply with the local gas company requirements, the State Code, and the City Code. Devices burning 20,000 Btu per hour or more shall be vented to the outside. Where applicable, appliances shall carry the AGA stamp. All such devices shall have approved safety pilots.

.3 LARGE GAS BURNING DEVICES (such as boilers, incinerators, ovens, and kilns over 50,000 Btu) shall comply with Factory Mutual or Industrial Risk Insurance recommendations. In buildings of high occupancy, Industrial Risk recommendations shall be followed.

22 70 30. GAS PIPING:

.1 Piping shall not be run under buildings or basement floors. Double pipe with a vent shall be used where piping passes through an outside wall of a building or tunnel or under pavement other than normal sidewalk. Piping shall not pass through plenum chambers.

.2 INTERIOR PIPING: An insulating flange shall be furnished and installed at the point of service entrance, to electrically isolate interior and exterior piping.

.3 CONCEALED PIPING shall be welded.

.4 REGULATORS: Properly vent to the outside where required by code or for safety.

.5 PIPING SHALL ENTER BUILDING ABOVE GRADE. Wall shall be sleeved and caulked at entrance.

END OF DIVISION 22 - PLUMBING

23 00 00. HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

*[**Commentary:** Note: Division 23 applies to piping and valves, etc., within buildings. For piping and valves external to buildings (campus district heating, district cooling, natural gas, etc.,) Division 33 applies. For buildings connecting to campus utilities, review with University Project Manager where Division 33 applicability stops and Division 23 starts.]*

23 00 03. GENERAL PROVISIONS

.1 Specialized exhaust systems will need to be provided for offset printing and dark room operations. Refer to Appendices for laboratory ventilation and fume hood exhaust air systems.

.2 COHESIVE DOCUMENTS OF BUILDINGS, UTILITIES AND SYSTEMS: The A/E's design documents shall provide one-line diagrams of all utilities, organized in relation to the new construction plus the existing construction. Provide one-line diagrams of each system, organized in relation to the new construction plus the existing construction. The one-line diagrams and system documents must display the interrelationship of all systems with all attributes of the building (number of floors, future or shelled-out spaces, original buildings, added building areas, etc.).

.3 All electrical equipment provided by the HVAC contractor shall be in accordance with the requirements of Division 26.

.4 All equipment provided by the HVAC contractor that is furnished with fuses shall be provided with spare fuses in accordance with Division 26.

.5 ROTATING EQUIPMENT

.5.1 GENERAL PROVISIONS: Where possible, specify rotating equipment with antifriction sealed spherical ball or roller bearings, split pillow blocks, and lubrication of bearings in accordance with manufacturer's recommendations before start-up. Bearing life (on equipment 5 hp and larger) per Anti-Friction Bearing Manufacturers Association rating procedures shall be 90 percent expectancy of reaching at least ~~87,360~~ 150,000 hours under design conditions. Caution the contractor to exercise extreme care in cleaning and lubrication of bearings after equipment has been subject to prolonged periods of storage before operation. The contractor shall be made responsible for continued lubrication of equipment until acceptance of his work.

Wexner Medical Center: Provide ceramic bearings on fans controlled by a VFD for protection against eddy current bearing failures. Bearing life per Anti-Friction Bearing Manufacturers Association rating procedures shall be 90 percent expectancy of reaching at least 150,000 hours under design conditions.

.5.2 NOTIFICATION OF START-UP: The A/E shall notify the University Project Manager of the schedule for start-up of all equipment.

.5.3 REPORT REQUIRED: The A/E shall specify that the Contractor, at the time of acceptance, shall provide the University Project Manager with a report listing the following:

.5.3.1 Dates equipment arrived at job site.

.5.3.2 Installation completion date.

.5.3.3 Dates of maintenance at start-up and periodic inspections.

.5.3.4 Dates of lubrication, specific brand names, manufacturer and type(s) of lubricant.

.5.3.5 Dates of maintenance inspections and scope of maintenance services performed.

Wexner Medical Center: OSUWMC Facilities Operations shall be provided with the above-mentioned report.

.6 EQUIPMENT IDENTIFICATION: Specify that fans, controls, switches, ventilators, pumps, and other items of equipment, which have had the manufacturer's data plate ~~tag~~ removed or rendered illegible, be equipped with new name plate ~~tag~~ by the installer. Plate shall be brass on which operational data plus information regarding areas or other equipment served is stamped. Permanently attach name plate ~~tag~~ to the equipment in locations where they can easily be read.

.7 SPRINKLER PIPING IN CEILING SPACE OF VESTIBULES and similar locations shall be protected from freezing.

.8 All installed equipment requiring maintenance shall be designed to enable proper access.

Wexner Medical Center:

.8.1 Systems serving patient care areas and systems serving clinical buildings as a whole shall be designed with N+1 redundancy such that the areas and building can still fully function with the largest piece of equipment out of service.

.8.2 The use of duct liner is strictly prohibited.

.9 SLEEVES:

.9.1 PROTECTION FOR INSULATED PIPES: When insulated pipes penetrate floors that will be covered with finish flooring, specify that a sheet metal protective covering be installed around the insulation

jacket. Sheet metal jacket shall extend through and above the pipe sleeve far enough to protect the insulation from bumping by floor polishing machines and vacuum sweepers. Space between the pipe sleeve and the sheet metal must be sealed. Where insulated pipes pass through wall sleeves, cover insulation with sheet metal and seal both ends of the space between the sleeve and sheet metal with non-combustible packing.

.9.2 CLEARANCE: Provide not less than 1/4 inch clearance on all sides for both insulated and non-insulated pipes which penetrate walls and slabs.

9.3 LENGTHS: Except where greater lengths are required for penetrations through floors, sleeves shall be fabricated to a length equal to the thickness of construction through which they pass. See below.

.9.3.1 SLEEVES THROUGH WATERPROOFED FLOORS shall project a minimum of 4-inches above the floor.

.9.3.2 SLEEVES IN HVAC AND PLUMBING EQUIPMENT ROOMS shall extend no less than 1-1/4 inches above the curbs.

.9.3.3 SLEEVES IN ALL OTHER FLOORS shall extend 3/4 inch above the finish material on the floor.

.9.3.4 SEALS: Special wall sleeve fittings with soft rubber seals shall be specified for water service piping. In other installations, the void between pipe and sleeve shall be sealed with mineral wool or other non-combustible material to prevent passage of flame and smoke. In locations exposed to public view, the packing materials shall be concealed with sheet metal cover plates or split type, chromium plated brass escutcheons.

.9.4 FIRE-STOPPING: Specify and show fire stopping at all penetrations of fire-rated assemblies.

.9.5 Sleeves for copper pipe shall be fabricated of copper pipe for up to 4 inches in diameter.

.10 MOTORIZED EQUIPMENT: Basic requirements for electrical work and equipment are covered in Division 26 of these standards. The requirements included herein cover specific items that have been troublesome in the past and require that the specifications incorporate adequate provisions for electrical work and equipment furnished by the Plumbing, HVAC, and Fire Protection Contractors. The A/E shall specify motors, drives, and equipment to meet all operating requirements for the installation. Consideration for motors should be for voltage, phase, frequency, frame size, temperature rise, and sufficient starting torque to start loads with high inertia. Performance requirements should include capability to make multiple starts

per day to meet energy conservation control requirements. Where necessary, non-recycling shall be specified to protect the equipment from short time recycling.

.10.1 WIRING: Specifications shall clearly point out the responsibility for wiring related to Plumbing, HVAC, Fire Suppression and Fire Alarm equipment. In general, it is required that power wiring is provided by the Electrical Contractor and control wiring is provided by the Plumbing, HVAC and Fire Suppression Contractor. Also see Communications Wiring Standard in Appendix.

.10.2 STARTERS: Specifications shall require that motor starters be provided by the Electrical Contractor. Exceptions to this requirement will require the approval of the A/E and his review is necessary to ascertain that standards stipulated in the electrical specifications are followed. Variable Frequency Drives (VFD's) shall be specified by the A/E.

.10.3 MOTORS shall be sized in accordance with applicable NEMA standards for the operating conditions of each specific items of equipment with a 1.15 service factor. Motors must be selected to operate within nameplate HP and shall not operate on the service factor. Short shaft motors shall not be used for belt drives. In general, motors one-half horsepower or smaller shall be single phase; motors larger than ½ horsepower shall be three-phase. Motors shall be provided with electrical overload protection to prevent burn-out under operating conditions. Large motors shall have adequate internal overload and thermal protection in addition to the overload elements in the motor starter. Definite purpose inverter fed motors shall be specified for use with VFD's.

.11 POWER AND CONTROL DRAWINGS: Electrical power and control drawings for large, complex electrical equipment shall be supplied in a legible format on site.

.12 DIAGRAMS AND OPERATING INSTRUCTIONS: Complete diagrams and operating instructions for all control systems shall be posted near the related equipment. Provide framed glass or clear acrylic plastic protection. When multiple equipment rooms exist in a building, these diagrams will be required at each piece of equipment. Additionally, a complete set of diagrams will be posted or made available in the main equipment room and shall be included in the O & M manuals submitted as part of the project closeout.

.13 Domestic water shall not be used for condenser heat rejection. No single pass cooling water may be used on mechanical equipment in new construction or retrofits, except in the case of emergency.

.14 A REVIEW OF ENERGY CONSERVATION REQUIREMENTS

The subject of energy conservation is discussed in various sections of these BUILDING DESIGN STANDARDS. This review is made for the purpose of

consolidating all requirements for this important part of design under one heading for easy reference.

.14.1 GENERAL REQUIREMENTS

.14.1.1 The University is dedicated to the principle of conserving energy and will scrutinize proposed construction for means of reducing not only initial cost, but also long-range operating costs. The A/E must work in close cooperation with his consultants to design new buildings and remodel existing buildings making the most efficient use of building materials and energy sources available. Energy Conservation is dependent on all elements of a total building structure. Compliance with the OHIO STATE **Green Build and Energy Policy 3.10** is mandatory. If, in Schematic or Design Development submittals, it is determined that the project does not meet or exceed the requirements of OHIO STATE Policy 3.10, a conference with The University Engineer will be required to determine the course of action. Redesign of problematic portions of the building will be required with all professionals working in close cooperation to design energy efficient buildings. Refer to Part 1, "The Design Process" of the BDS for the required design documentation submittals to show compliance with OHIO STATE Policy 3.10.

.14.1.2 In the design of the HVAC and Electrical systems, consideration must be given to building utilization by planning for conservation of energy during summer and winter vacations and for other periods of minimum occupancy. Research laboratories, spaces for animals, server rooms, communications rooms, IDFs, MDFs, and other spaces which might require 24 hours/day operation must be serviced by systems separate from office systems which may require only 8 hours/day operation, and classrooms which may be shut down during summer and vacation periods. HVAC systems that require chilled water below 50 F outside air temperature require prior approval by the University Engineer or Wexner Medical Center Facilities Engineering.

.14.1.3 The capability of using alternate sources of energy is of extreme importance. If gas-fired boilers are installed, the facilities must be provided with stand-by equipment for use of other fuels or sources of energy.

.14.1.4 The Ohio Building Code allows the use of either the International Energy Conservation Code (IECC) or ASHRAE 90.1 for energy code compliance. The University

prefers ASHRAE 90.1. Use of IECC requires University Engineer approval.

.15 BUILDING SYSTEMS - DESIGN REQUIREMENTS

.15.1 HVAC systems, lighting systems, building envelopes and other building energy consuming systems shall be designed to conserve energy. Replacement of air handling units, lighting systems, or other systems utilizing energy, directly or indirectly, shall be treated as new systems and not as repair or maintenance. New systems must comply with the OHIO STATE Green Build and Energy Policy 3.10.

.15.2 Design temperatures for heating and air conditioning systems shall be as follows:

Summer:	Outside conditions,	92 degrees FDB and 74 degrees FWB
	Inside conditions,	76 degrees FDB and 64 degrees FWB

Winter for space conditioning:

Winter:	Outside conditions,	+1 degrees FDB
	Inside conditions,	70 degrees FDB

Winter for preheat coil sizing on 100% outdoor air fan systems:

Winter:	Outside conditions,	(minus)	-22 degrees FDB
	Coil Leaving Air conditions,		+55 degrees FDB

Relative humidity should range between 40 and 70 percent in order to control the growth of molds, fungi, bacteria, etc.

Special areas, such as computer rooms, animal areas, etc., will have temperature and humidity requirements transmitted to the A/E by the University Engineer.

.15.3 Occupied-unoccupied programming of systems should be initiated to shut-off ventilation air, exhaust air, fan systems, pumps, etc., wherever possible. Where shut-down of systems cannot be accomplished during unoccupied hours, heat recovery systems should be considered. Each application should be examined independently to determine any special sources for obtaining a recovery of usable energy. An economic analysis by the A/E's consultants may be required to determine the feasibility of energy recovery systems before the University Engineer will render a decision of their acceptability. This analysis shall be furnished by the A/E to the University Engineer.

.15.4 Fan coil units and radiation will be required in specific areas to facilitate shut-down of major fan units. Where necessary, the controls on these units shall be coordinated with the controls on the air handling units.

.15.5 All air conditioning systems shall have controlled economizer cycles where required by the energy code. Air conditioning systems smaller than this shall have controlled economizer cycles where the cost for additional work and equipment involved can be justified. All systems that have economizer cycles shall be capable of running the cooling equipment independent of the economizer cycle controls. Furthermore, the economizer control shall not revert to the minimum outside air damper position for cooling season unless mechanical cooling is available.

.15.6 All air conditioning, heating, ventilating, and exhaust systems shall be closely matched to the minimum required performance. The use of variable volume supply and exhaust air systems is encouraged to compensate for diversities in loads and reduce equipment sizes. Space air outlets should be aspirating types to prevent "dumping" of air into occupied spaces.

.15.7 Interior spaces requiring cooling the year around should be handled independently from perimeter areas requiring heating during the winter and cooling during summer. Interior areas should be supplied from a variable volume cooling system utilizing controlled economizer cycle. The perimeter systems should utilize controlled economizer cycles when cooling is required and minimum ventilation rates when heating is required.

.15.7.1 For any system based upon variable air volume, include a pre-heat coil as the first coil in the fresh air stream, sized to preheat the fixed-minimum ventilation air from design heating outdoor air temperature up to design mixed air temperature. This will help to maintain the required fixed minimum ventilation air, by preventing the mixed air temperature controller from closing the outside air damper.

.15.8 The following criteria shall be employed in the selection of equipment (each project to be reviewed on an individual basis):

.15.8.1 FANS selected for operation above 6-1/2" total static pressure must be approved by the University Engineer.

.15.8.2 COMPRESSORS for electricity-driven chillers and refrigeration units, Electrical power consumption shall be in compliance with Policy 3.10. Absorption water chillers should not be used unless waste heat is available. The University's central steam distribution system in NOT considered waste heat.

.15.8.3 Due to the highly technical nature of chiller selection as to its performance characteristics, space requirements, isolation requirements with regard to noise and vibration,

and other requirements, the A/E and Facilities Operations and Development through the University Engineer will mutually designate one manufacturer to be specified as base bid. Equals will be developed for bidding two other units.

.15.8.4 Water-cooled, air-cooled, or evaporative condensers are acceptable depending upon job requirements and necessities. Water-type cooling towers are preferred to conserve energy and shall generally be used on systems 80-tons and larger. On units below 80-tons, an economic evaluation, including cost of maintenance should be made to determine if the condensing unit will be air cooled or water cooled.

Cooling tower fan motor loads shall not exceed 0.06 H.P./ton of chiller capacity. Reduced condenser water temperatures should be utilized when possible to reduce the chiller electrical consumption. At design conditions air cooled condensers shall have not more than 115°F condensing temperature with 20°F temperature difference between air entering and leaving the condenser.

.15.9 Variable Frequency Drives, elevator controllers and other electronic equipment are to be located within a separate temperature controlled area of building maintenance rooms to avoid the harmful effects of heat produced by steam stations, heating hot water pumps or other building systems producing local environments which exceed safe operating conditions for electronic equipment.

23 00 05. SUBMITTALS:

.1 FOR DESIGN CONSIDERATION:

.1.1 Refer to Division 00 ~~Part One~~ of the Building Design Standards.

.2 FOR PROJECT CLOSEOUT:

.2.1 Refer to Division 00 ~~Part Two~~ of the Building Design Standards.

23 00 07. TESTING

.1 TESTING PROCEDURES

.1.1 Testing Procedures: Specify that all tools, instruments, and equipment required for performing tests be furnished and that required temporary connections be made. Defects that develop under tests shall be repaired promptly and the tests shall be repeated. No caulking of screwed joints, cracks, or holes will be permitted. Leaks shall be repaired by tightening joints or by replacing pipe, fittings, or equipment with new materials. Minor leaks in welded joints may be chipped out and rewelded.

.1.1.1 Do not insulate ducts prior to duct leakage testing.

.1.1.2 Hydrostatic and air tests shall be made before piping is concealed or covered. Specify that systems be completely drained after hydrostatic tests are performed and that damages caused by freezing, prior to acceptance of the completed installation, be repaired at no cost to the University.

.1.1.3 Preparation for Testing: Prior to testing, obtain satisfactory operation and uniform temperatures; perform air and water balancing and adjustment of pressure reducing stations and HVAC equipment. Pressure reducing valves, relief valves, air vents, and motor-operated valves shall be checked for proper operation. Pumps shall have operating heads adjusted in accordance with the performance curves; test reports shall include amperage readings.

.1.1.4 Water Chiller and Boiler Check Out: Specify that a factory-trained serviceman employed by the manufacturer perform adjustments, start-up, tests, and provide syllabus-of-training plus instructions to designated University operating personnel. Training by the manufacturer shall be coordinated with the University Project Manager and Wexner Medical Center Facilities Services (for Med Center Projects)

.1.1.5 Refrigeration piping shall be isolated from the refrigeration system and tested in accordance with ASHRAE 15. Perform tests at an ambient temperature above 50 degrees F.

.1.1.6 Testing of service lines shall follow recommended code practices. When lines are tested with water pressure, care must be taken to remove all air to avoid false pressure readings.

.1.1.7 Refrigerant piping shall be tested independent of existing piping systems and existing or new equipment.

.1.1.8 Underground and buried lines testing: See Division 33.

.1.1.9 Conduit for underground thermal lines testing: See Division 33.

.1.1.10 Pressure and Duration of Tests: Exposed lines shall be tested with the test fluid at pressures indicated for a period of not less than 6 hours and shall show no drop in pressure. Follow ASME B31.1 and B31.9 for pressure testing and the below pressures are min pressures.

Line	Test Fluid	Pressure Not Less Than
Steam - 200 lbs.	Water	300 lbs.
Steam - 100 lbs.	Water	200 lbs.
Steam - 15 lbs.	Water	125 lbs.
HWHS & HWHR	Water	125 lbs.
Chilled Water	Water	125 lbs.
Condensate	Water	125 lbs.
Condenser Water	Water	125 lbs.
Air	Air	150 lbs.

.2 BALANCING: Specifications shall make recommendations for balancing of air and water systems and shall stipulate that the Balancing Contractor shall be a company certified by the Associated Air Balance Council (AABC), National Environmental Balancing Bureau, Inc. (NEBB), or other nationally recognized authority to perform tests, and shall be certified in the disciplines specific to the project applications and needs. The balancing contractor shall be hired by the A/E, except for Design-Build projects, where the balancing contractor shall be hired by the Criteria A/E. The balancing contractor may be hired by the A/E [Engineer of Record], HVAC contractor, or Design-Build Contractor for small, simple projects with prior approval by the University Engineer.

Commentary: *The University desires that Testing, Adjusting, and Balancing results be verified independently of the HVAC Contractor and of the A/E for Design-Build. The TAB contractor may be hired by the HVAC Contractor, Construction Manager, A/E, or Criteria A/E for any project with TAB verification by an independent Commissioning Authority under contract with the University.*

Wexner Medical Center: The balancing contractor shall be hired by the A/E or Commissioning Agent.

.2.1 Pre-balance Meeting: At a date determined by the University Project Manager, a pre-balance meeting will be scheduled with the balancing company, designated University personnel, the A/E, and his engineering consultants, and contractor to review the system or systems involved. During the meeting, it shall be determined whether the system or systems will be balanced for full cooling, full heating, or modulated as applicable to both design and weather conditions. In preparation for this meeting, the company selected to perform the system balance shall be required to review the project drawings and, within 30 days, submit to the A/E a summary of proposed methods of test procedure for each system and

indicate if any changes are required to permit balancing. Proposed tests shall include, but not be limited to, the following:

.2.1.1 Testing of hot and cold mixing dampers.

.2.1.2 Testing and setting of balancing dampers.

.2.1.3 Testing total C.F.M., S.P., R.P.M., O.V., and B.H.P. of all fans.

.2.1.4 Testing air and water velocities and flow at coils. Describe test conditions and procedures.

.2.1.5 All new supply air handling equipment shall be leak tested.

.2.1.6 Testing ducts and air shafts for leakage. Duct leakage testing shall be per ASHRAE 90.1. Student Life requires that equipment also be leak tested.

.2.1.7 Testing and adjusting of variable air volume systems and the tracking of supply air fans with return air fans at the following normal extremes of system operation:

.2.1.7.1 Maximum volumes, i.e., maximum summertime cooling design volumes, with constant volume toilet exhaust in operation.

.2.1.7.2 Minimum volumes, i.e., minimum wintertime heating design volumes, with constant volume toilet exhaust in operation.

.2.1.8 Prior to any hydronic balancing, the following must first occur. The hydronic systems shall have been circulated and shall be determined to be internally clean and leak-free. The hydronic system contractor shall open all hydronic strainers, remove the strainer from the strainer fitting, throw away the start-up strainer, run the system with the new permanent strainer, then remove, clean and re-insert the permanent strainer, and remove all air from the water system. The balancing contractor may then perform the hydronic balance.

.2.2 Conducting the balance: The balancing company will coordinate with the Contractor to adjust equipment or to arrange for personnel of equipment suppliers to be available for the necessary adjustment at the time of balance. Any discrepancies or items not in accord with contract documents, which may affect the total system or systems balance, shall be reported in writing to the A/E and University Project Manager. Air and water balance must be repeated following corrections to confirm that corrections were made.

.2.3 FUME HOOD BALANCING shall be in accordance with procedures outlined in Appendix W. Coordinate balancing with OHIO STATE Environmental Health and Safety through the University Project Manager.

.2.4 REPORTS: One copy of the preliminary air and water balance report is required. One hard copy and one electronic copy of the final balance reports indicating specified and actual tested conditions, including verification of equipment performance, as well as explanation for variation from specified conditions shall be submitted following OHIO STATE's Closeout Standard.

*[**Commentary:** The A/E should determine the level of effort desired based on individual project needs when specifying verification of performance (e.g., will testing and demonstration of design capacity for chillers, cooling towers, boilers, etc., be required?).]*

.3 COMMISSIONING: Refer to Owner's Project Requirements (OPR) for systems to be commissioned. Reference ASHRAE Standard 202, Commissioning.

23 05 05. HVAC SPECIALTIES

23 05 14. VARIABLE FREQUENCY MOTOR CONTROLLERS

.1 Refer to Appendix A for controls compatibility requirements of VFDs.

.2 Contractor must submit a harmonic distortion study to show that harmonics are within NEC code compliance.

23 05 19. METERS, GAUGES AND THERMOMETERS

.1 METERS: Refer to Division 33

Wexner Medical Center: Utility metering shall support connection to the OSUWMC Building Automation Delta Controls front-end through a BACNet compliant system to monitor for the purpose of improving operational efficiency of the building systems.

.2 GAUGES:

.2.1 Gauges other than draft gauges shall be 4-1/2 inches diameter single spring type with recalibration adjustment in the dial face and with ball valve shut-off. Tailor the range to the application. Gauges shall not be positioned over 6-feet above the floor; install remote sensing gauges as required to

conform to this restriction. Gauges shall be applied on all pumps, strainers, air handler coils, and pressure reducing stations. Provide separate gauges on inlet and discharge. Do not use a single gauge with a valved manifold. Gauges shall include snubbers and/or siphons. Gauges in applications with possible dirty strainers shall include compound-ranges.

Wexner Medical Center: Gauges shall be installed with ball valve shut-off and manifold to allow single gauge use. Gauges should also be installed upstream and downstream of pressure reducing stations. Gauge range shall be applicable to the installation.

.2.2 ~~Draft~~ Magnehelic type gauges ~~in systems of more than 5000 CFM~~ shall be installed across all pre-filter/intermediate filter systems, across after-filters and across low efficiency filters. ~~Below 5000 CFM install magnehelic type gauge~~

.2.3 Pressure gauges, at refrigeration compressors of over 100 Ton capacity, indicating high side, low side and oil pressure shall be provided, if they are not included as a part of the compressor package.

.2.4 A steam gauge with syphon after regulators (within sight of the regulator but at a suitable distance downstream from the regulator to assure good pressure readings) shall be provided to enable operating personnel to properly adjust the regulator.

.2.5 Other piped systems: Locate vacuum or pressure gauges as required to properly identify pressure within each system.

.3 THERMOMETERS:

.3.1 Thermometers shall be mercury-free blue or red-reading-in-glass type with 9-inch magnified column, Fahrenheit scale, recalibration feature, adjustable head and brass separable socket. Tailor the range to the application. Thermometers shall not be positioned over 6-feet above the floor; install remote head type of thermometers as required to conform to this restriction.

Wexner Medical Center: Thermometer scale range shall be applicable to the installation.

.3.2 Where appropriate to the application, consider using light-powered, digital thermometers with Fahrenheit scale, recalibration feature, adjustable head, brass separable socket, LCD with minimum 3/8-inch characters, high-impact ABS or cast aluminum case, and glass-passivated thermistor. Minimum range shall be minus 40 to plus 300 degrees F. Minimum ambient operating range shall be minus 30 to plus 140 degrees F. Thermometer shall have a lux rating of 10 lux (1 footcandle) and require no batteries.

Wexner Medical Center: Required applications include hot water converters, domestic water heaters, water tempering stations, air handling unit heating coils, air handler cooling coils, pressure reducing stations, chiller and condenser water systems.

.3.3 Piped systems and storage tanks: Locate thermometers as required on all systems or tanks where temperature should be identifiable for operation and maintenance. Suggested applications include hot water converters, domestic water heaters, water tempering stations, air handler heating coils, air handler cooling coils, chiller and condenser water systems, etc.

.3.4 For each temperature sensor well location, also install a thermometer well and thermometer to allow verification of the sensor reading.

23 05 25. VALVES

Commentary: *For steam and steam condensate valves, the A/E shall review the type of connections (welded, flanged, or screwed) and the type of isolation valves (gate or high-performance butterfly) desired with the University Project Manager and University Mechanical & Electrical Systems, Student Life Building and Mechanical Services, and OSUWMC Facilities Engineering, as appropriate.*

.1 PROPRIETARY BRANDS: All valve-types furnished on a project shall be products of one manufacturer for each type of valve specified. List 3 (minimum) manufacturers of equal products from which the contractor will make a selection.

.2 TYPES: Specify the following valve-types for installations indicated:

.3 VALVES IN STEAM LINES (150 psig and above):

.3.1 Gate valves 2 inches and smaller: Use Division 33 valve 3GT10W, with socket weld or threaded ends.

.3.2 Gate valves 2-1/2 inches and larger: Use Division 33 valve 3GT20W, with butt weld or flanged ends.

.3.3 High-Performance Butterfly valves: use cast steel, Class 300, flanged rotary valves, suitable for bi-directional shutoff, dead-end steam service at 250 PSIG and 650 degrees F. Specify metal-seated, quarter- turn, triple-offset type valve with the following construction and characteristics:

.3.3.1 Suitable for installation above ground or in steam vaults.

.3.3.2 Body: WCB carbon steel; double-flanged body construction, ASME/ANSI B16.5 class 300 flanges.

3.3.3 Seat: Stellite or similar hard surfaced material.

.3.3.4 Resilient, non-flexing laminate metal seal composite of stainless steel and graphite retained such that centering movement is permitted.

.3.3.5 Retainer screws, disk, and plate shall be stainless steel.

.3.3.6 Shaft shall be single piece construction.

.3.3.7 Per ANSI B 16.5, 31, 34 construction for body components B31.1, 31.3 ASME section VII, IX.

.3.3.7 Valves shall meet API 607 Rev.4 standards.

.3.3.8 Hardened bearing with bearing seal shall be retained in body.

.3.3.9 Shaft seal shall be graphite with multiple stud packing gland follower for adjustability utilizing Belleville style washers.

.3.3.10 Right angle gear with 2 in. AWWA nut, with loose steel hand wheel or chain wheel attachment, for remote "tee" handle operation (identify

.3.3.11 Rotary valves for services requiring insulation shall be equipped with stem housings of suitable length to clear insulation.

.3.3.12 INSTALLATION: Do not use gaskets for resilient seated valves unless instructed by the manufacturer.

.3.4 Above 15 psig, for steam lines 6 inches and larger, provide a small globe ~~angle~~ valve bypass around isolation valve for warmup. ~~per OSU Utilities guidelines~~

.4 VALVES IN STEAM LINES (above 15 to below 150 psig): Use cast steel, Class 150, bolted flange yoke bonnet, outside screw, rising stem, butt welding or flanged ends 2 inches and larger. Use forged steel, socket welding or threaded ends 1-1/2 inches and smaller. Bodies shall be cast carbon steel conforming to ASTM A216, Grade WDB. Bonnet shall be one-piece cast carbon steel conforming to ASTM A216, Grade WCB. Gasket shall be compressed in the body-bonnet. Valves shall be repackable under pressure. Seat rings shall be threaded.

.4.1 Gate Valves: Stem and solid wedge shall be stainless steel #P-140 conforming to ASTM A182, Grade F-6. Seat rings shall be stainless steel #P-140 –15, conforming to ASTM A182, Grade F-6, surface hardened. Stuffing boxes shall have high temperature packing. Condensation chamber shall be provided immediately below packing.

.4.2 Globe Valves: Disc shall be stainless steel P-140-15 conforming to ASTM A182, Grade F-6, surface hardened. The seat shall be stainless steel P-140 conforming to ASTM A182, Grade F-6. The type "S" seat and disc shall

have spindle on underside of the disc guided through a bridge cast integral with the seat. Seat ring shall be threaded.

.4.3 Check Valves: Swing disc and seat ring shall be stainless steel P-140 conforming to ASTM A182, Grade F-6.

.5 VALVES IN STEAM LINES (15 psig and below): Use bronze or cast iron, 150 lbs. SWP at 500 degrees F, bolted flange yoke bonnet, outside screw rising stem, flange ends 2-1/2 inches and larger; screwed ends 2 inches and smaller. Gate and globe valves shall have Teflon packing. Other construction as specified in paragraph 23 05 25.4.2.

.6 VALVES IN HYDRONIC SYSTEMS:

.6.1 Gate valves: ~~Make the same as gate valves in 0 to 15 psig steam lines~~ Prohibited for isolation.

.6.2 Globe valves (2 inches and smaller): Use all bronze, threaded, union bonnet, rising stem, 200 lbs. SWP, repackable under pressure. Control valves shall have pilot positioners.

.6.3 Globe valves (2-1/2 inches and larger): Make the same as for 0 to 15 psig steam lines. Control valves shall have pilot positioners.

.6.4 Check valves: Make the same as 0 to 15 pounds steam lines.

.6.5 Ball Valves: 3 inch and smaller, two or three piece bronze body, screwed ends, stainless steel ball, steel stern, reinforced TFE packing and seat ring with appropriate pressure and temperature rating for specific application.

.6.6 Butterfly Valves: 2.5-inch and larger, lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange; ASTM A 126, cast iron or ASTM A 536, ductile iron, NBR seat, SS stem, SS or aluminum bronze disc, 150 psig CWP rating. Butterfly valves 6 inch and larger shall have gear actuators.

.6.7 Isolation shut-off valves with ball-type drain valves shall be provided in major branch lines serving multiple terminal units, risers and branch lines serving each floor that are connected to these risers, and at air handling unit coils.

.6.8 Lock-shield balancing valves shall be provided at all terminal units and should also be considered for return branch lines connected to multistory risers.

.6.9 Blow down valves shall be provided for all strainers.

.6.10 Manual air vent valves shall be provided on all convectors, radiators and terminal unit coils.

.7 BALANCING VALVES: Special types of balancing valves may be approved if submitted with detailed information in advance to the University Engineer.

.7.1 Valves (2 inches and smaller): Use 150 lbs. SWP, all bronze, renewable composition disc, union bonnet, lockshield stem, repackable under pressure, or 175 lbs WOG, threaded brass body, wrench operated ball centric valve suitable for 250 degrees F continuous operating temperature, adjustable stop.

.7.2 Valves (2-1/2 inches and larger): make the same as for globe valves in 0 pounds to 15 pounds steam lines; hand-wheel shall be removed and tagged with number of turns that valve is open, or 175 lbs. WOG, flanged iron body, wrench operated ball centric valve suitable for 250 degrees F continuous operating temperature, adjustable stop.

.7.3 The University prefers separate balance and shutoff valves. In that way, the setting of the balance valve is more likely to be retained without tamper when any shutoff valve is closed. ~~If triple-duty valves are applied, provide a separate shutoff valve.~~ Consider the cost versus benefit of pressure-independent balancing valves. Triple-duty valves are prohibited. Circuit setters shall be installed along with check and shutoff valves.

.7.4 For accuracy of balance readings, the design and the installation must include the manufacturer's recommended upstream and downstream unobstructed distances to obtain reliable flow readings.

.8 VALVES IN STEAM CONDENSATE LINES: A union shall be provided downstream of (and within 12 inches of) each valve.

.8.1 Steam Condensate valves shall be as specified for valves in steam lines. Class of service shall be based on class of steam upstream (inlet side) of steam trap. For stainless steel condensate return systems, specify Division 33 valve 10GT20F for valves 2-1/2 inches and larger and valve 10BL11W (socket weld or threaded ends) for valves 2 inches and smaller.

.8.2 Drain valves shall be ¾ inch gate valves, as specified for valves in water lines, and shall have ¾ inch hose nipple switch caps.

.8.2.1 Nipples shall be of same weight and material as pipe with which they are used, except all close and shoulder nipples shall be extra heavy.

.8.3 Swing check/silent check valves shall be flanged, 250 pounds, semi-steel (ASTM A-126 – Grade B cast iron) body, bronze trim, 1/16 inch raised face.

.9 VALVES IN HOT WATER HEATING BOILER SYSTEMS: Attention is directed to "Ohio Boiler Inspection Laws and Rules," relative to valves at boiler connections and in blowdown lines.

.10 VALVE TAGS: Each valve in each piping system shall be tagged with a brass ~~or aluminum~~ tag numbered consecutively for each system and attached to the valve with a brass ~~or aluminum~~ chain. Valve tags shall have stamped abbreviations of the system in addition to the valve number. Valve tags shall be tagged with OHIO STATE nomenclature as: service-building ID (2 letter designation)-floor-valve number. For example, a heating hot water supply valve on the 2nd floor of Rhodes would be tagged HWHS-RH-2-34.

.11 Isolation Shut-off valves with ball drain valves shall be provided in branches and risers.

23 07 00. HVAC INSULATION

.1 GENERAL PROVISIONS FOR FIRE AND SMOKE HAZARD RATINGS: All insulation shall have a system fire and smoke hazard rating as tested by procedure ASTM-E-84, NFPA 255, and U.L. 723 not exceeding: Flame Spread 25 and Smoke Developed 50. The system rating shall be based on insulation, jacket, adhesives, coatings, fittings, and cements. Any treatment of jackets or facings to impede flame and/or smoke shall be permanent. The use of water-soluble treatments is prohibited. ASBESTOS IN ANY FORM OR MIXTURE(S) IS PROHIBITED.

23 07 13. DUCT INSULATION:

.1 THERMAL INSULATION: Thickness of supply air duct and plenum insulation shall be selected to prevent condensation on the surface of insulation when the ambient relative humidity is 90 percent at the maximum difference between the ambient air temperature and the supply air temperature. ~~Minimum thickness of supply air duct insulation shall be 1 inch nominal and 2 inches nominal on outside air duct or plenum.~~ Insulation shall be continuous through all openings but shall be interrupted at fire dampers. The thermal insulation used to cover the ducts shall meet or exceed the R-value in ASHRAE Standard 90.1 for energy conservation and be asbestos free.

.1.1 Exposed rectangular air conditioning supply and return ducts in non-air conditioned space shall be insulated with rigid or semi rigid fiberglass insulation board having a density not less than 3 pounds/cubic feet and with field or factory applied fire retardant glass cloth jacket with vapor barrier. When factory applied facing is used, all insulation joints will be sealed with pressure sensitive joint sealing tape to match the insulation facing.

.1.2 Concealed air conditioning supply air ducts in ceiling space above an air conditioned room shall be insulated with fiberglass duct wrap insulation of 3/4 pounds/cubic feet density with factory applied vapor barrier and fire

retardant jacket. When insulation is necessary on return air ducts, ducts shall be insulated in the same manner.

.1.3 All exposed round air conditioning supply air and return air ducts shall be insulated externally using either a closed-cell elastomeric sheet or roll insulation, with antimicrobial protection, adhered directly to the duct or a rigid preformed fiberglass insulation with All Service Jacket. Double wall insulated ductwork is acceptable.

.1.4 Outside air intake ducts and air plenums shall be insulated the same as specified for exposed rectangular air conditioning supply air ducts.

Commentary: The insulation described above is for "indoor" applications. Installation of "outdoor" ductwork that requires insulation is not a preferred location for the University and requires prior approval by the University Engineer.

.2 ACOUSTIC LINING: INSTALLATION OF INTERIOR DUCT INSULATION (DUCT LINER) IS PROHIBITED. Exceptions: Lined ductwork is permitted for: transfer ducts connecting adjacent rooms; return air ducts from a room to a return air plenum; supply and return air ducts for ceiling mounted heat pumps and fan coils; other applications with prior approval of the University Engineer. Duct liner shall be fiber-free and anti-microbial. Sound attenuation for each individual project must be reviewed and is subject to approval by the University Engineer before design is completed.

.3 Noise Criteria

Type of Room or Area	Range of A-Sound Levels in Decibels	Range of NC Criteria Curves
AUDITORIUMS		
Concert and Music Halls	25-35	20-25
Lecture Halls and Auditorium	35-45	30-35
Multi-Purpose Halls and Theaters	30-40	25-30
CIRCULATION		
Corridors, Lobbies, and Waiting Rooms	40-50 45-55	35-45 40-45
Wash Rooms and Toilets		
CLASS ROOM AND STUDY AREAS		
Class Rooms	35-45	30-40
Conference Rooms, Seminar Rooms	30-40	25-35
DINING AREAS		
Cafeterias	45-55	40-50
Dining Rooms	35-45	30-40
Restaurants	40-50	35-45

Type of Room or Area	Range of A-Sound Levels in Decibels	Range of NC Criteria Curves
LABORATORIES		
Laboratory Class Rooms	40-50	35-45
Processing Laboratories	40-50	35-45
Research Laboratories	40-50	35-45
LIBRARIES	35-45	30-40
OFFICES		
Executive Offices	35-45	30-40
General Office and Reception Rooms	35-50	30-45
Open Offices and Drafting Rooms	40-55	35-50
RECREATION		
Gymnasiums, Bowling Alleys, Squash and Hand Ball Courts	40-50	35-45
Recreation Halls and Rooms	40-55	35-50
Sports Arenas	35-45	30-40
Swimming Pools	45-60	40-55
STUDY AREAS Auto Tutorial Study Carrel Rooms, Closed Study Carrels, and Study Rooms and Lounges	35-45	30-40
STUDIOS		
Sound Reproduction Studios	30-40	25-30
Television Studios	35-45	30-35
MISCELLANEOUS		
Computer Machine Rooms	45-65	40-60
Dormitory Sleeping Rooms	35-45	30-40
Kitchens and Laundries	45-55	40-50
Museums, Court Rooms Museums, Court Rooms	35-45	30-40

23 07 16. EQUIPMENT INSULATION

.1 All pieces of equipment with surface temperatures over 130 degrees F or with temperatures causing condensation at ambient relative humidity of 90 percent shall be insulated. Type and thickness of insulation shall be as specified for piping.

.2 INSULATION NOT REQUIRED: Steam traps, hot water, and condensate return pumps, and hot water expansion tanks shall not be insulated.

.3 Chilled water pumps are required to be insulated. Insulation may be closed-cell elastomeric, equivalent to Armacell AP/ Armaflex.

Wexner Medical Center: Chilled water pumps should be insulated with removable, reusable blanket insulation.

.4 BOILER BREECHING shall be insulated with manufacturer-provided, pre-fabricated, factory-insulated breeching. Follow specification to determine the specific operating temperature. Apply appropriate finish jacketing range.

.5 Provide removable, reusable blanket insulation for applications needing routine maintenance, including but not limited to, pumps, chillers, etc.

23 07 19. PIPING INSULATION:

.1 REQUIRED INSTALLATION: The following piping shall be insulated:
Steam and Steam Condensate lines
Domestic cold and hot water lines
Exposed Geothermal/Ground Source Heat Pump lines
Cooling Coil Condensate Drain Lines
Chilled water lines
Heating hot water lines
Refrigerant lines, where necessary
Fuel oil lines, where necessary or exposed to low temperatures.

.2 SPECIFICATIONS: Maximum temperature limit of the insulation must be above the maximum operating temperature of piping. Surface temperature of insulation for heated piping in still ambient air at 80 degrees F shall not be above 110 degrees F at the pipe operating temperature below 400 degrees F. The minimum thickness of insulation shall be one inch. Thickness of insulation for cold piping shall be selected to prevent condensation on the surface of insulation and ambient temperature is 50 degrees F above the pipe temperature. Specify that insulation be installed with a continuous unbroken and unpunctured factory applied vapor barrier. A/E shall evaluate whether environmental conditions dictate requirements for corrosion inhibiting coating. Insulation shall meet or exceed the current version adopted by Ohio of ASHRAE Standard 90.1 -- Energy Standard for Buildings Except Low-Rise Residential Buildings for energy conservation.

.2.1 Piping with an operating temperature of 300 degrees F and above shall be insulated with calcium silicate insulation molded in sections with a minimum of .016 Aluminum jacket having a factory applied 3 mil polysurlyn inner layer moisture barrier. As an alternative to insulation being entirely calcium silicate, the first 3 inches (closest to the pipe) of insulation shall be calcium silicate, with the remaining thickness required by the energy code being fiberglass. Additionally, ceramic insulation may be specified that meets energy code and surface temperature remains at or below 110F

.2.2 Piping with an operating temperature under 300 degrees F shall be insulated with molded pipe covering composed of fiberglass, resin bonded and factory applied all service jackets. Compression strength at 25 percent deformation shall be 500 pounds per square foot.

.2.3 Fittings, flanges, unions, and valves, except valves in hot water lines, shall be insulated. Insulation shall be beveled down to unions with all exposed end sealed with CP.10 or equivalent. Insulation covers shall be either prefabricated or fabricated of pipe insulation. Insulation efficiency shall not be less than that of the adjoining piping. Specify that insulation vapor barrier be installed continuous and unbroken.

.2.4 Hangers, supports, anchors, secured directly to cold surfaces, must be adequately insulated and vapor sealed to prevent condensation.

.2.5 Rigid insulation inserts of proper length shall be installed between pipe and insulation protection shield to prevent sagging of pipe covering at hanger points. Compressive strength of insulation inserts shall be not less than 350 psf at 10 percent deformation. Specify that inserts be installed as pipe is erected.

.2.6 Insulated piping lines running outdoors shall have corrugated or plain 0.016 inches aluminum jacket complete with integral longitudinal laps with 2" overlap and butt joint laps with 3" overlap installed in order to shed water. In addition to the vapor barrier, this jacket is required on cold lines.

.2.7 In service tunnels, pipe insulation shall be covered with PVC jacket secured in place with aluminum straps on 18 inches centers. Sections exposed to heavy mechanical abuse shall have 0.010 inches stainless steel jacket secured in place with stainless steel straps. The lap shall be at least 2 inches on side shedding water and 3 inches overlap on the end.

.2.8 Provide removable, reusable blanket insulation for applications needing routine maintenance, including but not limited to, steam pressure reducing stations, strainers, etc.

23 09 00. INSTRUMENTATION AND CONTROL FOR HVAC:

.1 DIRECT DIGITAL CONTROL (DDC) SYSTEM: To achieve precise control of all HVAC systems and to provide the means to integrate standard control functions with energy saving strategies, it is intended that all newly constructed and remodeled buildings on the Columbus campus be controlled using standalone microprocessor based Direct Digital Control (DDC) computer systems. All hardware, software, and miscellaneous equipment required to insure that the DDC system can be managed from the building and from a remote control center shall be provided as a part of the project. Appendix A includes additional and detailed requirements for BAS and DDC systems. Separate versions of Appendix A exist

for FOD, OSUWMC, and Student Life. Comply with the version of Appendix A appropriate for the project. Control centers now in existence are:

Columbus Campus - Academics and Research – FOD [See Appendix A – FOD
Columbus Campus - University Medical Center [See Appendix A – WMC]
Columbus Campuses - Student Life [See Appendix A – SL]
Regional Campus - [Review requirements with University Project Manager.]

The A/E shall submit schemes for connecting new facilities to the control center(s). All DDC systems shall be connected to the appropriate control center(s) using the University's fiber optic network, a hard-wired communication trunk, or a telephone communications trunk, as dictated by the capabilities of the system selected and by the location of the building being controlled. Telephone and cellular communications shall not be utilized for the Wexner Medical Center BAS network nor FOD Buildings.

The control centers in the Columbus Campus (FOD), Wexner Medical Center, Student Life, Lima Campus, Mansfield Campus and Wooster Campus have Central Processing Computers (CPU's) that are compatible with Direct Digital Control. Any expansion in any building within these networks must maintain the integrity of the existing system and allow the new equipment to be controlled by the existing CPU. These locations are to be treated as exceptions and cannot be addressed in the same fashion as an expansion in an area where no CPU exists. The A/E will coordinate this requirement through the University Project Manager.

Wexner Medical Center: All newly constructed and remodeled buildings/projects are to be controlled using BACnet compliant Direct Digital Controls. All controls shall tie into the existing building automation front end. See OSUWMC design standard for Building Automation Systems (Appendix A – WMC).

.1.1 An interconnecting conduit system shall be installed between all DDC panels within a given building. This conduit system shall be extended to the appropriate building exit point to provide the link to the remote communications network. All communications cables required to provide the communications link between the DDC controllers and the external communications network shall be installed as a part of the project. The remote communications link shall be established and remote capabilities shall be verified by the contractor prior to final acceptance of the DDC system.

Wexner Medical Center: Medical Center DDC panels shall connect to existing IT network and comply with their requirements. OSUWMC will require one BACnet Broadcast Management Device for every floor of every building. The OSUWMC network will be segmented so that each floor will be a separate subnet from all others.

.1.2 Schemes shall include necessary provisions in the Plumbing, HVAC, Fire Protection and Electrical construction documents for making system connections. Provisions for DDC Systems are described thoroughly in

Appendix A. Also see Communication Wiring Standards in Appendix M and Electrical in Division 26.

23 09 05. HVAC BUILDING SYSTEMS CONTROL:

.1 Before design is begun, consult with the OHIO STATE Building Automation Shop (FOD, OSUWMC, Student Life, or Lima, Mansfield, or Wooster Campus, or other, as appropriate) to determine exact requirements for connection to control centers. In addition to requirements for Direct Digital Control Systems described in Appendix A, the following must be considered in design and installation of equipment.

.2 AUTOMATIC DAMPERS: Automatic dampers which are under proportioning control should be accurately sized in accordance with temperature control manufacturer's recommendations to provide proper mixing and control.

No damper shall have a dimension exceeding four feet or be over 12 square feet in area. Each damper section shall have an individual operator. No linkages shall be installed between dampers to transfer operator power. Manufacturer's catalog information shall be de-rated 50 percent for application to provide positioning of the dampers. Damper operators shall not be of the swing mounting type. They should be mounted outside the air stream where possible, especially in outside air applications. Pneumatic control lines, where they penetrate outside air ducts, shall include dehydrator units. Outside air and return or relief dampers that are automatically controlled shall be of the minimum leakage type.

Quality of dampers shall be specified, including air leakage at 1-inch static pressure when the damper is in the closed position. Provide neoprene edge seals on blades.

.3 AIR COMPRESSORS: Air compressors, when required, shall be provided in the main equipment room for each building. Two compressors shall be provided with the sizes calculated on 50 percent operating time of one compressor to meet the building's compressed air needs. The units' control will include a manual lead/lag control switch. If other compressed air systems are within the building or adjacent to the building, consideration will be given for cross-connecting of the systems. All temperature control air compressors shall be provided with an air dryer.

23 20 00. HVAC PIPING AND PUMPS

23 20 03. PIPING

.1 GENERAL PROVISIONS:

.1.1 Submittals for Approval by the University Engineer: Provide three copies each of the following and obtain approval before preparation of final documents.

.1.1.1 Calculations of stresses in steam, hot water, and condensate lines.

.1.1.2 Request for permission to use expansion joints in piping in lieu of bends and/or loops.

.1.1.3 Request for permission to use special materials for condensate piping in lieu of steel pipe with welded fittings. Provide pressure and temperature characteristics.

.1.1.4 Operating pressures and temperatures for grooved pipe mechanical coupling systems if permitted to be used.

.1.1.5 Detailed information on special types of balancing valves.

.1.2 Valve Tags: Specify that each valve be tagged with a brass ~~or aluminum~~ tag numbered consecutively and attached to the valve with a brass ~~or aluminum~~ chain. Valve tags shall have stamped abbreviations of the system in addition to the valve number. Valve tags shall be tagged with OHIO STATE nomenclature. As: service-building ID (2 letter designation)-floor-valve number. For example, a heating hot water supply valve on the 2nd floor of Rhodes would be tagged HWHS-RH-2-34.

.1.3 Valve Chart: A typewritten directory of valve numbers (by system, describing location) shall be furnished, framed, placed under glass, and installed in equipment rooms, where indicated by the A/E. A copy of the valve directory shall be included in each O-&-M manual, and separate copies of the valve directory, bound in hard fiber binders, shall be delivered to the University Project Manager.

Wexner Medical Center: Valve number directory shall be noted on the as-builts.

.2 DESIGN OF PIPING SYSTEMS:

.2.1 Prohibited Installations:

.2.1.1 Condensate drip traps above 15 psig shall not be designed to discharge directly into condensate return mains or condensate pump receivers, but shall be designed to discharge into a flash tank (vented into the low pressures side of the system, if possible), and to drip through a low pressure F. & T. trap to a condensate return main or receiver. Where discharge to a flash tank unavailable/uneconomical, use a condensate mixer/sprayer to connect drip trap to pumped condensate return line.

.2.1.2 Bullhead connections in any piping service are prohibited.

.2.1.3 Cast iron, brass and ASTM A120 pipe shall not be used on lines with pressures higher than 49 psig or temperatures higher than 292 degrees F.

.2.1.4 Drain, steam, and condensate lines, and any wet lines (including pipes, fittings, valves, or other), shall not be installed or designed for installation over electrical switchgear, motor control centers, transformers, nor in elevator shafts and equipment rooms.

.2.2 Provisions for Expansion and Contraction: Steam lines shall be engineered with adequate provisions for expansion and the removal of condensate. The campus steam is distributed at 200 psig and 600 DegF.

Generally, for all campus distribution steam piping outside the buildings, bends or loops shall be used to absorb the pipe expansion and contraction. Particular attention shall be given to proper design of guides and anchors in lines with expansion loops. Expansion joints are not recommended. Approval by FOD Operations is required prior to use of expansion joints.

OARDC: Steam distribution system is operated at 140 psig and 375 Deg F.

.2.3 Pipe anchors to control movement of piping shall be shown on drawing. Anchors shall be welded to the pipe, but anchor connection must be ~~bolted~~ mechanically attached to the building or other structure and details/analysis provided by structural engineer. Provide structural support and lateral structural support for all kinetic forces.

.2.4 Designs shall include provisions to accommodate both horizontal and vertical movement. ~~Vertical risers for hot water and steam lines passing through more than two floors shall have spring support, preferably at the floor nearest to the center of the risers~~

.2.5 Unions shall be provided on piping at the following locations:

.2.5.1 Adjacent to valves on the downstream side.

.2.5.2 At the final connections to items of equipment.

.2.5.3 On each side of traps.

.2.5.4 Where required for construction and assembling purposes.

.2.6 Supports: Spacing for the horizontal pipe supports and hanger rod sizes must be specified. ~~Refer to paragraph Facility Services 3.19.2 et al.~~

.2.7 Hangers: Where piping is subject to expansion and contraction caused by changes in temperature of carried fluid, adjustable roller hangers or adjustable pipe roll stands shall be provided. A thermal expansion stress analysis is required to determine where vertical spring supports are necessary. Hangers for copper piping shall be copper plated or shall have a suitable lining to prevent electrolysis. Hangers for cold insulated pipe and all roller hangers shall be only outside of the insulation with appropriate banded ~~"U"~~ support plates to prevent crushing of insulation and to avoid condensation.

.2.8 Pipe Guides shall be detailed and locations shall be shown. Guide shall consist of a guide spider clamped to the pipe for which movement is to be controlled and a guide casing bolted to a suitable support. Casing shall be of two pieces bolted together by 4 bolts for sizes 3 inches and larger and by 2 bolts for sizes 2-1/2 inches and smaller. The inside diameter of casing shall be larger than the outside diameter of the insulated pipe.

.2.9 Discharge Piping from all refrigeration system pressure relief devices shall extend, in an approved manner, to the building exterior.

.2.10 Glycol: If glycol is necessary on a new installation, specify propylene glycol. Consider: whether freeze or burst protection is appropriate; need for formulation compatible with aluminum; and automatic makeup system. Use of ethylene glycol requires University Engineer approval. When using domestic water for temporary fill of an ethylene glycol system, the contractor shall use a temporary reduced pressure principle backflow preventer. The domestic water shall be disconnected from the ethylene glycol system after filling.

23 20 05. PIPING MATERIALS:

.1 STEAM PIPING (15 psig and below):

.1.1 Schedule 40, ASTM A-53, Type E or S, Grade B black steel pipe shall be used. Schedule 40 butt welding seamless forged steel fittings shall be used with NPS 2-1/2 and larger pipe. Elbows shall be long radius; flanges shall be 150 pounds class forged steel, welding neck, or slip-on, welded inside and outside. For 2 inches or smaller pipe125 psig class black cast iron screwed fittings may be used.

.2 STEAM PIPING (above 15 psig to 200 psig, temperature less than 600 degrees F):

.2.1 Schedule 40, ASTM A-53, Type E or S, Grade B Black steel pipe shall be used. Schedule 40 butt welding seamless forged steel fittings shall be used with NPS 2-1/2 and larger pipe. Flanges shall be 300 pounds class. For 2 inches or smaller pipe, fittings shall be socket weld forged steel, 3000 lbs. (minimum) class.

.2.2 Steam piping above 15 psig within University buildings shall be designed, fabricated, and installed to comply with ASME B31.1. Such piping shall be inspected, examined, and tested per the requirements of Chapter VI, Article 136, of ASME B31.1. Inspection services per ASME B31.1 shall be provided by the A/E (Criteria A/E for design-build). Qualifications of inspector(s) shall be submitted and are subject to approval by the University.

.3 CONDENSATE PIPING: Schedule 40S seamless stainless steel, conforming to ASTM A312 Type TP316L, or Schedule 80 black steel pipe, ASTM A-53, Type E, Grade B shall be used with Schedule 80 butt welding fittings of seamless steel or forged steel socket weld fittings 2000 pounds WOG. Special materials might be approved, upon request, if pressure and temperature characteristics are submitted in advance of design to the University Engineer.

.3.1 Underground and Tunnel Applications condensate distribution piping requirements: Refer to Division 33.

.4 HOT WATER HEATING (HHW) PIPING: Shall be ASTM A53, Gr B, Type E except that lines 4-inch diameter and smaller may be hard copper type L with wrought copper fittings. All copper pipe fittings, regardless of size, shall be brazed.

.4.1 Fittings 2-1/2 inches and larger: Schedule 40, butt welding seamless forged steel. Elbows: long radius; flanges: 150 pounds SWP, forged steel, welding neck, or slip-on, welded inside and outside, or wrought copper for use with type L copper piping.

.4.2 Fittings 2 inches and smaller: 125 pounds SWP black threaded cast iron or forged steel welded fittings, or wrought copper for use with type L copper piping.

.4.3 Press fittings for copper pipe HHW systems (up to 4-inch diameter) may be used with the approval of the University Engineer. Press fittings made of bronze or copper conforming to ASME B16.18 or ASME B16.22 and performance requirements of IAPMO PS 117. Press fittings shall have factory installed EPDM sealing element and an identification feature on the fitting that provides a visual indication of fittings that have NOT been pressed. Installers of the press fittings shall be certified by the manufacturer.

Wexner Medical Center: Press fittings for copper pipe HHW systems require prior approval by OSUWMC Facilities.

.4.4 Press fittings for black steel pipe HHW systems (up to 2-inch diameter), up to Schedule 40 pipe, may be used with the approval of the University Engineer. Press fittings conforming to

ASME A420 or ASME B16.3 and performance requirements of IAPMO PS 117. Press fittings shall have factory installed EPDM sealing element and an identification feature on the fitting that provides a visual indication of fittings that have NOT been pressed. Installers of the press fittings shall be certified by the manufacturer.

.4.5 The use of press fittings for copper or steel pipe systems shall be limited to accessible locations only (not in chases or above inaccessible ceilings).

Commentary: *In lieu of University Engineer approval, FOD Operations personnel who have received appropriate training may use press fittings with the approval of the Senior Director of Facilities Support or their designee.*

.4.3 Grooved Piping Systems: Grooved piping is prohibited on hot water systems.

.5 CHILLED WATER SUPPLY AND RETURN: Same as specified for Hot Water Heating Piping except do NOT use press fittings for chilled water systems that are connected or that may be connected in the future to a central campus chilled water plant.

.5.1 Underground chilled water distribution piping requirements: See Division 33.

.5.2 Grooved Piping Systems: For chilled water systems, an engineered system of rolled-grooved piping with couplings and gaskets designed for the application may be used with the approval of the University Engineer. Cut-grooved piping shall be specifically prohibited.

Wexner Medical Center: Grooved Piping Systems for chilled water require prior approval by OSUWMC Facilities and OSEP.

.6 CONDENSER WATER SUPPLY AND RETURN: Same as specified for Hot Water Heating Piping.

.6.1 Grooved Piping Systems: For condenser water systems, an engineered system of rolled-grooved piping with couplings and gaskets designed for the application may be used with the approval of the University Engineer. Cut-grooved piping shall be specifically prohibited.

Wexner Medical Center: Grooved Piping Systems for condenser water require prior approval by OSUWMC Facilities.

.6.2 For condenser water systems, Schedule 80 PVC piping and fittings may be applied. The PVC shall include UV-protectants and shall be rated for exterior applications.

Wexner Medical Center: PVC piping shall not be used.

.7 DRIP PIPING FROM PUMPS: Schedule 40 galvanized steel pipe with 150 pounds galvanized banded malleable iron fittings, minimum size ¾ inch. Run drip piping to floor drain. Hard copper, type L, minimum size ¾-in., may be used if protected and clamped in place.

.8 COOLING COIL CONDENSATE DRAIN PIPING FROM AIR HANDLING UNITS: Type "L" hard copper, minimum size 1 inch. Specify that wrought copper fittings with sweat joints of 95-5 solder be used. Trap drain lines and run to suitable drains. Provide cleanouts at traps and in the piping system where pipe changes direction.

.9 REFRIGERANT PIPING: Dry Seal Type "L" or ACR (Air Conditioning & Refrigeration) nitrogen-charged hard copper. Wrought copper fittings with joints brazed with a 6 percent or higher silver alloy with a 1000 degrees F solidus minimum and comparable to J.W. Harris Co., Inc. "Dynaflow". Copper-steel joints shall be brazed with 55 percent silver alloy brazing materials. Zoomlock pressure seal fittings are also acceptable. Fittings for 5 inches or larger lines shall be tinned cast brass.

.10 Piping, fittings, and piping accessories manufactured, fabricated, or assembled in China, including Taiwan, are prohibited.

23 20 07. UNDERGROUND CONDUIT

.1 Underground distribution piping: See Division 33.

23 20 09. PIPING SPECIALTIES

.1 GASKETS: Where flanges must be used, gaskets shall be of materials suitable for use at temperatures and under conditions encountered in the system. Gaskets on steam lines, with pressures of 50 psi gauge or over, shall be wound stainless steel and appropriate composition gaskets.

.2 AIR VENTS:

.2.1 AUTOMATIC AIR VENTS with isolation valves shall be installed at the high points of all hydronic piping, and at all points where horizontal flow goes to vertical down flow. Vents with visual drain shall be specified. The discharge drain shall be extended to a suitable floor drain.

.2.1.1 Specify automatic air vents for hydronic systems employing a bladder-type expansion tank (i.e., a tank having air and water surfaces separated by a flexible membrane).

.2.2 AN AIR CHAMBER with manual vent shall be provided at high points on lines above finished ceilings and in areas where a safe and suitable drain point is not readily available. Provide a flexible drain line.

.2.3 Specify manual air vents where existing hydronic systems have compression tanks (direct air-water interface).

.3 STEAM TRAPS: Traps shall be installed at least 24 inches below steam heating devices to assure adequate draining of the coils. Valves, strainers, check valves and unions or flanges shall be provided at ~~upstream of~~ traps stations. Provide check valve downstream of trap where any portion of the condensate discharge line is flooded and/or where condensate is lifted.

.3.1 INVERTED BUCKET TRAPS: On saturated drips, regardless of steam pressure, inverted bucket traps (IBT's) may be used.

.3.2 BIMETALLIC TRAPS: On superheated drips, use bimetallic traps (BMT's). Suggested for consideration are Armstrong SH-300 or Bestobell DM25.

.3.3 Deleted.

.3.4 FLOAT AND THERMOSTATIC TRAPS: On any modulating application such as hot water converters, steam heating coils, steam humidifiers, or any other modulating application, use float and thermostatic traps (F&T's). Pay special attention to temperature rating.

.3.5 Steam traps shall be stainless steel for stainless steel piping and cast steel for black steel piping, except for black steel piping at 15 PSIG and lower traps may be cast iron.

.4 VACUUM BREAKERS AND AUTOMATIC AIR VENTS shall be provided on all steam heating coils with modulating valves or automatic on-off valves.

.5 EXPANSION TANKS: Specify replaceable bladder- type expansion tanks. Do not specify compression tanks having direct contact between air and water surfaces or expansion tanks not having a replaceable bladder.

23 20 11. PIPING INSTALLATION:

.1. INSTRUCTIONS TO BE INCLUDED IN THE SPECIFICATIONS: The following instructions to the contractor should be included in the applicable paragraphs. These instructions must be edited to suit the work.

.2 DIELECTRIC CONNECTIONS: In water lines where dissimilar metal pipes connect to one another, use dielectric nipples or flanges with dielectric gaskets to counteract electrolysis. All piping and piping accessories shall be suitable for the working pressures and temperatures of the lines in which they are installed. Do not install dielectric unions.

.3 WELDED CONNECTIONS:

.3.1 Stamped Welds: Welders on pressure piping shall be certified and shall carry their certification and stamp with them. Welds on lines with pressures above 125 psig shall be stamped.

.3.2 Items Requiring Welded Connections: Weld steel piping 2-1/2 inches and larger. Weld steel piping installed above finished plaster ceilings and in pipe chases. Weld steam condensate pipe except at 2 inch and smaller threaded connections to equipment and traps.

.3.3 Welded Fittings (see piping specifications 23 20 05 for specifications of fittings)

.4 BRANCHES: "T" or "Y" forged branch connections or reducing tees are acceptable for branch connections to mains 2 inches diameter or larger. Design all other branch connections with main size tees and eccentric reducers or reducing tees. Branch piping shall not be welded directly to mains. Drip legs in steam lines shall be made with steam line size tees. Eccentric reducers shall be used for pipe size changes with bottom of steam line level, bottom of condensate return lines level, and top of hydronic waterlines level.

.5 VIBRATION ISOLATION shall be provided on chilled and condenser water supply and return piping at all compressors.

23 20 13. PUMPS:

.1 GENERAL PROVISIONS:

.1.1 COUPLING ALIGNMENT: The University requires that the final coupling alignment be documented and the results furnished in writing to the University Project Manager. Field check all alignments and report the maximum angular and eccentric misalignments to the nearest 0.001 inch.

.1.1.1 Align coupling flanges for concentricity to assure that the face and curved edges are concentric within the manufacturer's recommendations.

.1.1.2 Align coupling for angular alignment to tolerances recommended by the manufacturer.

.1.1.3 Align coupling for parallel alignment. On large equipment, subject to heat conditions, alignment must be done in the hot condition.

.1.2 SHOP DRAWINGS AND PUMP PERFORMANCE CURVES: Reference should be made to Division 1 for instructions for submittals of shop drawings. Submit performance curves with shop drawings.

.2 PUMPING SYSTEMS DESIGN:

.2.1 A PRIMARY-SECONDARY PUMPING SYSTEM is preferred where practicable.

.2.2 DESIGN PUMPING SYSTEMS so that the engineer-designed net positive suction head available (NPSHA) at the pump intake will be larger than the (manufacturer-required) net positive suction head required (NPSHR) at the highest possible water temperature at the pump intake.

.2.3 THE PUMP CURVE REPRESENTING FLOW-HEAD RELATIONSHIP shall intersect the system curve at design operating point. Pumps shall be selected to operate at an efficiency of not less than 90 percent of the maximum efficiency. Maximum total pump head at the no flow condition shall be specified.

.2.4 FRICTION HEAD CALCULATIONS FOR CHILLED WATER SYSTEMS shall be based on the friction loss standards of the Hydraulic Institute in new pipe. For steam condensate (pumped and gravity) and hot water heating systems, base on friction losses in 15 years old pipe. The A/E may submit for approval by the University of use other sizing standards, such as ASHRAE, Cameron, or Bell & Gossett.

.2.5 PUMP MOTOR shall be selected and specified as non-overloading over the entire pump curve shown by the manufacturer.

.2.6 ALL PUMPS shall be installed with system size isolation valves on both sides.

Commentary: *System size refers to the pipe size of the building system: NOT the pipe size of the suction and discharge size of the pump.*

~~.2.7. Power factor Correction: Motors (drives) 50 HP and larger shall be provided with fused, switched, power factor correction capacitors sized to correct to 100 percent or greater. It is preferred that the units be connected between the contactor and overload coils. Units shall meet all fire codes and not be an environmental problem~~

.2.7 Motor and impeller speeds shall be 1750 RPM or 1150 RPM. 3600 RPM selections are prohibited unless approved by the University Engineer.

.2.8 Refer to Owner's Project Requirements (OPR), of the project, for pump redundancy requirements.

.3 CONDENSATE RETURNS: Electric condensate return systems are preferred. Steam-powered condensate return systems require prior approval by the University Engineer. When pumps must be used, specify packaged duplex units, shipped assembled as a complete factory unit with cast iron receiver.

Wexner Medical Center: Steam powered condensate return systems shall be supplied with sight glass.

.3.1 LEAD-LAG ALTERNATOR for pumps shall be automatic with a manual override. Electrical float switch shall bring on the second pump if the flow is too great for one pump. Audible alarm shall be activated when either pump fails.

.3.2 Condensate return pumps shall be limited to no greater than 1800 rpm.

Wexner Medical Center: Combination pump-trap assemblies shall be utilized on systems with modulating steam valves to prevent condensate backup. Unless approved otherwise by Medical Center Facilities Engineering

.4 PUMP TYPES

.4.1 IN-LINE PUMPS: In-line pumps shall be connected directly to the piping. Motor shall not be separately supported except for large pumps specifically designed for such support. Pumps shall not be mounted with motor shaft vertical unless special thrust bearings are provided. Provide gauge valves at in-line pump suction and discharge. Locations for installation of in-line pumps shall not be obstructed by overhead or beneath equipment or services, such that the pump can be easily maintained and/or removed. Provide split- or flexible-coupled, in-line, horizontal or vertical pumps. Exceptions for FOD and Student Life buildings only (not for OSUWMC): Pumps 5 HP and under may be close-coupled.

.4.2 BASE-MOUNTED WATER PUMPS: For primary pumping application, split case centrifugal pumps are preferred over the end suction pumps.

.4.2.1 MECHANICAL SEALS are preferred and should be used where adaptable. Complete flushing arrangement shall be provided for mechanical seals and packing.

.4.2.1.1 Horizontal split case pump ball bearings shall be double row on outboard. Pump casings shall have vent and drain plugs and pressure gauge tapping.

.4.2.2 PUMP AND MOTOR shall be installed on a common steel or cast iron base, isolated from the building structure so that the unit will not transmit vibration to the building (concrete inertia base, CIB). Pump coupling to motor shall be flexible. Coupling shall be equipped with a guard.

.4.2.3 PIPING CONNECTIONS to pump shall be flexible to reduce vibration transmission. Braided over corrugated flexible connections are preferred. The flexible connection shall not be used

to correct for piping misalignment. Provide separate valved pressure gauges, mounted at the same elevation, for pump suction and discharge.

.4.3 TURBINE PUMPS: Regenerative turbine pumps may be utilized on clean liquid applications. Pump shall have both inboard and outboard bearings. The motor shall be 1750 RPM and shall be sized to prevent overloading at the highest head conditions when the flow of liquid is shut off. Impeller shall be hydraulically self centering. On larger turbine pumps 5 hp and over, a relief valve may be used on the pump to avoid overloading the motor at shut off conditions.

23 25 13. WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

.1 Cleaning, Flushing and Water Treatment guidelines can be found in BDS Appendix G-1.

Commentary: *The Guideline is intended to provide the A/E with general procedural information. The wording in the Guideline is not mandatory; however, the procedure is mandatory for all Closed-Loop Hydronic Systems.*

23 30 00. HVAC AIR DISTRIBUTION

.1 GENERAL DESIGN CONSIDERATIONS:

.1.1 LEAK DETECTION requirements shall be discussed with the University Project Manager. Take into account such factors as upper floor mechanical rooms, coils that see freezing entering air conditions, and cost of damage to building and its contents. For air handling units installed above occupied spaces, consider providing a cooling coil condensate overflow detector to lock out cooling in the event the primary drain line is blocked. Alarms shall be connected into the Building's Automation System and annunciate at the BAS shop.

23 30 05. AIR HANDLING UNITS WITH AND WITHOUT COILS:

.1 CONSTRUCTION: Central station air handler units shall be of sectionalized construction, consisting of fan section, coil section, and drain pan to catch all condensate. All condensate drain pans shall be aluminum or stainless steel. Galvanized steel, plastic or fiberglass pans are not permitted.

.2 MULTI-FAN UNITS: Selection of a multiple-fan wheel housing assembly in a common fan section (multiple fan wheels on a common shaft or multiple fans operating in parallel) is subject to the approval of the University Engineer. Note:

University Engineer approval is not required for a "fan wall" assembly (array of modular, direct-drive, plenum fans).

Wexner Medical Center: MULTIPLE FAN UNITS: Multiple fan units shall be provided for patient care areas, including but not limited to patient room units, operating room units, radiology area units, emergency department units, procedural area units.

.3 FAN WHEELS AND HOUSINGS shall be AMCA Class II construction; except, high velocity systems requiring total fan static pressure over 4 inches shall use Class III fans. Medium and high velocity draw-through and built-up systems shall have duct discharge sections designed per accepted good practices to minimize losses and for velocity energy recovery. Minimum length of transition shall be equivalent to one wheel diameter.

.4 CONDENSATE LINES from drain pan must have deep traps to prevent either draw or blow through conditions.

Wexner Medical Center: Floor of all AHU's shall be designed to have all sections sloped to drain to the exterior of the AHU through a drain hole to allow all cleaning fluids to be drained out of the AHU floor. Drain hole shall be capped when not in use.

.5 INTERIOR SURFACES, as well as the division panel separating the hot and cold deck, shall be insulated with not less than 1 inch thick fiberglass blanket. The drain pan shall be insulated preferably on the exterior; however, interior insulation, if provided, shall be of a type that will resist mechanical damage and deterioration by water. All condensate drain pans shall be aluminum or stainless steel. Galvanized steel, plastic, or fiberglass pans are not permitted.

Wexner Medical Center: INTERIOR SURFACES: All interior panels shall be solid metal covering insulation. No perforated panels are allowed.

.6 FACE AND BY-PASS DAMPERS AND ZONE DAMPERS shall have bronze or nylon bearings with non-slip spline and rib connections between damper blades and mounting rods. Zone dampers shall have neoprene gaskets for blades to seal against entire stop.

.7 MISCELLANEOUS DETAILS:

.7.1 Solid shafts shall be specified. All shafts will be provided with machine centers.

.7.2 Wheels shall be of heavy gauge riveted or welded design.

Wexner Medical Center: Wheels shall be of heavy gauge welded design.

.7.3 Wheel hubs shall be machine bored with full line contact on solid shaft.

Wexner Medical Center: Air handling units serving patient care areas shall be on emergency power.

23 33 00. AIR DUCT ACCESSORIES

.1 FIRE AND SMOKE DAMPERS:

.1.1 INSTALLATION: All fire and smoke dampers shall be provided with access panels for routine inspection and maintenance. Specify that, after dampers are installed, the contractor shall operate each damper through all positions to assure free operation and witnessed by FOD project manager.

Specify that, after dampers are installed, the contractor shall operate each damper through all positions during air handling unit operation to assure free damper operation and witnessed by University or OSUWMC (where applicable) representative.

.1.2 LABELING: All fire and smoke dampers shall be labeled in accordance with OHIO STATE requirements. Dampers shall be labeled with either FD for fire damper, SD for smoke damper or FSD for combination fire/smoke damper, building abbreviation, floor and number. For example, a smoke damper on the 5th floor of Rhodes Hall shall be labeled SD-RH-5-19. Any modifications, deletions or additions within existing buildings shall have the number coordination performed with OHIO STATE Operations. A color coded dot shall be placed on the ceiling tile grid at the location of the access panel for ease of maintenance.

.1.3 INSPECTION: Specify that, at final acceptance inspection, approximately 10 percent of all fire and smoke dampers, as randomly selected by the University Project Manager, must be demonstrated by the contractor to be in proper position and in operational order. Failure of any one of the demonstrated dampers shall require the contractor to check and demonstrate all dampers.

.1.4 CERTIFICATION: Specify that the contractor must certify in writing that all fire and smoke dampers were checked by operation at installation and that all are in proper position and functional order.

Wexner Medical Center:

.1.5 Provide means of notifying the building automation system when a smoke damper or fire smoke damper has closed.

.1.6 Smoke dampers shall be electrically operated.

23 34 00. HVAC FANS

.1 GENERAL REQUIREMENTS: Centrifugal fans are preferred for supply and return air requirements. Tubular centrifugal, axial and propeller fans may not be used unless written authorization is obtained from the University Engineer.

Wexner Medical Center :

GENERAL REQUIREMENTS: Centrifugal fans are preferred for supply and return air requirements. Air handling units shall be designed as draw-through units. Tubular centrifugal, axial and propeller fans may not be used unless written authorization is obtained from OSUWMC Facilities.

.2. SUPPLY AND RETURN AIR FANS:

.2.1 HIGH PRESSURE FANS: Fans selected for operations above 6-1/2 inches static pressure are subject to approval by the University Engineer.

.3 EXHAUST FANS:

.3.1 EXHAUST FOR HAZARDOUS AIRBORNE CONTAMINANTS: Exhaust fans handling dangerous or obnoxious agents of a contagious disease shall discharge vertically from an outlet and extend at least eight feet above the roof of the building at velocities in excess of 3,000 feet per minute. Extreme care must be exercised to avoid locating exhaust fans and ducts close to high roof lines, other systems, radioactive systems, operable windows, doors, or fresh air intakes.

.3.1.1 Finishes for Exhaust Systems: Consideration should be given to the use of special metal in preference to special paint when designing exhaust fan systems for use with dangerous, corrosive, or noxious fumes.

23 36 05. AIR TEMPERING SYSTEMS:

.1 GENERAL DESIGN CONSIDERATIONS:

.1.1 Outside air, in lieu of machine cooling, shall be utilized on air conditioning systems serving spaces with cooling loads when outside temperatures of 56 degrees F or below are prevalent and when the cost for additional work and equipment involved can be justified.

Commentary: *The University typically resets mixed-air temperatures higher (to approximately 65 F) in heating season to save energy. Consider higher cooling supply air temperatures in heating season when sizing zone*

airflows for systems using airside economizers. Medical Center Information – this is not always an option in critical and patient care areas

Outside air shall be controlled via two separate dampers. – a two-position minimum outside air damper and a modulating economizer damper – on all systems.

.1.2 Variable volume air distribution systems should be used to vary the air quantities with the loads rather than falsely loading the system with reheat or mixing at the terminal units. Space-air outlets should be aspirating types to prevent dumping of unmixed air into occupied spaces.

.1.3 Interior spaces requiring cooling the year around should be handled independently from perimeter areas requiring heating during winter and cooling during summer. Interior areas should be supplied from a variable volume cooling system utilizing a controlled economizer cycle. The perimeter systems should utilize controlled economizer cycles when cooling is required and minimum ventilation rates when heating is required.

.1.4 Heat recovery systems should be considered for use when shutdown of systems cannot be accomplished during hours when building is unoccupied. Each application should be examined independently to determine any special sources for obtaining a recovery of energy.

.1.5 Local cooling for limited areas or rooms may be provided by window air conditioners with approval by the University Engineer. Window Air Conditioner Policy:

.1.5.1 Evaluate the circumstances for suitability and consider the use of window air conditioning units only as a last resort. Obtain approval from the University Architect and the University Engineer prior to any window unit installation.

.1.5.2 Unit shall not protrude beyond the exterior surface of the building. Unit shall be installed in a manner to assure proper condensate drainage and without using the building façade as a surface path (staining potential) to grade level or creating a nuisance or hazard to pedestrians. Installations, whenever possible, should permit winter closing of windows (double hung and single hung type) past the exterior surface of the unit. This will both conserve energy and somewhat discourage improper turn-on at temperatures below 50 degrees F.

.1.5.3 Install only in lower sash to provide better access for maintenance.

.1.5.4 Provide a separate electrical circuit for each unit (typically 208 volt). The 208 volt characteristic results in somewhat more

efficient use of energy and also acts as a deterrent to theft for use in residential applications.

.1.5.5 Purchase and install only units which do not have side vents for condenser air exchange (rear vent units are capable of internal mounting so that window can close past them in winter).

.1.5.6 Insofar as feasible, standardize with a single manufacturer's units to minimize problems with stocking parts and familiarization of maintenance personnel.

.1.5.7 Use of combination heat/cool units is prohibited.

.1.5.8 Purchasing and/or installing a window unit in a University building without proper review and authorization is prohibited.

.1.5.9 Window air conditioners, when permitted, shall have a 240 volt DPST timer; 0- 4 hour for offices; and 0-12 hour for computer rooms and laboratories. Timers are not required for residential applications.

.2 EQUIPMENT:

.2.1 General: Equipment shall be of adequate size to handle air quantities and static pressure in accordance with design. Air quantities and distribution pattern shall be shown on the pattern drawings. Provisions for controlling air flow to or from outlets shall be included in the specifications, as well as indicated on the drawings. Air velocities in branch runs shall be kept low enough to maintain acceptable noise levels at air grilles.

Wexner Medical Center: General: Equipment shall be of adequate size to handle air quantities and static pressure in accordance with the design plus 20%. Air handling units shall be sized for the full connected load with no diversity consideration. Air velocities in branch runs shall be kept low enough to maintain noise levels of NC 25 or less in the room.

.2.2 Fans and Air Handling Units:

.2.2.1 Fans: Specify each type of fan separately. All fans shall be statically and dynamically machine balanced and fan motors shall operate within nameplate values.

.2.2.1.1 Fan ratings shall be based upon test performance in strict accordance with the AMCA Standard 210-67 Test Code for air moving devices. Specify that each fan bear the seal authorized by AMCA indicating that ratings are certified and that fans not bearing this seal will not be accepted.

.2.2.1.2 Centrifugal fans with motors 5 hp or over shall have bearings of the split pillow block, double row roller or ball, grease-lubricated type, with pedestal-type supports. Bearing life per Anti-Friction Bearing Manufacturers Association rating procedures shall be 90 percent expectancy of reaching at least 150,000 ~~87,360~~ hours under design conditions.

Wexner Medical Center: Provide ceramic bearings on fans controlled by a VFD. Bearing life per Anti-Friction Bearing Manufacturers Association rating procedures shall be 90 percent expectancy of reaching at least 150,000 hours under design conditions.

.2.2.1.3 Space Planning: Fans, motors, and drives shall be located so that safe and easy access for periodic inspections and maintenance is possible.

.2.3 Drives: The following guidelines must be considered in the selection of, and specifications for, belt drives:

.2.3.1 Single belt drives shall not be used on equipment with 1 hp motor and over.

.2.3.2 Drives shall always be installed with provisions for center distance adjustment. Motors shall be located on their respective motor bases allowing for 1/6 of the total motor base travel for installation of new belts with remaining 5/6 of the travel available for belt tightening.

.2.3.3 Arc of contact on the smaller sheave should not be less than 120 degrees.

.2.3.4 Ratios should not exceed 8 to 1.

.2.3.5 Belt speed should not exceed 5,000 feet per minute.

.2.3.6 A full and free circulation of air should be around the drive at all times.

.2.3.7 Drives operating in an explosive atmosphere should be well grounded and equipped with static-conducting belts.

.2.3.8 Variable drive pulleys used with 5 hp and larger motors are prohibited on final drive installations. Specify that original sheaves be changed when required to achieve proper rpm balancing.

~~.2.3.9 Power factor Correction: Motors (drives) 50 hp and larger shall be provided with fused, switched, power correction capacitor sized to correct 100 percent or greater. Units shall be connected between~~

~~the contactor contacts and overload. Units shall meet all fire and environmental codes.~~

.2.4 Ducts: Ducts shall not be run above electrical panelboards, switchboards, substations or within electric rooms except for the duct serving the electrical room.

.2.5 FRESH AIR SUPPLY:

.2.5.1 Intakes: Fresh air intakes shall be located in a vertical plane a minimum of 8 feet above grade and should not be located in close proximity to loading docks, driveways, loading zones, or any other contaminant source. Sufficient distance or a direction change of fresh air shall be provided between the outside air intake louver and the filters to eliminate snow and rain being carried to the air filters. Intake ducts ahead of filters must incorporate adequate and accessible drains. Duct must also be totally rust resistant.

.2.5.2 Masonry Structures: If masonry plenums or air shafts are used to handle air flow, they shall be coated with special materials or lined with sheet metal to make them airtight.

.2.6 Return Air: Include return air fans in ventilation systems. Provide controls to coordinate return air fans with supply fans and to use return air or outside air as needed for highest energy efficiency.

.2.6.1 Plenums: The use of return air plenums in lieu of ducted return air systems requires prior approval by the University Engineer.

Wexner Medical Center:

.2.7 Terminal Boxes: Terminal boxes shall be provided with fiber free liner with solid sheet metal interior. Terminal boxes shall be pressure independent with hot water reheat coils. Terminal boxes shall be located outside of patient rooms and other patient care procedural rooms for ease of maintenance and accessibility. Control boxes shall be installed where easily accessible. Terminal boxes shall be provided for each individual office, lab, exam room and patient care room unless approved otherwise by OSUWMC Facilities Operations.

.2.7.1 Labeling: All terminal boxes shall be labeled in accordance with OSUWMC requirements. Terminal boxes shall be labeled with TB, building abbreviation, floor and number. For example, a terminal box on the 5th floor of Rhodes Hall shall be labeled TB-RH-5-19. Any modifications, deletions or additions within existing buildings shall have the number coordination performed with OSUWMC Operations. A color coded dot shall be placed on the ceiling tile grid at the location of the access panel for ease of maintenance.

.2.7.2 VAV applications: minimum settings shall be carefully chosen so as not to create excessive negative pressurization and therefore infiltration.

.2.7.3 Modification: When modifying systems within existing buildings, confirm design conditions with OSUWMC Facilities.

23 40 00. HVAC AIR CLEANING DEVICES

.1 REQUIREMENT FOR FILTERS: All air supplied by a forced air type unit or system shall be filtered. Pre-filter in a single filter installation or a pre-filter intermediate filter combination shall be upstream from the coils. After-filter, where required, shall be on the discharge side of the fan and downstream from all coils. All HVAC equipment shall have new filters provided by the Contractor upon completion of construction and the Contractor shall provide new filters at the end of the 1 year warranty period.

Wexner Medical Center:

REQUIREMENT FOR FILTERS: All air supplied by a forced air type unit or system shall be filtered. Pre-filter and intermediate filter combinations shall be provided upstream from the coils. After-filters shall be on the discharge of the fan and downstream from all coils. Filter size shall be 24”x24” without approval from OSUWMC Operations.

Pre- Filter % Efficiency	Intermediate- Filter % Efficiency	After- Filter % Efficiency
30	60	80-95
30	60	95-99
30	60	HEPA

.2 SPACE REQUIREMENTS: Adequate clearances must be allowed for cleaning or changing filters.

.3 EFFICIENCIES: Filter efficiency shall be specified as minimum efficiency reporting value (MERV). Pre-filters shall be MERV 8 and final filters shall be MERV 14.

.4 DRAFT GAUGES: See 23 05 19.2

.5 AIR FILTRATION FOR HOSPITALS: Air filtration shall comply with the FGI ~~AIA~~ Guidelines for Design and Construction of Hospitals and Health Care Facilities.

Wexner Medical Center:

AIR FILTRATION FOR HOSPITALS: Air filtration shall comply with the FGI Guidelines for Design and Construction of Health Care Facilities, latest edition, unless noted differently above.

.6 PRE-FILTERS in a single filter installation shall be of the following types; filter size and thickness shall be specified.

.6.1 Throw-away type.

.6.2 Disposable media pad between permanent frames.

.6.3 Disposable media pad and frames.

.6.4 Disposable filtering media for roll-type filters. Roll-type filters shall not exceed 10 ft. in width for horizontal or vertical operation and shall be provided with dust covers and motor and drive covers. The filter media shall be provided with adequate support to keep it from being pulled out of place.

.7 INTERMEDIATE AND AFTER-FILTERS shall be of the following types:

.7.1 Dry-type throw away cartridges. Cartridge casings shall be fabricated from zinc-coated steel, with fully gasketed holding frames with compression fastening devices set in a zinc-coated sheet steel frame.

.7.2 Deep pockets of high performance filter media.

.7.3 Bag-type filter, fixed to a zinc-coated steel holding frame and equipped with wire supports to hold bags erect.

.8 ELECTRO-STATIC FILTERS may be incorporated in a project only with approval of the University Engineer.

Wexner Medical Center: ELECTRO-STATIC FILTERS shall be prohibited.

.9 HEPA FILTERS:

.9.1 Shall be on air handling units serving operating rooms, all cancer patient rooms, all intensive care rooms, and per FGI Guidelines.

.9,2 HEPA filter installations shall be tested and certified by a third party testing agent hired by the AE. Testing for certification shall include a smoke test for leakage and particle count verification. Any deficiencies for certification shall be repaired/replaced by the installing contractor.

23 50 00. CENTRAL HEATING EQUIPMENT WITHIN BUILDINGS

.1 GENERAL PROVISIONS: Refer to paragraph 01 78 23 (01730). In Division 01; specifications shall include provisions for:

.1.1 TRAINING OF University OPERATORS by specially qualified personnel furnished by the boiler manufacturer.

.1.2 OPERATING AND MAINTENANCE INSTRUCTIONS: electronic copies of operating and maintenance instructions and wiring diagrams shall be submitted to the University Project Manager.

.1.3 CAPACITY AND EFFICIENCY TESTS of each boiler, including the proper testing of other equipment in the boiler plant installation.

.1.4 TESTS: The specifications shall be written to require the contractor to prepare and perform all tests, to place the boiler in operation, and to demonstrate to designated University personnel that the safety valves and all other safety and control devices function properly.

.2 COORDINATION WITH BUILDING DESIGN:

.2.1 TWO SEPARATE MEANS OF EGRESS shall be provided, consistent with requirements of current Ohio Building Code, in boiler plants housing large boilers.

.2.2 LOCATION AND ARRANGEMENTS of the combustion air openings shall be such that any piping or equipment in the boiler room will not be subject to freezing.

.2.3 ACCESS for cleaning, replacement of tubes or sections, and maintenance is mandatory. Show manufacturer-specified clearances on plan views and elevation views for tube-pull areas, flanges, unions, etc., as needed to remove equipment heads as required for service.

~~.2.4 Sprinkler piping in ceiling of Vestibules and similar locations shall be protected from freezing.~~

~~2.5 Leak Detection requirements shall be discussed with the OSU Project Manager. Take into account such factors as upper floor mechanical rooms, coils that see freezing entering air conditions and cost of damage to building and its contents. For air handling units installed above occupied spaces, consider providing a cooling coil condensate overflow detector to lock out cooling in the event the primary drain line is blocked. Alarms shall be connected into the Building Automated System an annunciated at the BAS shop~~

.3 FUEL HANDLING EQUIPMENT:

.3.1 GENERAL: Fuel handling equipment and fuel burning equipment on boilers shall comply with FIA recommendations.

23 52 00. HEATING BOILERS:

.1 PREFERRED BOILER PLANTS: Where their use is practical, hot water boilers are preferred over steam boilers. Minimum 10 to 1 turndown.

.2 SEPARATE PLANTS: Many buildings will be heated with separate boiler plants. It is the intent of the University that these plants be fully automatic and equipped with the latest and best safety devices.

.3 SIZES: Plants shall be designed with boiler sizes so selected as to not require an attendant licensed operator.

.4 ELECTRIC BOILERS: The A/E must submit for review and approval by the University before applying any electric boiler. Electric boilers shall use the highest voltage available. Electrode boilers are favored over resistance-element type boilers. Adequate provisions shall be made for boiler capacity control.

.5 STEAM BOILERS: Steam boilers shall have blow down flash tanks located below the boiler water level in compliance with the State of Ohio rules for the construction and installation of steam boiler blow off systems.

.6 VIBRATION CONTROL: Boilers located on floors above grade shall be installed on pre-compressed fiberglass vibration pads.

.7 ALUMINUM HEAT EXCHANGERS: Use of boilers having aluminum heat exchangers requires approval by the University Engineer.

23 52 10. BOILER ACCESSORIES:

.1 THE WATER COLUMN on steam boilers shall comply with the Ohio Boiler Code. Float controls are desired.

.2 CONTROLS: On multiple boiler plants, the controls shall be of the modulating selector type so that individual boilers can be made to lead or lag. These controls shall be located in view of the boilers themselves so that personnel can see the boilers as controls are being adjusted. Boiler controls shall be BACnet compatible and connected to the University's BACnet network via MS/TP utilizing a Delta Controls DSM-RTR router.

.2.1 Float chambers of level control devices shall have gate valve drains with pipes extended to discharge over a floor drain.

.2.2 Pressure Type Relay: Steam boiler plants having more than one boiler shall have a pressure type relay and non-return valve on each boiler to prevent steam pressure in lag boilers from dropping below header pressure. (The purpose of this control is to prevent header steam from condensing in the boiler and raising the water level above the high level point in the header).

.2.3 Aquastat Relay: On steam and hot water boilers, an aquastat relay shall be installed on each boiler to prevent the burner from reaching high fire rating before the water temperature in the boiler rises to within a few degrees of the normal operating temperature.

.2.4 Safety Valves: On both hot water and steam boilers, relief valves shall be installed and so vented that they may be blown down without danger to personnel. Design will require adequately sized vent lines with appropriate drains to prevent steam and hot water from blowing back into the boiler room or other areas where they can endanger personnel.

.2.5 Vacuum Breakers: Each steam boiler shall have a vacuum breaker provided on a pipe connected to the top of the water column or float control for vacuum release.

.2.6 Cut-offs: Boilers shall have a low water cut-off on the burner.

.3 GAUGE GLASSES shall be automatic ball shut-off type.

23 53 00. HEATING BOILER FEEDWATER EQUIPMENT:

.1 WATER SOFTENER: Each boiler room shall be provided with a water softener for boiler feedwater makeup.

.2 THERMAL SHOCK PREVENTION: Each steam boiler plant shall have a factory assembled de-aerating feedwater heater with automatic controls. The heater shall be located at an elevation to provide net positive suction head for the boiler feedwater pumps. Hot water boilers shall have system piping and cold water makeup arranged to prevent cold water from entering a hot boiler.

.3 CHEMICAL TREATMENT: Boilers shall be provided with individual means for feeding chemicals into the boilers. Steam boilers having an output of 3,000,000 Btu or more and having at least 75 percent feedwater makeup requirement shall be provided with an automatic surface blow off arrangement. The device shall maintain a constant conductivity concentration by means of a boiler water probe and controller. Boilers having a high makeup requirement shall be provided with special chemical feed pumps for continuously feeding chemicals into the boiler.

.4 BACK FLOW PREVENTERS: Domestic “makeup” waterlines to boilers shall be provided with backflow preventers.

Wexner Medical Center:

23 57 00 HEAT EXCHANGERS

.1 SYSTEM DESIGN:

.1.1 The building shall be supplied with a fully redundant heating system, including heat exchangers and pumps. Heat exchangers shall be designed to supply 180-200 deg F heating hot water to the building.

.1.2 Heat exchangers shall be steam to hot water converters utilizing shell and tube configuration. The tubes shall be stainless steel.

23 60 00. CENTRAL ~~COOLING~~ HVAC EQUIPMENT

23 60 05. COILS AND PIPING SYSTEMS:

.1 COILS: All coils shall be ARI certified. Direct expansion coils may be used on small systems and shall be piped and installed in accordance with factory recommendations, if the installation can be considered normal or average by the manufacturer. Additional design precautions shall be taken, or a field refinement procedure shall be included in the specifications, on those installations not covered by the manufacturer's guide.

.1.1 Water coils shall have copper tubes (0.035" thickness) with aluminum fins, permanently bonded. Steam coils that could see superheated steam shall have 316 stainless steel tubes. Water cooling coils shall be designed for full counter-flow of water and air with water inlet at the bottom of the supply header and outlet at the top of the return header.

.1.2 Water Coils versus Steam Coils: Hot water coils are preferred over steam. Use of steam coils requires prior approval by the University Engineer.

.1.2.1 For VAV (variable air volume) HVAC systems, include a preheat coil of sufficient size to preheat the code-required minimum ventilation air up to 55 Deg F leaving air temperature. This will help to prevent nuisance low-temperature shutdowns, and will help to avoid negative pressurization of the building, during the heating season.

.1.2.2 For any hot water preheat coil provide either:

.1.2.2.1 integral face-&-bypass dampers and a control valve piped normally open to the coil; above 40 F position

dampers full open to coil and modulate control valve; below 40 F position valve wide open to coil and modulate dampers, or

.1.2.2.2 a coil recirculation pump for continuous flow through the coil and a control valve piped normally open to the coil. The control valve shall modulate to maintain preheat discharge air temperature.

.1.2.2.3 the heating control valve shall remain in control when the fan is OFF, except upon alarm of the low-temperature detection thermostat.

.1.2.2.4 glycol may be used for preheat coil protection with University Engineer approval.

.1.2.3 Steam coils, if used, shall be positive drain type with vacuum breakers, air vents, and double parallel condensate traps to reduce the possibility of freeze-up. The steam coils shall be installed with suitable pitch such that condensate shall naturally drain from the coil. Steam coils shall have integral face & bypass dampers. Provide adequate differential pressure for steam traps. Do not lift condensate if modulating steam valves are used.

.1.3 Design Details:

.1.3.1 Condensate Removal: Whenever cooling coils are stacked one above the other in a plenum, drip troughs shall be installed on the downstream side of the top coil(s) to eliminate drip into the air stream of the bottom coil. Pay special attention to pitch of cooling coil housing, exterior piping, and traps to ensure adequate removal of condensate from the plenum.

.1.3.2 Access: Provide access per manufacturer's recommendations. Access on inlet, outlet, and both ends of coils is desired, if possible, for maintenance and/or replacement purposes. Provide coil pull space on the piping connection side. Student Life – access on both ends is required to permit repair of tube bends without removing coil.

.1.3.3 Freeze-up Protection: Specify that the volume of heating medium being supplied to a coil facing outside air shall not be modulated. Provide manual reset freeze-up protection, applied to the downstream side of the coil.

.2 PIPING: Piping for hot and chilled water systems shall include isolation valves, drain valves, air vent facilities, and pipe unions at each coil, as well as a lockshield balancing valve or balancing cock for those systems having more than one coil being served. Air vents (automatic, or manual, as appropriate) with a line extended to an adjacent floor drain shall be specified for installation wherever air is likely to be trapped. A strainer with isolation valves on the suction side of a pump and a

pressure relief valve are required on all systems. Back-flow preventers shall be provided to prevent contamination of potable water systems.

Wexner Medical Center:

PIPING: Piping for hot and chilled water systems shall include isolation valves, drain valves, air vent facilities and pipe unions at each individual coil as well as its own isolation, calibrated balance valves. Air vents (automatic or manual as appropriate) with a line extended to an adjacent floor drain shall be specified for installation wherever air is likely to be trapped. A strainer with isolation valves on the suction side of a pump and a pressure relief valve are required on all systems. Back-flow preventers shall be provided to prevent contamination of potable water systems.

.2.1 Refer to Appendix K Technical Provisions for Corrosion-Scale Inhibitors, Microbiocides and Water Analysis Services for Cooling Towers, including OSUWMC requirements.

.2.2 Refrigerant Piping: Accessory equipment in a refrigerant circuit shall include:

.2.2.1 A dryer of adequate size.

.2.2.2 Sight glass-moisture indicator installed in the liquid line at a convenient and accessible location.

.2.2.3 Liquid solenoid valve located near the expansion valve on systems using coil pump-down.

.2.2.4 Service hand valves shall be considered a convenience on small refrigerant systems and a necessity on extensive or large systems. They shall be located for component isolation purposes during normal maintenance.

.2.2.5 Liquid charging port and service valve installed in the liquid line for large systems.

23 61 05. REFRIGERANT COMPRESSORS

.1 COMPRESSORS OF 60 TO 100 TON CAPACITY: Screw or scroll type, equipped with full running protection as described for larger compressors, suction and discharge oil pressure gauges, crankcase heater(s) oil reservoir sight glass, replaceable refrigerant filter-dryers and 5-year warranties. Incorporated features shall include the following:

.1.1 Deleted.

.1.2 Positive unloaded start.

.1.3 An adequate discharge muffler.

.1.4 Internal vibration isolation to provide minimum vibration transmission.

.1.5 Closed transition starting switchgear, determined by the electrical specifications for the particular sizes of motors.

.1.6 Air cooled units shall be furnished with a receiver on the condenser and provisions for pumping the full refrigerant charge into the receiver.

.1.7 Power factor correction as described for large compressors.

.1.8 Provide low ambient accessory as required for the particular application.

.2 COMPRESSORS UNDER 60 BUT OVER 15 TON CAPACITIES shall be scroll type. Incorporated features shall be as specified in paragraph 23 61 05.1 plus inherent thermal overload protection for motors. Provide low ambient accessory as required for the particular application.

.1.1 Chiller control panels shall be equipped with energy management and metering features including current kW usage, kWh used, and water side differential pressure sensors. This data must be available via the BACnet connection.

.3 COMPRESSORS BELOW 15 TONS OF CAPACITY SHALL be scroll. Unloaded start features are not required, but should be considered. Units shall have inherent thermal overload protection for motors. Provide low ambient accessory as required for the particular application.

.4 COMPRESSOR PRESSURE RELIEF DISCHARGE PIPING -See 23 20 03.

23 63 05. CONDENSING UNITS AND CONDENSERS:

.1 All condensing units under 100 tons shall come factory pre-charged with NON-CFC refrigerants and compressor manufacturers recommended lubricating oil. The unit shall be clearly marked as to the refrigerant and oil that it contains.

.2 SPECIFIC DESIGN REQUIREMENTS:

.2.1 CONDENSER CONSTRUCTION: Blow-through evaporative condensers are preferred to draw-through units. Where required for all season operations, air cooled systems shall be designed for condenser location within equipment rooms with discharge air to the outside. Where this is not possible, the condensers must be exterior mounted, the system shall be provided with adequate winter protection to prevent short cycling of the

system. Winter protection shall be in accordance with the manufacturer's recommendations and so warranted by the manufacturer.

***Commentary**: Consider hinged water boxes, polymer coating, and sacrificial anodes.*

.2.1.1 Air cooled condensers shall be selected in accordance with ASHRAE Standard 20-70 or ARI Standard 460-70 using 115 degrees F condensing temperature and 95 degrees dry bulb entering air temperature.

.2.1.2 Water-cooled condensers utilizing city water are prohibited. Exception: evaporative condensers.

.2.1.3 Modulating dampers used for controlling air quantities through towers or condensers shall have non-ferrous blades, linkages, and bearings. The operator motors and linkages shall be located outside the tower for convenient maintenance and operation.

.3 ARRANGEMENT OF EQUIPMENT:

.3.1 Condensers shall be located so that tubes can be rodded without hindrance from walls, piping, or equipment.

.3.2 Evaporative condensers shall be located near their compressors to reduce refrigerant piping to a minimum.

.4 CONDENSER PIPING: Piping of condensers shall have proper and adequate fittings and supports to facilitate removal of water box ends for maintenance. One set of flange fittings shall be located adjacent to the water box and a second set of flange fittings located away from the water box at such a distance that would permit the removal of the header and to provide maintenance space. This same provision for removal of headers in piping shall be made in the chilled water circuits at the chiller unit. Provisions shall be made for TDS-controlled blowdown per Appendix L. Dry sumps shall be utilized with interior storage when winter operation is required.

.4.1 Water treatment control of pH and solids shall be provided as outlined in Appendix L. Backflow prevention or an air gap shall be provided to prevent contamination of all potable water systems. Refer to Appendix L for condenser water treatment systems sample specification.

.4.2 Condenser water lines and city water make-up lines exposed to the weather shall have drain facilities properly located to allow drain down of the system to prevent freeze-up during the winter.

.4.3 Check valves shall be installed on condenser water pump discharge lines where a reverse flow could occur in event of pump shut down.

.4.4 A basket type strainer shall be installed ahead of the condenser water pump on all systems. Strainer shall be valved so that minimum amount of water will be lost when strainer is removed for cleaning. The pressure gauges on any condenser water strainer or condenser water pump shall be compound-range gauges, such that if the strainer becomes plugged, the gauge will read below zero (0) without damage to the gauge.

.4.5 Refrigerant piping to and from an air-cooled condenser shall be installed in accordance with the manufacturer's recommendations (re: pipe size, traps fittings, and receiver size).

.4.5.1 Installation of Refrigerant Piping: Specify that lines be fitted, installed, and pressurized with dry nitrogen before being brazed. Use 6 percent or higher silver alloy with a 1000 degrees F solidus minimum. Specify that lines be blown with dry nitrogen to eliminate brazing debris before starting evacuation and charging procedures.

.4.5.2 Elbows and fittings for refrigerant lines shall be long-radius to minimize capacity loss.

.5 HVAC WATER TREATMENT SYSTEMS:

.5.1 See BDS Appendix L.

23 64 05. CHILLERS:

.1 CHILLERS OF OVER 100 TON CAPACITY: Units will be centrifugal, screw or scroll type which utilize NON-CFC refrigerants with safety classification A-1 or B-1. (as defined per ASHRAE Standard 34- -- Designation and Safety Classification of Refrigerants) such as R-134a or R-123. The use of HCFC-22 is not permitted for use on campus. The primary considerations are high efficiency at part load, high efficiency at full load, low acoustic noise, ease of service, high reliability of operation, low operating costs, low service costs, fast response from local service representatives, and ease of data transfer using BACnet communications to the building automation system from chiller controller. Also specify:

Wexner Medical Center: Refrigerants shall be coordinated with OSUWMC Facilities.

.1.1 Motors: Dual winding, star-delta design, with matching two-step, closed transition, time-delay starting switchgear is preferred. An auxiliary timer in the starting circuit is required. Specify that timer be set to limit starts to a minimum of 60-minutes apart, or greater as recommended by the manufacturer.

.1.1.1 Alternate Starting Arrangements: An auto-transformer with reduced voltage start or solid state starter are acceptable alternates.

.1.1.2 Thermal Protection: All motors shall have heat sensors in the windings for thermal protection.

.1.1.3 Consider variable frequency control of chiller drive motor; justify with Life Cycle Cost Analysis.

.1.2 Power Factor Correction: The equipment manufacturer shall provide fused, switched, power factor correction capacitors to correct to 100 percent or greater. It is preferred that the units be connected after the contractor, before the overloads. Units shall meet all fire and environmental codes.

.1.3 Full-running Protection: Specify that compressors be equipped with high and low pressure safety cut out, external overload protection, and low oil pressure safety cutout. Safeties shall be manual reset type initiating an electrical lockout of the starting circuit when tripped, with an indication of which safety device has tripped.

.1.4 Gauges: See 23 05 19.2.

.1.5 Forced feed lubrication with filter, cooler and visual inspection port in the oil reservoir shall be provided.

.1.6 Capacity Control: A capacity control will be located in the machine control cabinet with an adjustable range of 20 to 100 percent. This will be a pneumatic-electric or a microprocessor based device suitable for remote reset.

.1.7 Heaters: Compressors shall be equipped with crankcase heaters wired on a separate electrical circuit. Units using low-pressure refrigerants shall be furnished with purge units to eliminate the non-condensable gases. Units shall be furnished with a pump-out unit and receiver large enough to hold the full refrigerant charge.

.1.8 Air-cooled units shall be furnished with a receiver on the condenser and provisions for pumping the full refrigerant charge into the receiver.

.1.9 Bidding Requirements: See Division Facility Services-6 for Base Bid requirements for CHILLERS over 100 ton capacity.

.1.10 Evaporator and condenser connections shall be specified to include marine boxes with hinges which will permit ease of service to tubes. Condenser shall include factory installed sacrificial anodes and polymer coating.

.1.11 Oil filtration system shall be specified to include isolation valves, to isolate the filter from the machine and avoiding removing the refrigerant charge when servicing the oil filter.

.1.12 Refrigerant circuit shall be specified to include refrigerant isolation valves, and sufficient volume in both evaporator and condenser to allow all of the refrigerant to be moved into one section of the circuit while servicing the other section, to avoid removing the refrigerant from the machine.

.1.13 Chiller control panels shall be equipped with energy management and metering features including current kW usage, kWh used, and water side differential pressure sensors. This data must be available via the BACnet connection.

***Commentary**: Intent is to have direct communication between the chiller and BAS*

.1.14 Extended Warranty: Review including a 5-year parts and labor chiller warranty and a 5-year refrigerant warranty with University Project Manager.

23 65 00. COOLING TOWERS:

.1 GENERAL DESIGN REQUIREMENTS: Cooling towers shall be of the induced draft design with propeller type fan. Fan drive shall be right angle gear type with electric motor mounted outside the air stream.

.1.1 Free-standing towers shall be provided with appropriate factory made service platforms, ladders and a safety railing to provide adequate access for servicing the equipment inside and on top of the tower.

.1.2 Cooling towers shall be sized based on 78 degree F wet bulb outside air temperature. Cooling tower capacity requirements shall be checked by the A/E throughout the full operating range of the chiller and outside air ambient conditions to ensure adequate tower capacity.

.1.3 Fan motors shall be inverter-rated, to permit warranted-use of the motors when controlled by variable frequency drives.

.1.4 The use of variable frequency drives for tower fans is strongly encouraged in order to provide the lowest suitable condenser water supply temperature to the chillers, such that the chillers can operate more efficiently at the lowest lift.

.1.5 Provide tower bypass control valves in order to allow friendly start-up to chillers and avoid nuisance shutdowns of chillers with too-cold tower water. It is encouraged to apply a two-way tower-bypass valve for modulating control with a line-size valve to the tower for positive shut off of flow to the tower. Avoid using three-way valves. Consider having the chiller directly controlling the bypass valve in lieu of the Building Automation System.

.1.6 The tower condenser hot water distribution pans and cold water sumps shall be stainless steel

.1.7 For towers with indoor sumps, provide a 1"-size drain-equalizer at the indoor sump, interconnected between tower supply and tower return lines, such that both lines will automatically drain to the sump. The 1" drain-equalizer shall have zero (0) valves and shall be continually open to both lines.

Wexner Medical Center : Provide sump heaters on all cooling towers.

.1.7 Specify that cooling tower manufacturer shall furnish balancing valves for distribution pans. Do not specify butterfly valves with lever actuators for this purpose.

23 80 10. LIQUID HEAT TRANSFER:

.1. HOT WATER HEATING PIPING AND INSULATION: Refer to Sections 23 07 19, 23 20, and 23 20 09.

.2. STEAM HEATING PIPING AND INSULATION: Refer to Sections 23 07 19, 23 20 05, and 23 20 09.

.3. HEAT EXCHANGER PIPING AND INSULATION: Refer to Sections 23 07 19, 23 20 05, and 23 20 09.

4 **Wexner Medical Center** :Consideration shall be given to provide 50% propylene glycol in all systems requiring freeze protection.

23 80 15. DESUPERHEATER (DSH) STATION:

.1 De-superheat all superheated steam to within 20 F of saturation downstream of the main high pressure building pressure reducing station. Submit details for construction and installation during preliminary design for review and approval.

.2 Review with University Project Manager whether: 1) the DSH should be designed for N+1 (100% backup), or 2) all equipment downstream should be designed for superheated temperature, or 3) an automatic shutdown of the steam system upon failure of the DSH is desired. [One of these methods shall be provided.] Automatic shutdown valve shall be slow-closing (2 minutes, adjustable, from fully-open to fully-closed).

3. Each DSH shall have at least a 100:1 turndown ratio and be sized for the peak design steam load. DSH shall be Copes Vulcan VO II (variable orifice) or Schutte & Koerting Fig. 6910 (absorption). Other types of DSH (e.g., steam atomizing) are prohibited. Provide DSH control system per Appendix A.

.

4. Steam condensate (not domestic water) shall be used for DSH cooling. Consider using coalescing dirt separator. If DSH is designed for N+1, the condensate cooling injection system shall also be designed for N+1.

23 80 17. DESIGN AND INSTALLATION OF STEAM PRESSURE REDUCING STATIONS:

.1 SOUND ATTENUATION: Provide either sound attenuating valve trim or a downstream in line silencer or both to maintain noise levels below 85 dB. Attenuator outer body and inner wall shall be of steel construction with pressure and temperature rating as required by the safety relief valve set point and stream conditions. Acoustical insulation shall be fiberglass for service below 300 degrees F and fiberglass with steel casing for service above 300 degrees F.

.2 Not used

.3 MAIN HIGH PRESSURE BUILDING STATIONS: Steam stations processing campus high pressure steam at 200 psig at 600 degrees F to produce building utilities such as heating hot water, domestic hot water and reduced pressure process steam shall be located immediately adjacent to an exterior wall. The Control Valves shall be selected to satisfy winter and summer steam usage, which in most cases has a turndown of 50:1.Routing campus high pressure lines through interior building spaces is prohibited except in the case where the steam line is completely enclosed in a utility tunnel physically segregated from interior building space. The space shall be adequately ventilated /cooled to achieve an overall temperature not to exceed 95 degrees F at a distance of 4 feet from the station. Label all piping that is anticipated to carry superheated steam with the appropriate abbreviation listed in the Facility Services section and an additional 'S' plus steam pressure in parentheses. For example medium pressure superheated steam: MPSS (70 psig). High pressure stations, requiring close reduced pressure control and reliable operation, shall be designed to include:

Wexner Medical Center:

MAIN BUILDING STATIONS: Pressure reducing stations and desuperheaters shall be utilized to reduce the incoming campus steam from 200 psi/585 degF to 70psi/400 degF for utilization to produce heating hot water, domestic hot water, etc. Pressure reducing stations shall be located immediately adjacent to the exterior wall within the building walls, not in a vault.

.3.1 Valves shall be cast carbon steel body, Class 300 rating and flanges or threaded ends, Stellite-faced stainless steel plug, cage, and seat ring, normally closed single port, cage guided, bonnet extension, with graphite packing and Belleville style washers.

.3.1.1 Diaphragm shall be molded type suitable for 300 degrees F operating temperature with a fabric insert, iron, steel, or aluminum diaphragm plate, silicone manganese-steel actuator spring, and stainless steel travel indicator scale.

.3.1.2 Pressure Controller: Specify that each valve be furnished with a proportional and reset action pressure controller with overload protection on the bourdon tube. For sensing line to bourdon tube, provide minimum 6-inch length of tubing for temperature reduction, steam syphon ("pigtail"), and three-valve manifold (all 316 stainless steel). Provide pneumatic pilot positioner. Provide supply and output pressure gauges at controller and valve positioner. See 23 05 19.2.

.3.1.2.1 A 1/4 inch filter regulator shall be installed in the air line ahead of each controller.

.3.1.2.2 The sensing line connecting the pressure controller to the steam pipe shall be #316 stainless steel pipe, minimum 3/8" NPT size, or larger as specified by the controller manufacturer. The sensor line shall be sloped down and away from the controller to the steam main.

.3.1.2.3 Valve manufacturers: Fisher, Copes Vulcan, Spirax-Sarco, or Leslie.

Student Life: for Student Life buildings, Armstrong is acceptable.

.3.2 The A/E shall provide a detailed steam system piping diagram on the Drawings to clarify the design intent indicated above, showing for example, steam pressures and temperatures, valve Cv ratings, relief valve settings, pressure gauges, and thermometers, etc.

***Commentary**: The steam system piping diagram will enhance the visual aid for the Operations staff for determining the status of the steam delivery system.*

.4 MEDIUM PRESSURE (LESS THAN 150 PSIG) HIGH VOLUME STATIONS: Medium pressure stations that can see superheated steam shall be same as for high pressure building stations. Medium pressure stations that can only see saturated steam and that require close reduced-pressure control shall be designed to include:

.4.1 Valves shall be Class 300 cast steel body, Class 300 flanges or threaded ends, with Stellite-faced stainless steel trim, normally closed single port, cage guided, with PTFE packing.

.4.1.1 Diaphragm, pressure controller, and filter regulator shall be the same as required for main building station.

.4.1.2 The Control Valves shall be selected to satisfy winter and summer steam usage, which in most cases has a turndown of 50:1.

.5 SMALL VOLUME STATIONS: Stations with small loads and that do not require close reduced-pressure control, shall be designed to include:

.5.1 Air loaded (no pilot) reducing valve with no stuffing box.

.5.2 High pressure and superheated steam valves shall have Class 300 screwed or flanged cast steel bodies, single port with top and bottom guided stainless steel valve plug, replaceable screwed-in Stellite-faced stainless steel seat, stainless steel main spring, and double stainless steel diaphragm. Medium pressure valves that can see only saturated steam shall be same except Class 150 cast steel body.

.6 OTHER CONDITIONS: The A/E may consider using valve materials and pressure/temperature ratings different than described above if the building steam system is a lower temperature or pressure application. Where a desuperheater is used, the A/E shall consider the consequences of a desuperheater failure on the equipment installed downstream. The design assumptions for these conditions shall be documented in the Basis of Design and submitted to the University Engineer for approval.

Commentary: *The A/E is encouraged to consider using valve materials and pressure/temperature ratings that meet the needs of the application without incurring unnecessary expense for the University. Some examples of such applications would be standalone boilers or systems using only desuperheated steam.*

.7 INSTALLATION DETAILS: Specify that:

.7.1 Valves with pneumatic controls shall be provided clean, dry air at up to 80 psig, as required.

.7.2 Steam gauges: See 23 05 19.2.

.7.3 Safety valve and safety valve vent shall be provided. Safety valves shall discharge to the outside. The pressure drop in the safety valve discharge piping shall be minimal so that it does not impede the safety valve operation. Where steam passes through regulators to a lower class of piping, safety valves shall be installed with enough capacity to prevent over-stressing the piping in the event of regulator failure.

.7.4 A drip-leg, full pipe size, and a trap be provided just ahead of each regulator to remove the moisture from the steam before it enters the regulator.

.7.5 A minimum of two regulators shall be provided on pressure reducing stations, both sized for full flow capacity with one being a standby. Regulators shall be installed with valves and unions or flanges so that any regulator can be removed without disturbing the others. Strainers (100 mesh) with blowdown valves shall be installed horizontal ahead of regulators. Where two valves are necessary to meet the summer-winter turndown (e.g. 1/3 – 2/3, or ¼ -- ¾), the standby valve shall be sized for the

larger of the two valves. In lieu of a standby regulator, provide a full-flow globe valve bypass.

.7.6 Pressure reducing stations shall be of such design that regulators can be easily removed without straining the pipe.

.7.7 Gauges on steam lines should be compound-range gauges, such that gauges will not be damaged if steam systems draw a vacuum when shut-down.

.7.8 Provide removable/reusable insulation jackets on all devices, to reduce heat gain to the space, and allow for convenient service. Fiberglass insulation shall not be used on piping systems above 300 degrees F. (Exception: mats composed of 100% needle felted Type E fiberglass fibers may be used.)

.8 ZERO ENERGY POTENTIAL: Double block and bleed techniques, as recommended by OSHA, shall be used to achieve ZEP (Zero Energy Potential) on all systems of 50 psig or higher.

23 82 10. COILS, RADIATORS, AND FAN COIL UNITS:

.1 USAGE:

.1.1 Forced Air Type Units: An adequate supply of heat shall be provided at building entrances and in air locks. Cabinet unit heater with thermostat control shall be used. Units shall be equipped with filters to minimize dirt collection on coils.

.1.2 Convectors shall be used where architectural features cause an increase in heating requirements. When used, convectors shall have ratings based upon test procedures as set up by the Hydronics Institute, Institute of Boiler and Radiator Manufacturers (I=B=R).

.1.3 Through-wall type heating/cooling units shall not be provided with any liquid service to avoid winter freeze-up problems.

.1.4 Energy Conservation: Fan coil units and radiation will be required in specific areas to facilitate shutdown of major fan units after hours to save energy. Where necessary, the controls on these units shall be coordinated with the controls on the air handling units.

.1.5 Coils: All coils, except fan coil units, shall have a tube wall thickness of 0.035 inches.

.1.6 Hot water or steam heat should be used wherever possible; avoid use of electric heat. Radiant ceiling panels are prohibited.

.2 DETAILS:

.2.1 Convectors shall be wall hung type with sloping top and knob dampers. Elements shall be tested at 150 psi.

.2.1.1 Fins shall be non-ferrous, spaced not closer than 72 fins per foot.

.2.1.2 Tubes shall be copper.

.2.1.3 Cabinet shall be sheet metal, no less than sixteen gauge on fronts and tops, and eighteen gauge on backs.

23 84 00 HUMIDIFIERS

Wexner Medical Center:

.1 USAGE: Humidification levels shall be maintained per the requirements of the AIA Guidelines for Design and Construction of Health Care Facilities, latest edition.

.2 DESIGN: Humidifiers shall be direct steam injection. Humidifiers shall be accessible for routine maintenance.

23 90 00 MAKEUP WATER

All make up water systems (chilled water, HHW, cooling tower) shall be metered and connected to the BAS

END OF DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

26 00 00. ELECTRICAL

26 00 03. GENERAL PROVISION

.1 QUALIFICATIONS OF CABLE SPLICERS: Refer to Division 33.

.2 INFORMATION FOR DESIGN OF SYSTEM: During the initial planning conference, consult the University and Facilities Design and Construction, regarding the choice of primary service voltage to be used, its location, and the capacity available. Refer to Division 33 00 03.3.1 for requirements that the Architect/Engineer's (A/E) Electrical Consultant shall follow.

.2.1 EQUIPMENT AND INSTALLATION GUIDELINES:

.2.1.1 An important aspect of Power System Design and Installation involves consideration of service reliability of the proposed system and loads that are to be supplied. System Installation inspection and Service reliability will be performed by the Contractor in the presence of the Ohio State Energy Partners (OSEP) and Affiliates when and if the Systems are to be connected to University Electrical Power Systems. The System shall not be energized if these requirements are not met or it fails Final Inspection.

.2.1.2 Contractor(s) and A/E's electrical consultant(s) are responsible for addressing all the Design review comments to the satisfaction of the university in order to assure the continued reliability of the University Power Distribution System.

.2.2 SAFETY

.2.2.1 The incorrect application of Electricity and unsafe installation can cause both minor and serious accidents. The Designer must remain vigilant to Electrical hazards and take appropriate steps in meeting all safety rules and regulations in Electrical Power and Installation Distribution Design. It is important that the Design meet requirements of the following codes and regulations; NEC, NFPA, OSHA, and National Electrical Safety Code. It is also important that all the Equipment, Devices and Installations supplied and installed in all University's Facilities meet high level of Safety Requirements, and the Ohio State University Building Design Standards. It shall also be known that the equipment, devices, and installation that fail to meet these requirements will not be accepted.

.3 OVER CURRENT PROTECTION COORDINATION: For any building with an electrical service larger than 1,200 amperes, an analysis of the coordination of over current protection shall be shown on the drawings or provided on a separate document.

.1.1 the coordination study shall show the system by elementary diagram and indicate Arc Flash Coordination Study, Load Flow the available fault current at critical points in the distribution system and the selection of over current devices for time and interrupting capacity coordination. This study shall be

part of design services in addition to the ones supplied by the electrical contractor.

.1.2 a copy of the final studies shall be approved by the A/E and uploaded following Ohio State University's Project Closeout Standards with the one-line diagrams ~~in electronic form~~ and submitted in electronic form in the tool's native format for future use and modification.

.4 COORDINATION OF HARDWARE: All electric panel doors shall be equipped with BEST Access Systems cylinders with removable 7-pin cores. Refer to Division 08 for further details.

.5 Equipment belonging to other University Departments shall not be installed in or stored in Facilities Operations and Development mechanical or electrical rooms. ~~Unless permission is given by Facilities Operations and Development in writing.~~

.6 Building electrical service shall be received at medium voltage from Ohio State Energy Partners (OSEP) system or American Electric Power Company (AEP), depending on location and availability. ~~from the OSU power system, when in the vicinity and available.~~

.7 PROHIBITED MATERIALS AND CONSTRUCTION PRACTICES:

~~7.1 Door Closers: Refer to paragraph 08 70 20.5 regarding the prohibition against door closers with integral smoke detectors~~. Not used.

.7.2 Extra-flexible non-labeled conduit:

.7.3 Plastic conduit for interior electrical use, except that PVC conduit may be used for power circuits below basement concrete floors and for ground wires in any location. The transition from PVC to steel shall be made below the floor and shall be galvanized rigid steel conduit.

.7.3.1 Electrical Nonmetallic Tubing (ENT) or "Blue Tube".

.7.4 Steel conduit shall not be used outside unless in concrete. Use aluminum conduit outside and wet locations above grade.

.7.5 ~~Aluminum wiring shall not be used.~~ Use of aluminum plated bus and aluminum wound transformers is prohibited in all Ohio State University projects.

.7.6 Use of Incompatible Materials: Aluminum fittings and boxes shall not be used with steel conduit. All materials in a raceway system shall be compatible.

.7.7 Power actuated anchors or plug anchorage using wood, lead, or plastic.

.7.8 Multi-use Suspension Systems: Piggyback suspension systems for conduits, fixtures, etc. are prohibited. All suspensions must be hung independently from structure, or, in limited cases, from trapeze suspension systems.

.7.9 Use of wire ties to support conduit.

Exception: Flexible conduit for fixture whips may be supported with UV stable cable ties,

.7.10 Use of wood strips and wood screws to support lighting fixtures.

.7.11 Use of Class J fuses unless permitted otherwise in the Ohio State University Building Design Standards. (Permitted use: Elevator shunt trip fused switches)

.7.12 Direct burial electrical cable at any voltage.

.7.13 Electrical ducts crossing above gas piping.

.7.14 Ducts within 10 feet of a buried steam line in any direction. If it becomes necessary to cross a steam line, acceptable insulation of the crossing must be approved by the Utilities High Voltage Services, Facilities Operations and Development.

.7.15 Hard insulated wire connectors, which have Bakelite or Ceramic insulation, and "push-in" type connectors are prohibited.

.7.16 Not used. ~~Dimmable lighting unless permission is obtained in writing from the University Engineer. See 26 58 00.3~~.

.7.17 Armored cable (BX, AC, etc.)

Exception: MC Cable (Metallic cable with green ground wire) may be used where permitted in the Ohio State University Building Design Standards.

.7.18 Non-metallic sheathed cable.

.7.19 Flat conductor cable type FCC, under carpet, etc.

.7.20 Fluorescent fixtures using 4-foot, 2-foot, U-tubes or compact fluorescent lamps is prohibited. ~~Fluorescent fixtures using other than 4-foot tubes are discouraged. Where 2' x 2' fixtures are needed, use 2' long fluorescent tubes. Fluorescent U tubes are prohibited.~~

.7.21 Die cast setscrew and die cast compression type fittings outdoors.

.7.22 Not used. ~~Locating the following equipment less than three feet from a wall: electrical equipment that permits or requires rear cooling, rear access for maintenance or cleaning, or rear connection.~~

.7.23 Bottom fed switches, breakers or fuses, unless permitted by the University Engineer.

~~.7.24 Switches in which the blades pivot on the top.~~ Not used

~~.7.25 Switches, breakers, etc. that require greater than 75 pounds of force on the operating handle.~~ Not used

~~.7.26 Use of compact fluorescent lamps and/or T5 fluorescent lamps and fixtures as the main source of illumination in any area are prohibited unless~~

~~approved by the University Engineer Otherwise the use of compact fluorescent lamps or T5 fluorescent lamps shall be limited to accent lighting. Commentary: The definition of "accent" is a wall or artwork not "a task or an "egress path". T5 Fluorescent lamps have no standard sockets; hence they cannot be purchased from the open market. It is not cost effective for maintenance.~~ Not used

.7.27 Use of cable tray with primary conductors.

.7.28 Time clock controls used on exterior or security lighting.

.7.29 Use of busway other than as permitted in Section 26 05 35.11.

.7.30 Use of bus way for panel risers.

.7.31 Tapping existing switchgear, switchboards, panelboards, and motor control centers to provide power for new feeders or equipment shall be prohibited in all University facilities.

.7.32 Troffers: Use of radiant ceiling panels.

~~.7.33 Lamps not manufactured by GE, Phillips, and Sylvania.~~

~~.7.34 Lamps provided by only one Manufacturer.~~

~~.7.35 Fixtures that require proprietary lamps.~~

.7.36 General Duty Safety Switches

.7.37 Custom Built Lighting Fixtures <u>unless permitted by the University Engineer.</u>

.7.38 Recessed step lighting fixtures

7.39 Exterior wall recessed mounted lighting fixtures.

.7.40 Flush mounted in-ground fixtures

.7.41 Exposed wiring of any type in mechanical and/or electrical rooms

.7.42 Top entry in any exterior electrical equipment.

.7.43 <u>Use of Series rated equipment.</u>

.7.44 <u>Vacuum breakers or vacuum switches.</u>

.8 SPECIAL REQUIREMENTS FOR MANHOLES OR VAULTS

.6.1 Manholes shall not be installed inside buildings.

.6.2 If there are existing manholes (MH) or vaults inside buildings undergoing major renovation that cannot be moved or relocated, then provision must be made for access by a live truck, known as the High Voltage Truck, for emergency repair<u>,</u> maintenance, and cable termination or replacement.

26 05 05. ELECTRICAL MATERIALS AND METHODS:

.1 UL LISTED EQUIPMENT AND MATERIALS: Specify only Underwriter's Laboratories (UL) listed equipment, assemblies, and materials when such items are available. The equipment and materials shall be installed in accordance with its listing.

26 05 15. WIRE AND CABLE

.1 MATERIAL: Copper conductors of 98 percent conductivity shall be used unless use is restricted by Government Agencies.

.1.1 Aluminum conductors may be used in new construction for 600 V and below circuit's 100 amps (#1 AWG) and larger if approved in writing by the University Engineer and the Maintaining Authority, 225 amps and larger for Medical and Research facilities. Aluminum conductors shall be considered a substitution and shall be submitted in accordance with applicable Division 1 Specification Sections. In existing buildings do not mix conductor material types, do not introduce Aluminum wire into a building which has copper wiring throughout.

.1.1.2. Where permitted, Aluminum conductors shall be Compact stranded per ASTM B-801, AA-8000 series aluminum alloy and shall comply with ASTM B-800; UL 44.

.1.1.3. Aluminum conductors may not be used for feeders to mechanical equipment such as chillers, medical equipment such as MRI, CT, X-ray or similar, generators, or other equipment where the manufacturer requires incoming cables to be Copper.

1.1.4. If Aluminum conductors are used, connectors shall be dual rated CU/ALR, listed by UL for use with Aluminum or copper conductors, and shall be indent type, long barrel with chamfered entry, 2 – hole, compression type for 250Kcmil and above, 1 – hole for less than 250 Kcmil.

.1.1.5 Oxide inhibiting joint compound must be applied on the aluminum conductor for each termination, splice, and tap per the instructions of the cable manufacturer.

.1.1.6 Electrical connectors and terminals shall be tightened according to manufacturer's published torque-tightening values or those specified in UL 486A.

.1.1.7 Provide infrared scan reports with pictures of all items tested and pictures of repairs 11 months after University move-in. Repairs responsibility of installing contractor.

.1.1.8 Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate Aluminum cable. Cable splicer shall have a minimum of 2000 hours experience with terminating

and installing Aluminum cable. Furnish satisfactory proof of such experience for each employee who splices or terminates the cables. Persons listed by the Contractor may be required to perform a dummy or practice splice and termination in the presence of a University representative or Engineer before being approved as a qualified installer of aluminum cables.

.2 SECONDARY CONDUCTORS:

.2.1 COLOR CODING for new construction

Color-coding for 480/277V and 208Y/120V shall be as follows:

Phase	Voltage - 208Y/120	Voltage - 480Y/277
Neutral stripe)	White/Gray	White or Gray (identifiable colored
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Ground	Green	Green w/ Yellow stripe

.2.1.1. For existing buildings, maintain existing color code.

.2.2 Solid and Stranded Wire: No. 12 AWG and smaller may be solid. No. 10 and larger shall be stranded.

.2.3 Minimum size for lighting and power branch circuits: No. 12 AWG.

.2.3.1 Use No. 14 AWG stranded for control wiring between control panels and motor starters.

.2.4 ~~Field wired incandescent fixtures shall be wired with Type SF 150-degrees C 300-volt wire.~~ Not used.

.2.5 Field installed cords to portable equipment shall be type ST or G and Field installed cords for normal Equipment shall be type SRDT containing identified equipment.

.2.6 Circuit wiring through ~~ballast channels of fluorescent~~ LED fixtures shall be 600-volt 90-degrees C insulation. Fixture must be approved for through wiring, if thus used.

.2.7 General use insulation: NEC, 600-volt type THHN/THWN or XHHW.

.2.8 Connections in No. 10 and smaller wire shall be made with threaded-on plastic or nylon insulated wire nuts. Crimp connectors, except butt connectors, are prohibited. Joints in No. 8 and larger conductors shall be made with pressure type mechanical or split bolt connectors insulated with plastic electrical tape.

2.9 MC Cable may not be used in the following applications unless approved in writing by the University Engineer:

Exposed conditions, in mechanical and electrical rooms, kitchens, science laboratories, utility spaces or medical facilities. MC shall also not be run exposed below eight feet above finish floor.

Run in corridors ceiling spaces.

Exception: MC Cable may be used as fixture whips for lighting fixtures provided MC Cable longer than 6' shall be properly supported.

Exception: MC Cable may be used in existing walls.

.2.10 MC Cable may be used for branch circuiting in offices, pool classrooms, and corridors of office and classroom buildings provided it is supported properly and run taut.

.2.12 **WEXNER MEDICAL CENTER:** Medical Grade MC may be used for "Normal" side branch circuits in patient rooms where permitted by Code.

.2.13 "Homeruns" back to panels are not permitted to be MC Cable; EMT or rigid conduit shall be used.

.3 WIRE AND CABLE IDENTIFICATION

.3.1 See **Wexner Medical Center** Special Requirements Appendix E – Electrical System Labeling and Identification.

26 05 17. WIRING DEVICES

.1 DESIGN: All wiring devices provided shall be Heavy Duty specification grade. New building devices will be ~~ivory~~ white with stainless steel plates for standard and ground fault interrupter use on normal power. Isolated ground devices shall be orange with stainless steel coverplates. Wiring devices on emergency power shall be red with stainless steel coverplates. In existing buildings, designers shall match existing color scheme that is prevalent throughout building with the exception of emergency power. All emergency power receptacles added to existing buildings shall be red.

.1.1 **WEXNER MEDICAL CENTER**: Hospital grade devices required in patient care areas.

.1.2 Placement of Receptacles:

.1.2.1 In standard size classrooms (49 students or less) provide a double duplex receptacle at the front of the classroom centered under the chalkboard. Provide two additional receptacles at the front of the room spaced half way between corners and double duplex receptacles. Back of rooms to be provided with single duplex receptacle at center of wall and two additional receptacles equally

spaced from corners. Remaining walls to be provided with two duplex receptacles on each wall equally spaced.

.1.1.2 Classrooms (50 students +) Provide two duplex receptacles for the front wall, centered between the corners and double duplex receptacle at the center of the wall. Provide two duplex receptacles equally spaced on all remaining walls.

.1.1.3 Corridors shall be provided with duplex receptacles 35' on center and a maximum of 15' from end of corridor. These receptacles shall have separate circuits and shall not be fed from the adjacent room circuits.

.1.1.4 Lecture halls shall be provided with a double duplex receptacle centered on the front wall and two additional double duplex receptacles equally spaced between center double duplex and corners. Provide duplex receptacle in floor for podium. Provide additional receptacles throughout for cleaning. These receptacles shall be a maximum of 25' on center. If lecture hall is provided with a lab bench, than provide bench with double duplex for every eight-foot of bench.

.1.1.5 Computer Labs shall be provided with at least two general-purpose receptacles equally spaced per wall in addition to all receptacles for computers. These general purpose receptacles shall not be wired

.1.1.6 Mechanical room shall be provided with at least four duplex receptacles (one per wall) and additional duplex receptacle where walls are 25' or longer.

.1.1.7 Offices: Provide a minimum of one duplex receptacle per wall.

.1.1.8 In utility tunnels receptacles shall be placed a maximum of 100' on center and a maximum of 25' from the entrance, exit or intersection of tunnel. These shall be GFCI type in NEMA 3R enclosures. These shall be located on the ceiling in line with the nearest light fixture.

.1.1.9 In pedestrian tunnels, receptacles shall be a maximum of 100' on center and a maximum of 25' from entrance and/or exit. Receptacles shall be GFCI type and mounted 48" above the finished floor to the top of the receptacle <u>with spring-loaded cover.</u>

.1.1.10 <u>Receptacles shall be mounted with the ground pin "UP".</u>

.1.1.11 <u>Tamperproof receptacles shall be applied in accordance with the currently adopted edition of the National Electrical Code.</u>

.1.1.12 <u>Workstations shall be provided with a double duplex receptacle installation.</u>

.1.2 Switches

.1.2.1 Switches provided for all uses shall be specification grade. Color scheme shall match receptacles.

.1.2.2 Switches provided at roof hatches or where provided outside of rooms they are serving shall be provided with pilot lights not lit handles.

.1.3 Coverplates

.1.3.1 Generally coverplates for flush-mounted standard devices shall be stainless steel for interior use in new buildings. Where work is being performed in existing buildings coverplates shall match the majority of the existing devices.

.1.3.2 Coverplates for exterior use shall be type, which allow NEMA 3R rating to remain while in use. Where exterior device could be exposed to vandalism, provide locking type coverplates.

.1.4 **WEXNER MEDICAL CENTER**: Wiring Devices

.1.4.1 Receptacles located in acute care, clinical or procedural buildings shall be hospital grade. Receptacles located in public areas (e.g., waiting rooms, lobbies, corridors, etc.) shall be tamper-resistant.

.1.4.2 Patient care areas shall be tested (and documentation provided) for conformance to NFPA 99 Electrical Systems Performance Criteria and Testing.

.1.4.3 Coverplates for flush-mounted standard devices shall be stainless steel only.

.1.4.4 Provide all device plates with labeling indicating panel and circuit number on the outside of the cover plate in accordance with Medical Center Special Requirements Appendix E – Electrical System Labeling and Identification.

26 05 19 MULTI-OUTLET STRIPS

.1 Multi-outlet strips for power or data and/or communications shall be two piece single channel steel capable of accepting full size heavy duty specification grade devices. It shall be provided with a standard ivory finish

.1.1 Minimum dimensions of single channel multi-outlet strip shall be 1.26” X 2.75”.

.2 Multi-outlet strip for both power and data and/or communications shall be two piece channel multiple channel to keep power separated from data/and/or communications wiring.

.2.1 Minimum dimensions of two channel multi-outlet strip shall be 1.75” X 4.75”.

.3 Multi-outlet strips may be provided at laboratory benches, work benches and work counters in offices.

.3.1 Multi-outlet strips shall not be run through walls, fire rated or otherwise.

Commentary: *Consider including duplex receptacles with USB ports where appropriate. However, No USB type at* ***Wexner Medical Center****.*

3.2 Provide the University with 10% spare parts including but not limited to coverplates, elbows, entrance and end fittings, tees, utility boxes, etc.

26 05 29. HANGERS AND SUPPORTS

.1 MATERIALS FOR STRAPS AND HANGERS: Heavy-duty malleable iron or steel. For installation in locations above grade that are subject to moisture penetration, specify corrosion-resisting steel. Perforated straps are not acceptable.

.2 INDEPENDENT SUPPORT SYSTEMS: Required for all installations, except that light weight lighting fixtures on, or recessed into, suspended ceilings may have adjustable bar strap supports carried on the ceiling suspension system.

.2.1 Surface outlet boxes, to which fixtures are attached, and pull boxes, shall be fastened to the structure independent of the conduit system supports.

.2.2 Conduits above suspended ceiling shall be attached to the structure and shall not be supported by a ceiling suspension system

.3 COORDINATION WITH GENERAL CONSTRUCTION: The A/E shall include the following (or similar) statements in specifications for suspended lay-in ceilings:

.3.1 Surface mounted ~~fluorescent~~ LED lighting fixtures shall be supported from the structure above independent of any ceiling system by use of 3/8 inch all thread rods.

.3.2 Flush or recessed fixtures in ceilings of the suspended lay-in type shall be installed so that the long dimension of the fixture is supported on the main support member of the ceiling system. Provide at least two galvanized steel safety hangar wires or safety chains, attached from the fixture housing to the structure independent of the ceiling system. Wire or chain shall withstand a 3-foot, 50-pound drop test.

26 05 33.10 INTERIOR CONDUIT AND FITTINGS: Minimum conduit size for power, lighting, and control circuits shall be 3/4-inch. ~~Minimum conduit sized for control wiring shall be 1/2 inch.~~

.1 RIGID GALVANIZED THREADED UL LABELED CONDUIT shall be specified for use in exterior walls, outdoors, for indoors exposed (surface) applications from floor level to 8-feet above floor, seal penetrations, and all the areas having potential to corrode or eat away by chemical-action (corrosive atmosphere) and hazardous locations.

.1.1 Threaded couplings shall be used with rigid conduit ~~and I.M.C~~.

~~1.2 I.M.C. may be used in place of rigid galvanized where permitted by The NEC~~

.2 UL LABELED, GALVANIZED STEEL EMT up to 4-inch trade size may be used in interior partitions, above ceilings, and for surface applications, except in mechanical and electrical rooms and shop spaces where it may be used 8'-0" from the finished floor. In corrosive and hazardous locations, use fiberglass conduit.

.2.1 Insulating bushings and/or insulated throat fittings shall be used throughout EMT installations.

.2.2 Compression fittings shall be used exposed below eight feet from finished floors. Setscrew type fittings may be used in all other applications, including WEXNER MEDICAL CENTER (indoors).

Exception: Setscrew fittings may be used below eight feet if bolts are not pointing outward.

.3 PLASTIC JACKETED RIGID STEEL CONDUIT shall be used in corrosive atmosphere.

.4 FLEXIBLE CONDUIT used for motor make up and lighting fixture connections. Minimum size: 1/2-inch for lighting fixture whips and ¾" for motor connections; maximum length: 6 feet 0 inches. Flexible conduit of any type shall not be used in interior partitions or in walls as a substitute for EMT, IMC or rigid steel conduit. A ground wire shall be pulled in all flexible conduit.

.4.1 Plastic jacket shall be used on flexible conduit exposed to outdoor or moist locations.

.4.2 Liquid-tight flexible metal conduit may be used in raised floor computer room applications.

.5 RIGID ALUMINUM CONDUIT shall be used outdoors, above grade, in damp locations and may be used in other locations in place of rigid steel conduit where corrosion is not a problem.

.6 Conduit installed through a building wall shall have internal and external seals. Specify Link-seal or equivalent.

.7 Elbows used for medium voltage cable shall be long radius rigid steel or if above grade, outside, rigid aluminum.

.8 GROUNDING: Conduit crossing building expansion joints shall have expansion provision with grounding continuity.

26 05 33.11 BUSWAYS:

.1 In general, use of Busway is discouraged. Any proposed use shall be reviewed with FOD during the schematic design phase.

.2 The A/E shall not use Feeder Busways in lieu of conduit and wire except for short distances inside substation rooms. Maximum length shall be 10 feet.

.3 PLUG-IN BUS shall be used in shops where the load density provides an economic advantage over panels and shall not extend into more than one space. Plug-in bus shall be copper. Busway shall be used to serve one room or usable space. It is prohibited for busway to penetrate a fire rated wall**.** Provide two spare bus plugs of each size installed.

.4 INDOOR BUSWAY (if used) shall be water resistant per ANSI/IEEE Standard 141-1986.

.4.1 If use of busway is approved by special permission for a project, Contractor shall provide 50 feet of spare busway and 10% of total switches used. It includes when busway is installed in shop areas or specially approved conditions.

.4.1.1 For use in straight, accessible runs only.

.4.1.2 Not acceptable for use in emergency power systems.

26 05 33.12 SURFACE RACEWAYS

.1 The A/E shall specify Surface Raceway / Metallic Raceway with associated coupling, boxes and fitting to be mounted to the surface of structure for the installation of Electrical Conductors. It shall be used in the following locations:

.1.1 In dry locations.

.1.2 Where permitted in Class I, Division 2 Hazardous (Classified) locations by the National Electrical Code (NEC). ~~In Class I, Division 2 Hazardous (Classified) locations and as permitted by National Electrical Code (NEC).~~

.2 FITTINGS AND BOXES

.2.1 Raceway shall have manufacturer's finish standard prime coating suitable for field painting.

.2.2 Surface Metallic Raceway. Metallic surface raceway shall be one piece construction, manufactured of .040" steel with smooth finish manufacturer's standard color. Minimum size to be ¾" X 21/32".

.2.3 Surface Metallic Raceway shall be used in dry locations, extensions through walls, and shall be permitted to pass through drywall partitions and dry walls only if the length going or passing through is not broken. It is required that access to the conductors shall be maintained on both sides of the walls, partition and floor.

.2.3.1 The surface metallic raceway shall not be used where concealed, except as permitted by NEC. The use shall be limited to Class 2 power limited applications and communication.

26 05 33.13 UTILITY TUNNEL CONDUIT AND FITTINGS

.1 INSTALLATION REQUIREMENT for corrosive and external heat generating environment.

The conduit must be suitable for the best protection from corrosion in the most demanding environments such as utility tunnels, under bridges, chemical, utility plants, underground pipeline, laboratories, electrical substations, and parking lots.

The conduits and the fittings must meet the requirements of UL 1684 that covers conduit type AG for use above ground and/or below ground, and type BG for use below ground applications. The University requires that the Manufacturer supply a letter from UL, not a "Certificate of Compliance," for the product to be approved for use in University facilities.

.1.1 The preferred conduit and fittings shall be fiberglass reinforced epoxy manufactured using the filament process. The optional conduit shall be PVC coated rigid conduit that provides maximum protection against corrosion where fiberglass conduit usage is extremely difficult.

.1.2 FIBERGLASS CONDUIT AND FITTINGS

The Fiberglass Conduit and Fittings Standards cover the application Installation, and use of associated Fittings. The primary intent is to incorporate changes in technology and incorporate products that were not Proven or existing when earlier versions of the Ohio State University Building Design Standards were published.

All Fiberglass Conduits shall be listed by Underwriters Laboratory, UL Std., and UL 1684.

1.2.1 The materials made or manufactured for use as conduits, raceways, boxes, cabinets equipment enclosures, and the finished product (Fiber conduits) shall conform to the latest edition of NFPA 130, NFPA 502,NFPA 70(NAC) and shall have capability to withstand high temperatures up to 500 degrees C or (– 60 + 932 degrees F) for minimum of one hour. The Fiberglass conduits requirements of the Standards shall include the followings:

A. High Temperature Combustion Resistance.

B. Low Smoke Zero Halogen.

C. High Mechanical Strength.

D. High Dimensional Stability.

E. High Chemical Resistance.

F. No impact from Stray currents.

1.2.2 The A/E shall make certain that the type of Fiberglass conduits specified are manufactured from epoxy resins that had flame resistance and low smoke characteristics, zero halogen and meeting the requirements of section 26 05 33 1.2-to-.1.2.1 of this Standard

1.2.3 The fiberglass conduit shall be available in diameters ¾" to 6" and shall be UL Listed for use above and underground.

Again, the resin system shall be epoxy based using a hydride curing agent. The permitted fiberglass shall possess continuous E-glass roving. All additives for increasing flame spread and lowering smoke density must be halogen free (i.e. must not contain chloride or bromine).

The permitted type shall use carbon black as ultra violet inhibitor to protect the conduit and fittings during storage and if or when it is exposed outside.

.1.3 FITTINGS AND ACCESSORIES

All fittings, elbows, and accessories shall be manufactured from the same process, using the same methods and chemicals as the pipe. The exceptions are plastic duct plugs and access fittings (often referred to as non-dalet fittings). Access fittings shall be made from fire retardant vinylester materials, halogen free, must be hot compression molded and shall have couplings attached to the body of the access fittings.

.1.3.1 The use of Fiberglass conduit shall be permitted for both below and above ground if requirements of Section .1.2.2 of this Standard is met:

A. Tunnels

B. In Class 1 Division 2 Installation(For Class 1 and Div2 Application "XW" fiberglass Conduit shall be used meeting the requirements of section 501.10(B) of National Electric Code, and UL 1684A Listed for above Ground use)

C. Under Bridge Applications

D. Plenum Areas

~~E. Fire Pump Rooms~~ Not used.

~~F. Elevator Shafts.~~ Not used.

G. High Temperature Applications.

.1.3.2 Cement for PVC conduit and fittings shall be as recommended by the PVC class 1 div 2 conduit manufacturer

.1.4 OPTIONAL PVC COATED RIGID METAL CONDUIT

.1.4.1 The PVC coated conduit must be UL listed. The permitted PVC coating must have been tested and approved by UL as providing the primary corrosion protection for the rigid metal conduit.

.1.4.2 Applicable UL Standards may include: UL 6 Standard for safety, Rigid Metal Conduit, UL 514B Standard for Safety; Fittings for conduit and outlet boxes.

.1.4.3 The PVC coated galvanized rigid conduit must be ETL Verified to the Intertek ETL SEMKO High Temperature H_2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

26 05 35. RACEWAYS:

.1 For conduit/raceways penetrating walls separating pressure or large temperature differentials, provide packing within conduit/raceway at nearest j-box within the room to prevent the transmission of air between the spaces.

26 05 45. UNDERGROUND RACEWAYS:

.1 GENERAL REQUIREMENTS: All underground cables of any classification shall be installed in raceway systems. Raceways for street lighting shall be 2" minimum. All other applications shall be sized in accordance with the projected electrical load growth in the vicinity but not less than 1.5". For conduit requirements in utility tunnels and under bridges Refer to Division 33.

26 10 00. SECONDARY/LOW VOLTAGE ELECTRICAL DISTRIBUTION

.1 MAGNETIC INTERFERENCE AND MITIGATION

Magnetic Interference can pose major problems in the Design and Operation of Electrical and Electronic Equipment, Instruments, Control Systems, Data processing equipment and communication networks. This equipment frequently indicates aberrations whose sources may not be readily recognized, but which are due to magnetic interference. In general, such interference is classified as internal and external.

A. Internal Interference, created by Operation of Components within the system itself, can usually be eliminated or nullified by shielding the individual components and confirming the magnetic force they create.

B. External Interference is frequently caused by nearby or adjacent equipment such as transformers, medium voltage busway, or switching equipment, which generate magnetic "spikes" affecting apparatus that is not physically attached to the source of interference.

~~.1.1 Special Protective and Preventive materials: In addition to developing a basic protection design in preventing the penetration of magnetic interference, when it is required by this Standard to Design and specify EMF Mitigation Plans or Strategies that will prevent and solve the Magnetic Interference problems as described in Section 26 10 00.1. The expectation of this Standard is to reduce EMF to below one (1) milligauss, even in the most complex Field Environment.~~

~~.1.2 SPECIAL EMF SHIELDING MATERIAL: There are two means of EMF Shielding that may be used to achieve effective prevention of Magnetic Interference or Eliminate the existing problems (See Section 26 10 00.1.1 and 26 10 00.1.3). In fields of low intensity, use CO-NETIC AA perfection sheet because of its high initial permeability and corresponding high attenuation characteristics. In fields with high intensity, use NETIC S3-6 sheet because of its high magnetic saturation characteristics. CO-NETIC AA Perfection Annealed Sheet are available in standard gauge .014" through .062" thick, in flat sheet sizes up to 30"x59" or Full Sheet of .015" thick and 36" by 120".~~

~~Installation: For wall or floor coverings designer shall specify that sheets shall be butted at seams, all seams flush and tight. Fasteners: NETIC/CO-NETIC AA Sheets shall be mounted to walls by nonmagnetic fasteners to penetrate the shielding sheets. Hole in the NETIC/CONETIC AA alloy sheets for fasteners shall be drilled with standard metal drills (Cobalt Steel Drill Bits). Special fastening application (masonry, concrete, etc.) shall be consistent with EMF shield manufacturer's recommended attachment procedures and OSU Building Design Standards requirements. Seams: All seams between sheets to be covered by CO-NETIC AA foil, 0.01 inches thick, by 4 inches wide, with factory supplied PST backing. Apply foil centered over the sheet seams and press down tightly. Finishing: The CO-NETIC AA metal has a natural shiny, silver colored finish and will not rust. Gypsum Wallboard (drywall) or approved other materials shall be applied over the CO-NETIC AA sheets after seams are covered. No magnetic fasteners are to penetrate the CO-NETIC AA sheets.~~

~~.1.3 OPTIONAL SHIELD MATERIAL: The use of ferrous metal sheet for EMF shielding has been one method the University utilized for correcting EMF problems. But it has unavoidable installation difficulties for inexperienced installers. The sheet metal sheet is too heavy, requires accurate overlapping to achieve minimum EMF reduction, but it is very effective, if correctly installed. Installation: All Medium voltage transformers and switch gear including motor control centers that are adjacent to or under offices, computer centers/rooms or locations that will have the use of Sensitive Electronic Equipment (SEE) shall be shielded with ferro-magnetic material. Use of minimum 10 gauge ferrous steel sheet metal on the side(s) of walls~~

~~where said offices or rooms are situated, to prevent moving charges that produce Electric Magnetic Field (EMF) penetration that in turn destroys or distorts sensitive electronic equipment. In order to have an effective shielding, the 10 gauge sheet metal shielding shall be overlapped at a minimum of 4 inches at every joint.~~

.1.1 Not used

.1.2 Not used

.1.3 The A/E shall engage the services of an experienced shielding consultant to prepare a report detailing the project shielding requirements and specifications.

.1.4 A/E's ~~electrical~~ shielding consultant(s) shall contact the University Engineer for details, if there should be any questions.

.2 TRANSFORMERS - UNDER 600 VOLTS

.2.1 General-purpose distributing transformers shall be single-phase and three-phase dry-type which are generally used with primaries connected to secondary distribution circuits. They shall be designed for the voltages of 120, 208, 240, 480, and 600 with ratings ranging from 500VA to 500KVA and frequency of 60Hz.

.2.2 the transformers shall be designed for continuous operation at the rated KVA for 24 hours a day, 365 days a year operation with a nominal life expectancy and greater overload capabilities in accordance with the latest ANSI-C57 and shall comply with DOE 2016 requirements. The temperature rise of these transformers shall be 115 degrees C temperature rise over a 40 degree ambient and shall be insulated with a UL recognized 220 degree C insulation system. Transformers shall have a minimum K factor rating of 4 as recommended by ANSI/IEEE C57.110 - 2018, where required (i.e. computer center, lab, etc.).

~~The transformers shall be designed for continuous operation at the rated KVA for 24 hours a day, 365 days a year operation with a nominal life expectancy and greater overload capabilities in accordance with the latest ANSI-C57. The temperature rise of these transformers shall be 80 degrees C temperature rise and shall be insulated with a UL recognized 220 degree C insulation system. Transformers shall have k factor rating as recommended by ANSI/IEEE C57.110- 1986, where required (i.e. computer center, lab, etc.). It shall have a 30 percent overload capability~~

Commentary: *Continuous overload capacity is not designed into transformers because the objective is to be within the allowable winding temperature rise with nameplate loading*.

.2.3 The transformers shall be designed for a low coil watt loss.

.2.4 Coil and Core Assemblies

.2.4.1 Transformer cores shall be constructed with high grade, non-aging, grain-oriented silicon steel with high magnetic permeability, low hysteresis and eddy current losses.

.2.4.2 Transformer coils shall be wound of electrical grade copper and continuous wound construction. The neutral conductor shall be rated to carry 200% normal phase current, when required.

.2.4.3 Enclosure shall be ventilated, heavy gauge sheet steel primed and finished in gray baked enamel. The core and coil assembly of the transformers shall be impregnated with non-hygroscopic, thermosetting varnish and cure to minimize hot spots and seal out moisture. The core of the transformer shall be grounded to the enclosure.

.2.4.4 The sound levels of the transformer shall be designed in accordance with ANSI/NEMA recommended levels.

.2.4.5 Provide minimum clear working space of ~~3-1/~~2' 3 feet (36") in front of transformers operating at 600 volts, nominal, or less to permit ready and safe operation adjustment, repair and maintenance; minimum 6 inches on sides and rear.

.2.5 Transformers greater than 25 KVA shall not be mounted on or near the wall adjacent to an office, computer room or laboratory unless the wall is magnetically shielded.

26 20 00. LOW-VOLTAGE ELECTRICAL TRANSMISSION

.1 EMERGENCY SERVICE: Refer to Section 26 30 10.

26 20 03. LOW-VOLTAGE SWITCHGEAR – SERVICE ENTRANCE

.1 PROTECTIVE DEVICES: Main breakers and feeder breakers or switches shall be equipped with ground fault protection as required by applicable codes. In critical applications provide coordinated ground fault protection on feeder breakers. Provide settings and coordination information with the service manuals.

.1.1 Where applicable the following warning sign shall be provided:

WARNING: SHUTTING OFF MAIN SWITCH DOES NOT SHUT-OFF POWER IN ENTIRE BUILDING.

Provide the following additional information as applicable:

A ADDITIONAL MAIN SWITCH IS LOCATED IN ROOM O30M IN THIS BUILDING

B. AUTOMATIC TRANSFER SWITCH LOCATED IN ROOM 530M IN THIS BUILDING AND EMERGENCY GENERATOR IS LOCATED IN ROOM O36M OF MATH TOWER.

Include building and room number if emergency source is not in the same building as the main switch.

.1.2 All circuit breakers with solid state trip units shall comply with the following standards:

.1.2.1 ANSI/IEEE C37.90.1 – Surge Withstand Capability (SWC)

.1.2.2 ANSI/IEEE C37.90.2 – Withstand Capability of relay systems to Radiated Electromagnetic Interference from transceivers.

.2 Operating handle/mechanism shall be rated for 10,000 mechanical endurance operations. ~~The maximum operating force required to open or close a switch or breaker shall not be greater than 75 pounds on the operating handle.~~

.3 ~~Vacuum breakers or vacuum switches may be used with the approval of the University Engineer's Office.~~ All switches shall be top or horizontal fed to the breakers.

.4 Indicator lamps shall be LED ~~or transformer~~ type utilizing low voltage lamps.

.5 Provide substation interface pull box(es) in substation room to allow for connection to low voltage monitoring systems for breaker information, metering information and any other low voltage contacts (e.g., maintenance switch position indication) as defined below.

.6 The breaker manufacturer defined communications (BACnet communication protocol if available) bus shall be extended from main and feeder breaker trip units to an externally mounted hinged pull box containing a manufacturer provided gateway (if needed, e.g., Modbus to BACnet) for conversion to BACnet protocol. System communication shall be configured for monitoring purposes only. Coordinate and provide connection to BAS system via Ethernet or MSTP to nearest building controller.

.7 Main breakers shall be equipped with manual override of instantaneous trip unit settings in order to provide acceptable arc flash levels for maintenance work. Manual override position indication shall be monitored by building automation system.

.8 Substation feeder breakers shall not be less than 10% of the rating of the main and tie circuit breaker ratings.

26 20 04. METERING: Refer to Division 33

26 20 05. SERVICE DISCONNECTS:

.1 Secondary main disconnects shall be equipped with electronic trip devices.

.1.1 The analysis diagram fault currents shall be shown on a symmetrical basis; and for calculation purposes, the transformer primary available fault supply shall be considered as unlimited.

.2 Use of FUSES in new construction is discouraged. FUSES may continue to be used in existing primary-voltage services, secondary-voltage main switchgear, distribution panelboards, and motor controls. ~~FUSES may be used in primary-voltage services, secondary-voltage main switchgear, distribution panelboards, and motor controls.~~

.2.1 UL classification fuses shall be used as required for time delay and current limitation requirements of the application.

.2.2 Class J fuse is prohibited with the exception of elevator power modules. Use class RK1, 200,000 AIC rated fuses for up to 600 amp applications and RK1 for maximum short circuit protection.

.2.3 Fuses for secondary service mains and feeders over 600-ampere shall be UL Class L.

.2.4 Spare Fuses: Specify that a spare fuse complement be stored on existing metal shelves, metal mounting boards, or in a cabinet in the electrical switchgear room and that a typewritten and framed bill of material is mounted nearby. If there is no existing storage or additional storage space is required, specify that Contractor provide a cabinet equal to Bussmann SFC and provide hardware to accept BEST 7 pin interchangeable lock cores.

.2.4.1 Spare fuse complement shall include a minimum of three or 10% of the total each (whichever number is greater) spare fuses of each class, ampere, and voltage rating installed, including primary fuses and control circuit fuses in switchgear and any equipment.

.2.4.2 Provide two fuse pullers for every size fuse and voltage rating.

26 20 06. GROUNDING SYSTEM:

.1 DRAWINGS AND SPECIFICATIONS: Drawings shall show ground systems, protective conduit sizes, and relative locations. Specifications and drawings shall include detailed requirements of the grounding system. A reference only to the National Electrical Code, without elaboration, has proven to be insufficient. Specifying requirements only by referencing the National Electrical Code is prohibited. It is required that the A/E shall specify all requirements applicable, instead of referring only to National Electrical Code. All sensitive electronic equipment (computer rooms, etc.) shall have single point grounding system.

All connections to the grounding system shall be clamped, exothermic welded, cad weld or equivalent. It is required that the grounding system be tested and have a resistance reading of less than 3 ohms at the ground level. Only copper to copper may be clamped. The A/E shall calculate the system required to obtain 3 ohms. The contractor shall only be required to install the indicated system.

.2 SERVICE GROUND: Grounding rods shall be a minimum size of ¾" x 10' copper clad steel and shall not be placed in back-fill. It shall meet current NEC requirements and other applicable codes.

.2.1 Interconnection of the service ground, system neutral, and equipment ground conductors shall be made within the service equipment.

.2.2 Grounding path through feeder conduits must be kept at less than five ohms resistance. The entire feeder conduit shall include a grounding conductor. The equipment enclosure (transformer case, etc.) shall not be used as a grounding path.

.2.3 Grounding conductors shall be 600-volt insulated installed in rigid PVC or rigid galvanized conduit. No metal parts such, as locknuts shall surround the ground conductor. If metal is used, protective conduits for ground conductors shall be bonded at both ends to reduce impedance in the ground path under fault current flow. All conduit connections shall be threaded ~~and then welded~~.

.2.4 A/E shall require electrical contractor to provide resistance testing. Testing shall be witnessed by the A/E and the university project manager. Test results shall be recorded on contractor's letterhead and submitted as part of the Operation and Maintenance Manuals.

~~.2.4 LIGHTNING PROTECTION: It is well documented that insulation levels of overhead lines is considerably higher than insulation levels of terminal apparatus including transformers, switchgears, pothead, etc. which make up or comprise the service entrance to buildings. Such overhead lines (University overhead lines at Airport, West & Midwest, and Regional Campuses) are vulnerable to over voltage, mostly from direct or indirect lightning voltages and switching surges. It is a fundamental characteristic of the traveling voltage waves to increase in voltage when they arrive at equipment having a surge impedance higher than that of incoming line and the magnitude of such incoming waves will approximately double at breaker. Therefore, this standard requires that all equipment connected by cable to overhead circuits shall have lightning/surge arrester protection at each end of the cable to guard against the possibility of transient over voltages. It is of great importance that protection against direct strokes is provided at outdoor substation installations in the form of grounded masts or overhead ground wires stretched above the installation to intercept lightning strokes, which might otherwise terminate on the lines or apparatus. It is also required that entrance equipment such as transformers, circuit breakers, etc be protected against direct stroke from traveling waves by installing lightning arresters that possess protective characteristics below the impulse insulation strength of the terminal apparatus.~~

~~2.4.1 This standard requires that lightning/surge arresters be installed as close as possible to the HV/MV terminals of the Power Transformer and all other equipment requiring surge protection be grouped as close as possible to the arresters. Use the station type arrester for the best protective level and highest surge discharge ability for important and critical installations. But the intermediate class type arrester shall be used for less critical installations and mostly for feeder protection.~~

~~.2.4.3 This standard requires the following additional protective measures: A. Grounding network resistance shall not exceed 5 Ohms (5Ω). Lower values are preferred.~~

~~B. Ground Conductors: The surge arrester grounding conductor shall be connected into the common ground bus. The grounding conductor shall be run as directly as possible between the arresters and ground and be of low impedance and ample current carrying capacity. (See Section 26 20 06.2.4). These requirements must comply with National Electrical Code. (ANSI/NEMA 81-1990 (19, Article 190-193)).~~

~~C. Indoor locations: Arresters that are installed inside the buildings shall be enclosed or shall be located well away from passageways and combustible parts.~~

~~D. Installation: This standard requires that arresters must be located and installed in such a manner that the expulsion of gales or the arrester disconnect is not directed upon energized parts.~~

~~E. All protective lightning rods used for building or facility protection must have a Master Label pasted on them.~~

.2.5 **WEXNER MEDICAL CENTER**: REFERENCE GROUND POINT: Operating Rooms, procedural rooms, invasive procedure areas that equipotential grounding between multiple sources or grounded equipment and surfaces shall have a reference ground point located within the respective room. The reference ground shall consist of a copper bus mounted inside a dedicated, acceptable enclosure. Utilizing a local power panel ground bus for this purpose is not acceptable.

.2.6 **WEXNER MEDICAL CENTER**: BUILDING GROUND REFERENCE SYSTEM: Shall consist of an exposed copper bus located in mechanical rooms containing transformers on each floor (one per floor minimum). Grounding system riser drawing detail is required on the construction documents.

.3 TRANSFORMER GROUNDS:

.3.1 Building Service Transformers: Secondary neutrals shall be grounded separately from the neutral ground at the service main, unless close coupled in unit substation construction.

.3.2 Low Voltage Transformers: Secondary neutrals shall be grounded in the low-voltage service equipment, as required by NEC for services and all available grounding electrodes. (Building steel, etc.)

.4 EQUIPMENT GROUNDS: A wire equipment ground shall be installed within the branch circuit conduit and be grounded to the cabinet of the panelboard to a non-insulated ground bus. The neutral bar of the panel shall not be used for equipment grounds.

.4.1 Equipment grounds and the identified neutral shall not be electrically interconnected on the building side of the service ground.

.5 CONVENIENCE OUTLETS: Specify that a wired ground be provided for continuity of ground path from the device-grounding pole. Provide ground fault interrupter outlets in wet conditions and where required by NEC and other related codes.

.6 EXTERIOR LIGHTING POLE: For steel-framed structure, explore a concrete-encased reinforcing bar electrode. A steel rod similar to the reinforcing bar shall be used to join, by welding, a main vertical reinforcing bar to an anchor bolt. The bolt shall be permanently connected to the base plate of the steel column supported on that footing. The Electrical System may then be connected for grounding to the building frame by welding or by a bronze bolt tapped into a structural member of that frame. For Electrical Systems grounding, specify that a supplemental ground rod ~~or~~ and ground copper wire ~~is~~ are provided for equipment grounding at each light fixture. All underground PVC conduits to the light poles shall contain a dedicated ground copper wire in combination with equipment grounding. It shall be designed to provide a safe method of protecting electric distribution systems by causing the overcurrent or ground fault protective equipment at the source panelboard to disconnect the circuit in case of ground fault.

26 27 00. LOW-VOLTAGE DISTRIBUTION EQUIPMENT

26 27 03. DISTRIBUTION:

.1 DESIGN: If feasible, the secondary main breaker shall be made a part of the building distribution switchgear or switchboard. In no case shall the switchgear or switchboard or panelboard be directly attached to the transformer. A minimum 12-inch space with solid barrier is required to reduce the transfer of transformer heat to the low voltage section. Reduction of heat transfer may be accomplished with secondary throat or ventilated transition section.

.1.1 All Switchgear with “Main-Tie-Main” arrangement ~~dual fed switchgear with a tiebreaker~~ shall have trapped key interlocks per ANSI/ASSE Z244.1-2003 to prevent paralleling two electrical sources. The testing, phasing, and startup of dual fed switchgear shall be under the supervision of OSEP Utilities High Voltage Services.

.2 EQUIPMENT: Metal-Enclosed switchgear (UL 1558 construction above 1600A) or distribution switchboards (UL891 construction 1600A and less) shall be used in buildings or University Facilities at 600V and below for Service Entrance Power, lighting distribution and as the secondary sections of Unit Substations. The following components shall be specified as required:

A. Surge Protective Device SPD. ~~Service Protectors~~

B. Molded Case circuit breakers, group mounted, less than 800A, individual mounted 800A and above. ~~Model Case circuit breakers, group, or individual mounted~~

C. Fusible switches (existing buildings only)

D. Motor Starters

E. Low Voltage AC Power circuit breaker (generally limited to main or tie position)

F. ~~Bolted contact pressure switches~~. Not used.

G. Transfer devices or switches

H. Instrumentation and metering ~~and relaying~~

I. UL Service Entrance Label.

.2.1 Type of Molded Case Circuit Breakers: These devices are available in the following general types: Thermal-Magnetic,~~Dash Pot~~, ~~Magnetic only, Integrally Fused, Current Limiting,~~ Adjustable, instantaneous trip, and Electronic Trip (250 A and above) ~~High Interrupting Capacity~~. It is required that all circuit breakers that are equipped with electronic trip unit must comply with Section 26 20 03.1 of this Standard.

.2.1.1 Air circuit breakers shall be draw out type, installed in individual compartments.

~~A. Interrupting ratings of air circuit breakers and molded case breakers shall not be applied in "cascade".~~

.2.1.1.1 Air circuit breakers and molded case breakers shall be fully rated to interrupt the available short circuit current.

.2.2 Operating handle/mechanism shall be rated for 10,000 mechanical endurance operations. ~~The handle operating force on all equipment shall be 75 pounds or less.~~

.3 PROVISIONS FOR ADDITIONAL CIRCUITS:

.3.1 Size of Switchgear or switchboard: Select a size that will provide sufficient spare spaces, complete with bus and hardware, for a reasonable forecast of future installation of circuits. Provide the following spare devices at the design stage:

For Fusible Switchboards	For Circuit Breaker Switchboards
(Existing buildings only)	
Four 30 amp/ 3 poles	Ten 100 amp/3pole*
Four 60 amp /3 poles	One 225 amp 3/pole*
Two 100 amp / 3 poles	
One 200 amp /3 poles	
	*with adjustable trips

.3.2 Additional Section: Provide space and the bus arrangement for the addition of future switchgear or switchboard sections.

.4 INSTRUMENTATION shall be per section 26 20 04. Metering.

.5 SERVICE TO FIRE PUMPS: Fire pumps shall be served and protected as required in NFPA 20 and NFPA 70.

.6 Use circuit breaker type switchboard instead of panelboard for emergency systems for the purpose of future growth and expansion. The switchboard shall be equipped with metering systems as required in Division 33 of this Standard.

.7 When adding switches, circuit breakers, bus plugs or motor starters to existing equipment, the A/E shall include the following on the design documents:

.7.1 The manufacturers' nameplate data including manufacturer, catalog information and order number of the existing equipment.

.7.2 If the equipment is no longer being manufactured (i.e., Continental, Arrow Hart, Crouse Hinds, etc.) the A/E will contact a company that specializes in obsolete equipment and obtain information about availability of equipment and mounting for the bidding of the project.

.7.3 The A/E will provide appropriate staff and equipment during the design phase to open equipment to verify equipment has bussing, capacity and actual space to allow addition of switches, circuit breakers and/or starters.

26 27 04. FEEDER CIRCUITS:

.1 SYSTEM DESIGN: Design feeders for a voltage drop of not more than 2 percent between terminals and capacity for 30 percent load growth above initial design, unless greater growth is designated by the University in the initial planning conference.

.2 FEEDERS: Feeder ratings shall not be such a large percentage of the main that coordination of time and current and interrupting capacities cannot be achieved.

.3 WIRING: All feeders be installed in full-weight rigid conduit, EMT may be used indoors for sizes 4" or less where the risk of physical damage is not a concern. ~~Specify that all feeders be installed in full-weight rigid conduit.~~

26 27 05. GENERAL PURPOSE POWER AND LIGHTING CIRCUITS: Voltage drop in branch circuits must be considered in design. Increase conductors a minimum of one size when 120 volt branch circuit home runs exceed 75-feet.

.1 LIGHTING CIRCUITS shall not be loaded to exceed 70 percent of panel breaker rating.

.2 SERVICE CIRCUITS: Not more than six unassigned general use duplex convenience outlets shall be on any one 20-ampere branch circuit, which includes prewired furniture, and lecture hall tables.

.2.1 Corridor receptacles shall not be connected to any adjacent room receptacles.

.3 BRANCH CIRCUIT PANELS: Panels for lighting, convenience outlets, small motors, and equipment shall be molded case circuit breaker type with thermal-magnetic trip and a-c and d-c ratings. ~~Minimum number of poles in any panel enclosure shall be 42.~~ Maximum number of poles shall not exceed 84. Provide spare circuits and spaces as noted in paragraph .3.3.1 below. Use of series rated equipment is prohibited.

.3.1 Breakers shall be 20-ampere, 1-pole breakers, mounted in the panel with bolted bus connections.

.3.1.1 Trip rating of breakers for lighting and general use convenience outlets shall be 20-ampere. Provide other sizes as required for special loads.

.3.2 Sub-Feed Breakers: Panels shall not have sub-feed breakers. If two panels are supplied from a long feeder, use sub-feed lugs or separate splice box with full size tap to panel mains.

Commentary: *No panel feeder shall feed more than an 84 pole panel.*

.3.3 When installing new branch circuit lighting panels on a project the following shall be considered:

.3.3.1 All new panel enclosures shall be minimum 30 poles for Lighting panels and 42 poles for Branch Circuit panels. Designers shall provide each new panel with a minimum of 15% spare 20 amp single pole circuit breakers and 15% spaces. Designers shall consider an additional panel when these minimums cannot be met. For all three phase-4 wire panels greater than 100 A the maximum load unbalance between phases shall not exceed 10%.

~~All new panel enclosures shall be 42 pole minimum. Designers shall provide each new panel with a minimum of 15% spare 20 amp single pole circuit breakers and 15% spaces. Designers shall consider an additional panel when these minimums cannot be met. Phases shall be balanced as close as possible.~~

.3.3.1.1 Life Safety panels may be 12, 18, 24 or 30 pole where amount of load on panel is minimal.

.3.3.2 New panels shall be 200 Amp minimum for 208Y/120 volt, 3 phase, 4 wire service and 100 Amp minimum for 480/277 volt, 3 phase, 4 wire service. Do not provide 240/120 volt, 3 phase, and 4 wire tapped delta systems. Where 240 volts, 1 phase is needed, use buck/boost transformers as required.

. 3.3.2.1 Life Safety panels will be permitted to be a 100 amps or less depending on project requirements

.3.3.3 Any new or existing building with three-phase service shall only have three phase panels provided. All exceptions must be approved by the University Engineer.

.3.3.4 Do not provide panel feeders, fusing, or main circuit breakers at less than the panel main bussing rating.

.3.3.5 Branch circuits shall not be provided with shared neutrals regardless of what is existing in the facility.

.3.3.6 Where multiple branch circuits pass through a single box, all circuit breaker handles shall be provided with common tie, so all circuits will be taken out of service for servicing of the circuits.

.4 POWER PANELS shall be equipped with molded-case circuit breakers of adequate interrupting capacity ~~or shall be switch and fuse construction using time-delay fuses~~.

.5 ALL PANELS shall have silver plated copper bussing with full capacity neutral and ground busses.

~~Provide a dedicated 15 or 20 amp, 120 volt, single phase circuit for each hand dryer shown on the drawings.~~

~~.5.1 Provide GFCI circuit breakers where required.~~

.6 ALL PANELS shall have "Door-in-Door" front cover.

.7 Provide a dedicated 15 or 20 amp, 120 volt, single-phase circuit for each hand dryer shown on the drawings.

.8 Provide GFCI circuit breakers where required by N.E.C.

26 27 05. GENERAL PURPOSE POWER AND LIGHTING CIRCUITS:

.1 **Wexner Medical Center:** For any panelboard (existing that has been modified or new), contractors shall provide both hardcopy and electronic copy of OSUWMC panelboard legend standard (in Microsoft Excel format). Template can be provided by OSUWMC Facilities Services Department.

.1.1 Refer to Wexner Medical Center Special Requirements Appendix E for panel schedule requirements.

26 29 00. LOW VOLTAGE CONTROLLERS

26 29 03. MOTORS AND MOTOR CONTROLS:

.1 RELATED WORK: Air-conditioning chiller starters and fire pump controllers shall be specified with the equipment in Divisions 23 and 21. Wiring from switchgear or switchboard to this equipment shall be specified in Division 26.

.2 NEMA AND NEC REQUIREMENTS:

.2.1 MOTORS AND MOTOR CONTROL EQUIPMENT shall conform to NEMA voltage ratings.

.2.2 MOTOR BRANCH CIRCUIT PROTECTIVE DEVICES shall meet the requirements of NEC 430.

.3 MOTOR CONTROL CENTERS: Class 1, Type C with terminal strip terminations.

.3.1 LOCATIONS: MCC's shall not be located where ambient temperature could cause de-rating of overload devices.

.3.2 OVERLOAD HEATER CHARTS shall be furnished mounted inside doors of cabinets or separately framed and mounted outside the equipment.

.4 REDUCED VOLTAGE STARTERS: Motors, sizes shall be such that the inrush current exceeds 40 percent of the building transformer rating. Motors shall be equipped with reduced voltage starters of the closed transition autotransformer or star-delta type, or solid-state soft start, or current ramp starters. For existing applications only, new construction shall use VFD.

.5 OPERATING PROTECTION:

~~.5.1 CERTIFICATION by the motor manufacturer that motors meet the voltage requirements of NEMA.~~

.5.2 OVERLOAD RELAYS: Poly-phase motor controls shall be equipped with three bi-metallic overload relays. Reduced voltage starters shall provide overload protection during the starting step.

26 29 05. MOTOR STARTER APPLICATIONS:

.1 STARTERS RATED 7200V OR LESS shall conform to NEMA ICS3-2000, Part 1 and UL 347. This is a requirement for metal enclosed medium voltage motor controllers with fused power assemblies in a draw-out construction. Each motor controller shall be a complete self-contained Class E-2 Combination Starter, including disconnect means, main contactor, solid-state controller, and motor overload protection. Class E2 controllers employ their contacts for starting/stopping the motor and use fuses for short circuits or faults exceeding operating overloads. The contactor shall use vacuum as the interrupting means. The disconnect shall be a draw-out fuse carriage with Class R current limiting primary fuses for motor starting duty. Fuse and overload coordination shall be designed to allow the controller and contactor to clear low and medium level faults without opening and without exceeding the contactor interrupting ratings. Fuse assembly shall have a minimum short circuit rating of 50 kA symmetrical.

.1.1 STARTERS RATED 600V AND LESS shall conform to ANSI/NEMA ICS2-2000 (R2005). This is a requirement for magnetic controller ratings of 115-575V. AC Motor starters and contactors may be used for controlling the circuit to the motor. This standard requires that starters should be carefully applied on circuits and in combination with short-circuit protective devices such as circuit breakers that will limit the available fault current and let through energy level that the starter can safely withstand. This withstand

must meet the requirements of ANSI/UL 508/2018, and ANSI/NEMA ICS 1-2000 (R2008) which cover controls, systems, and devices. Starters shall be minimum NEMA size 1. Use of IEC type components is prohibited.

.1.2 A padlockable non-fused disconnect switch shall be installed and located as close as possible to each motor. The use of a remote switch with lockout, at switchgear, switchboard, panel board or a unit in a Motor Control Center as the sole means of disconnecting the circuit is not permitted.

~~The starters shall not be used without an adjacent line switch. A non-fused disconnect switch shall be installed; and shall be located as close to each motor as much as possible. This standard forbids the installation of a remote switch with lock arrangement, at switchgear, switchboard. Panel board or a unit in a Motor Control Center.~~

.1.3 All rooftop mounted equipment shall be provided with a local disconnect switch with NEMA type 3R enclosure.

26 30 00. FACILITY ELECTRICAL POWER GENERATING AND STORAGE EQUIPMENT

26 30 10. EMERGENCY POWER SYSTEMS:

.1 ALTERNATE POWER SOURCES: The University Master Plan provided for connecting groups of buildings with ~~parallel~~ redundant power circuits for obtaining electric power supply to a building from alternate sources. Where the interruption of electric power supply to a building would result in hazard to life or property, major loss of research or equipment, provision shall be made for an emergency supply of power, to be used in the event of failure of the normal supply. Details of the plans as they apply to the project shall be explained and included in the early Design/Development submittal and conferences. If tie-in on existing circuit or feeder is not practical at present, provision shall be made for future tie-in. Emergency Power Systems are of two basic types:

A. An Electric Power Source set apart from the primary source of power operating in parallel that maintains power to the emergency loads should the primary source fail.

B. An available reliable power source to which emergency loads are rapidly switched automatically when the primary source of power fails.

.1.1 Not used ~~References~~

~~A. NFPA 110 Emergency and Standby Power Systems~~

.1.2 Automatic Transfer Equipment: Reliable equipment and transfer switch must be specified.

.1.3 When emergency generators are specified, the A/E shall include requirements for acceptance load tests conducted under the supervision of a manufacturer's technical representative ~~by a factory representative.~~

.1.4 Provide identification labels showing normal, emergency, and connected load sources along with building name and room numbers for any automatic transfer switches.

Commentary: *Identification labels shall provide the following information*:

A. Normal Service – source, building (if different then building in which automatic transfer switch is located) and room number Label shall be black with white lettering.

B. Emergency service – source, building (if different then building in which automatic transfer switch is located) and room number. Label shall be red with white lettering.

C. Emergency load - source, building (if different then building in which automatic transfer switch is located) and room number Label shall be red with white lettering.

D. **Wexner MEDICAL CENTER:** See Special Requirements Appendix E – Electrical System Labeling and Identification.

.2 Emergency and Standby Systems: It is required that provision be made by designing an emergency power system / standby power source supplied by:

A. Engine Generator

B. Separate Emergency Source

~~**Commentary:**~~

~~*Emergency power systems are defined as systems that are intended to automatically supply illumination, power or both, to designated areas and equipment in the event of failure of the normal supply or in the event of an accident to elements of a system intended to supply, distribute and control illumination and power essential for the safety of human life.*~~

~~*Standby Power system is defined as providing power to loads that upon loss of power during any interruption of the normal electrical supply could create hazards or hamper rescue or fire - fighting operations.*~~

.2.1 Emergency electrical systems shall provide power to but not limited to the following essential electrical functions:

1. Life safety Illumination
2. Fire detection and alarm systems
3. ~~Elevators~~
4. ~~Fire Pumps~~
5. Public Safety communications systems
6. ~~Essential Ventilating and smoke removal systems~~
7. Processes where current interruption would produce serious life safety or health hazards
8. ~~Maintaining Business Continuity~~

.2.2 Standby electrical systems shall provide power to but not limited to the following functions:

1. Elevators
2. Fire pumps
3. Essential Ventilating and smoke removal systems
4. Maintaining Business Continuity
5. Heating and Refrigeration systems
6. Communications systems
7. Sewage Disposal
8. Lighting (Other than exit/egress lighting)
9. Industrial processes.
10. Generators provided for dedicated lab equipment

.2.3. Circuit breakers provided with generators shall have provisions for padlocking in the open or closed position. ~~be provided with lock out tag out capabilities.~~

.2.3.1 Circuit breakers provided with generators shall be supplied with a set of NO/NC auxiliary contacts to indicate breaker position. These contacts shall be wired to the remote annunciator to indicate "alarm" if the breaker is left in the OPEN position.

.2.4 Emergency generator drives shall be evaluated on a project-by-project basis.

.2.5 The required generator remote annunciator monitoring panel by shall be located next to the fire alarm remote annunciator panel or as required by Code.

.2.6 Emergency generator fuel type shall be reviewed and evaluated with FOD Operations and approved by the University Engineer.

~~*Commentary: Diesel is considered to be the primary fuel type for emergency generators. Natural Gas may be considered, but the impact of limited fuel source and business continuity shall be evaluated.*~~

.2.6.1 New generator installations shall utilize diesel as a fuel source. Natural Gas (NG) is not permitted to power generators supplying Life Safety or Emergency loads, use of NG shall be evaluated on a project-by-project basis by FOD.

.2.6.2 Location of the generator shall be reviewed with the University Engineer, University Architect and University Landscape Architect to determine the best location. The University's preference is for the generator(s) to be placed at grade level.

Commentary: *Points to consider include but are not be limited to the following:*

A. Flood Plain

B. Esthetics

C. Grade Level

D. Maintainability

E. *Access for refueling*

.2.6.3 If the generator cannot be located at grade level the following provisions shall be provided:

A. A path from the generator shall be provided with conduit(s) and conductors to allow for connection to a future temporary generator. Provide a quick connect generator switchboard with quick connect cables of sufficient conductor length so that no additional conductors shall need to be provided.

B. Provide three 120-volt 20 amp circuits from an emergency source adjacent to the quick connect generator switchboard should a temporary generator need to be provided.

1. One circuit shall be for a temporary battery charger

2. One circuit shall be for a temporary block heater

~~3. One circuit shall be for engine status.~~

C. Provisions shall be installed for connection to building automation system in the event a temporary unit is required to monitoring generator running signal.

D. An internal load bank shall be provided for all buildings where generators are not located at grade level. Provide load bank connection if at grade level.

E. A path and any required equipment (i.e. pumps, above ground tank, appropriate piping, etc.) for the filling of fuel for sub base or day tanks shall be provided when the diesel generator is not located at grade level.

F. Provide an automatic shutoff for the fuel line if fire is sensed at the tank.

.2.7 A/E shall only specify above ground, sub base or day tanks for fuel storage. Underground tanks are prohibited. A spill control kit shall be provided near any tank, See 2.5.5 for details.

.2.7.1 Storage tank fill pipe shall have a cap that shall accept a padlock. (Padlock shall be furnished by the University)

.2.7.2 Above ground tanks placed outdoors shall be placed inside secured screened areas. Location of tanks shall be approved by the University Architect and University Landscape Architect in consultation with the University Engineer.

.2.7.3: The above ground tanks shall be either of the following:

A. Double walled construction or

B. Located in a secondary containment curb that can contain entire (110% if outdoors) tank contents.

.2.7.4 The A/E shall ensure that the University Project Manager is provided with information relative to any fuel storage tank and the tank installation. University project manager shall share this information with Ohio State University - Environmental, Health and Safety group.

.2.7.5 Spill control kits shall be stored in a 20 gallon yellow drum and contain the following items as a minimum:

- One (1) Gallon of Super absorbent (ENSORB(R) or equal)
- Six (6) 42” socks
- Fifty (50) 15” x 20” absorbent pads
- Two (2) pairs of Nitrile Gloves
- Two (2) pairs of Goggles
- Two (2) 18” X 30” disposable bags and ties
- One (1) emergency response guide
- One (1) Instruction Sheet and Safety Data Sheets

.2.8. Contract Documents shall include the following in addition to any other requirements of the code.

A. Proper distances shall be provided from buildings, property lines, pedestrian traffic, building air intakes, and storm outlets.

B. Spill control shall be included via either double wall or secondary containment.

C. Above grade tanks shall be installed inside a secure screened area that is lockable and approved by the university Architect.

D. Provide permanently placed bollards for vehicular barrier protection.

E. An overfill prevention mechanism alarm monitoring system shall be provided

F. Provide a spill container to capture overfill at the fill connection locations.

G. Storage tanks shall be grounded

H. Feed lines shall be engineered to be protected from rupture and corrosion.

I. Fire extinguisher and weather resistant cabinet.

J. Emergency Power Off (EPO) pushbutton shall be separately mounted in an intuitive location. For outdoor installations the EPO shall not be mounted on the generator enclosure.

.2.9 Generators shall not be cooled using "Potable water".

.2.10 Generator battery chargers and block heaters shall be connected to an emergency power panel.

.2.11 Emergency lighting shall be included at the generator location, in all mechanical equipment spaces, and in electric transformer and switchgear or switchboard spaces. Substation lighting and receptacles shall be included on the emergency system.

.2.12 Electrical Equipment fed from an emergency generator or any two sources shall be tagged with a red label and white lettering.

A distinctive warning sign shall be provided indicating the location of both sources of power.

Commentary: *Signage at an automatic transfer switch may be similar to the following:*

NORMAL SERVICE – MAIN SWITCHBOARD MSB IN LOCATED ROOM 7M INTHIS BUILDING

EMERGENCY SERVICE - EMERGENCY SWITCHBOARD ESB LOCATED IN ROOM 35M IN THIS BUILDING

EMERGENCY LOAD LOCATED IN ROOM 10M IN MATH TOWER.

2.13 Generator batteries

A. Batteries shall be maintenance free heavy duty type.

B. Provide sufficient capacity for 1.5 minutes of total cranking time without recharging being required.

C. Provide the following items as required:

.1 Battery rack, cables, clamps and removable cover

~~A. Batteries shall be maintenance free heavy duty type.~~

~~B. Lead acid storage battery set of heavy duty diesel starting type.~~

~~C. Battery set shall be compatible with the starting system and voltage.~~

~~D. Provide sufficient capacity for 1.5 minutes of total cranking time without recharging being required.~~

~~E. Provide the following items as required:~~

~~.1 Battery rack, cables, clamps and removable cover~~

~~.2 Battery heater pads~~

.2.14 Battery Chargers:

A. Battery chargers shall be current limiting type and shall recharge the batteries automatically.

~~B. The battery charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell.~~

~~C. Chargers shall be provided with overload protection, silicon diode full wave rectifiers, voltage surge suppression, DC ammeter and fused AC input.~~

~~D. AC input voltage shall be 120 or 277 volts pending on the source available +10%.~~

~~E. Amperage output shall be no less than 10 amperes~~

F. Charger shall be provided with charger/battery failure alarm and dry contacts output to generator controller.

.2.15 Environmental Considerations

.2.15.1 The engine shall be EPA-certified with an accessible and readable nameplate. Provide complete documentation that the engine meets all US EPA requirements. A copy of this documentation needs to be provided to the project manager for transmittal to Ohio State University -EHS.

.2.15.2 Provide specifications for the emergency generator to the university project manager to furnish to Ohio State University - EHS. Ohio State University - EHS will obtain the necessary permit-by-rule (PBR) for the generator from the Ohio EPA.

.2.15.3 Show location and specifications for the exhaust from the emergency generator. Ohio State University has specific Building Design Standards relating to rooftop exhaust stacks. See Appendix V

.2.15.4 Batteries shall be located such that any potential leakage is contained and any supporting structure/concrete will not be damaged.

.2.16 A/E shall include commissioning ~~elements~~ requirements in the project manual.

.2.17 On site load testing of emergency generators

.2.17.1 Provide a minimum of two hour on site load test after generator is installed.

.2.17.2 The generator will be tested the first half hour at 50% load

.2.17.3 The second half hour shall be tested at 75% load.

.2.17.4 The final hour of testing will be at 100%.

~~**Commentary**: The load test may be expanded to four hours at the A/E's discretion (should be per NFPA 110 requirements)~~

.3 EMERGENCY PANELBOARDS shall be provided for:

.3.1 Communications systems used for emergency purposes and mass notification systems.

.3.3 Fire alarms, building security equipment, and fire protection systems; this does not eliminate the need for batteries. Batteries shall be tested to indicate amp-hour availability. The Manufacturer shall provide documentation that indicates conformance with repaired rating to the University.

.3.4 Elevators and/or elevator rooms when required by Ohio Building Code.

.3.5 Traffic signals fed from the building (from the Equipment Branch only).

.3.6 EMERGENCY ILLUMINATION: Emergency illumination shall include all required means of egress lighting, exit signs, stairwell lighting, and all locations where code required minimum illumination must be provided to allow easy and safe egress from the area involved.

.3.7 **WEXNER MEDICAL CENTER**: Consult OSUWMC Facilities Engineering for additional requirements.

.4 WIRING FOR EMERGENCY SYSTEMS shall be in separate conduits.

.4.1 Switches for emergency lighting circuits shall not be accessible to the public.

.5 TRANSFER SWITCHES: ~~Transfer switch is a vital part of the proper operation of the system. In addition to current carrying abilities, transfer switch must be able to withstand voltage surges to meet reliability requirements. Special consideration over normal circuit devices or breakers should be given to transfer switch because of its application requirements. Its design must include normal duty, and fault current ratings of the switch. These play an important part of transfer switch application and protection scheme. It shall be capable of closing into high currents, of fault currents without damage, and withstanding severe duty cycle in switching normal rated load. The design and operation of transfer switch must meet the requirements of this Standard and the following Codes and Standards: NSI/NFPA 70-1987(12) (National Electrical Code (NEC), NFPA 99-2002 and NEC 700-2005.~~

.5.1 In addition to the two sources feeding the automatic transfer switch, provisions shall be provided so that equipment, on the load side of automatic transfer switch, can be locked-out-tagged-out.

.5.2 All new and existing buildings being provided with generators shall be have dedicated automatic transfer switches ~~to separate~~ installed for both the emergency and standby distribution systems.

.5.2.1 For health care or similar projects where critical and life safety emergency systems are provided, bypass-isolation switches shall be included.

.5.3 Transfer switches shall be UL 1008 listed, contactor type, electrically operated using a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions. Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

.5.3.1 Where four-pole switches are required, a true four pole switch shall be supplied, with all four poles mounted on a common shaft.

.5.3.2 Use of three pole switches shall be reviewed with the University Engineer.

.5.4 Existing buildings where emergency and standby systems are not on separate transfer switches shall be provided with new transfer switches to accommodate new emergency and/or standby loads being provided by the project.

.6 EXISTING GENERATORS

Commentary: *Each existing generator will need to be looked at on a project-by-project basis. Many of the existing university generators are currently at rated load or over rated load and will not be able to accommodate any new loads.*

.6.1 Existing capacities will need to be reviewed with the University to determine if the generator can serve any new loads.

.6.1.1 Projects requiring generator power shall have an "Emergency Power Request" form completed and submitted to FOD for consideration.

.6.2.2 No new loads may be added to an existing generator without an approved "Emergency Power Request" form completed and submitted to FOD for consideration.

.7 TEMPORARY SOURCE OF POWER FOR MAINTENANCE OR REPAIR OF THE EMERGENCY GENERATOR

.7.1 For buildings with a single generator serving life safety loads, a permanent switching means shall be provided to connect a portable or temporary generator to the building for the duration of the downtime to comply with NEC 700.3(F); a 3-way manual transfer switch can be used for this purpose.

.7.2 The 3-way manual transfer switch shall consist of (3) mechanically-interlocked molded case circuit breakers, male cam-style inlet connectors, female cam-style outlet connectors, power distribution blocks and grounding terminals, all housed within a padlockable enclosure to connect a portable generator or loadbank.

.8 **WEXNER MEDICAL CENTER**: EMERGENCY POWER SYSTEMS:

.8.1 Emergency power generators shall utilize diesel fuel engines.

.8.2 See MEDICAL CENTER Special Requirements Appendix E identification standards for coloring and labeling schemes.

.8.3 Emergency Power Supply Systems (EPSS's) in critical care environments shall consist of N+1 power generation redundancy and utilize paralleling switchgear to provide increased reliability. Consideration shall also be given to the use of uninterruptible power supply (UPS) for critical and life safety branches of the emergency power system to eliminate switching interruption. External maintenance bypasses shall be provided to allow for removal and preventative maintenance of any UPS.

.8.4 Emergency generator electronic control systems shall be monitored via building automation system. Provide Ethernet jack in emergency generator locations to allow for connection to BACnet Ethernet backbone.

.8.5 EPSS fuel system shall also be monitored via building automation system. If dry contact indications are furnished with daytank and main fuel tank monitoring systems, provide connection to building automation system.

.8.6 Consideration shall be given quantity of transfer switches and respective loads to allow for load shedding in circumstances of emergency power system diminished capacity.

.8.7 Transfer switch control panels shall be provided with communications package to allow real time monitoring. Transfer switches shall be monitored via building automation system. If needed, protocol gateways shall be provided to convert generator protocol information to BACnet protocol (e.g., Modbus to BACnet). Provide Ethernet jack in transfer switch locations to allow for connection to BACnet Ethernet backbone.

.8.8 Delayed transfer switches shall have capability of "0 seconds" transfer time between normal and alternate sources. Those switches with minimum 1-second delay time are not acceptable.

.8.9 Transfer switches shall be open transition and of the bypass isolation type to enable servicing of equipment without shutdown. All bypass-isolation handles/controls shall be externally mounted and not require access into the enclosure for operation. Switches shall be capable of manual operation under load and be quick-make, quick-break. The switch shall have the capability of being fully manually operated and not be dependent upon electrical operators, relays or further interlocks for safe operation.

26 35 33 MOTOR MOUNTED POWER CAPACITORS

.1 Power Factor Correction: Motors (drives) 50 HP and larger shall be provided with fused, switched, power factor correction capacitors, one capacitor per phase, sized to correct to 100 percent or greater. It is preferred that the units be connected between the contactor and overload coils. Units shall meet all fire codes and be environmentally safe.

.1.1 Power capacitors shall be UL 810 labeled and factory wired ready for field connection with factory installed discharge device.

.1.2 Power capacitors shall be factory wired ready for field connection with factory installed discharge device.

26 37 00. ELECTRICAL PROVISION FOR ELEVATORS

.1 WIRING AND SWITCHING: Wiring shall be extended to fused switches located in elevator room.

.1.1 Provide shunt trip devices where elevator shafts are sprinklered.

.2 EMERGENCY CIRCUITS: A fused single phase disconnect switch powered from an emergency circuit shall be located in the Machine room to feed the lights and a GFCI receptacle; this circuit shall feed no other loads. ~~An emergency circuit to mid-point of the hoist way shall be provided for the elevator cab light, fan, and equipment room~~.

.3 PIT INSTALLATIONS: Coordinate with Division 14 requirements. Light fixtures, light switch and GFCI convenience outlet shall be provided in the pit of each elevator, each on separate circuits. If a sump pump is required for the elevator pit, then the sump pump shall be provided with a dedicated circuit and ~~not tied into the lighting or GFI circuit~~ single receptacle without GFI.

.3.1 Light fixtures in the pit area shall be arranged so that a minimum of 20 FC is provided at any point in the pit.

.4 Where an elevator is equipped with a battery lowering device the main disconnect switch shall be supplied with auxiliary NO/NC contacts wired to allow the power to be turned off for maintenance.

.5 Where an ATS is part of the system, additional contacts shall be provided to indicate switch position and signal before transfer in either direction.

26 40 00. ELECTRICAL AND CATHODIC PROTECTION

26 41 00. FACILITY LIGHTNING PROTECTION:

.1 Each building shall be considered individually to determine the necessity for lightning protection. Lightning Risk Assessment calculations as noted in NFPA 780 Annex L shall be performed and submitted to the University through the project manager for review as well as the University's insurance carrier.

.1.1 If it is deemed necessary to provide the lightning protection system for the facility, then the A/E shall design and specify a traditional Franklin type system that meets Underwriter Laboratory's Master Label Certification program. The A/E shall engage a certified Lightning Protection Designer for this purpose.

.1.2 If it is decided that lightning protection is not necessary, this decision shall be made a matter of record. A listing of the people consulted shall be included in the conference memos along with "RISK" calculations noted above.

.1.3 All existing lightning protection system shall be maintained during building renovations and extended to any additions to the building and re-certified at the completion of the work.

.1.4 Any new and modified existing systems shall have UL Master Label "C" Certificate submitted to the University.

.1.5 Copy of UL Master Label certificates shall be given to the University Engineer and posted to the UL website.

.1.6 Original certificate shall be framed and located next to fire alarm panel

.1.7 Copies of certificate shall also be included in Operations and Maintenance Manuals.

.1.8 This standard requires that lightning/surge arresters be installed as close as possible to the HV/MV terminals of the Power Transformer and all other equipment requiring surge protection be grouped as close as possible to the arresters. Use the station type arrester for the best protective level and highest surge discharge ability for important and critical installations. The intermediate class type arrester shall be used for less critical installations and mostly for feeder protection.

A. Grounding network resistance shall not exceed 5 Ohms (5Ω). Lower values are preferred.

B. Ground Conductors: The surge arrester grounding conductor shall be connected into the common ground bus. The grounding conductor shall be run as directly as possible between the arresters and ground and be of low impedance and ample current carrying capacity. (See Section 26 20 06.2.4). These requirements must comply with National Electrical Code. (ANSI/NEMA 81-1990 (19, Article 190-193)).

C. Indoor locations: Arresters that are installed inside the buildings shall be enclosed or shall be located well away from passageways and combustible parts.

D. Installation: This standard requires that arresters must be located and installed in such a manner that the expulsion of gales or the arrester disconnect is not directed upon energized parts.

1.9 All protective lightning rods used for building or facility protection must have a UL Label affixed to them.

.2 GROUNDING SYSTEM REQUIREMENT: Because of possibility that a breakdown in grounding insulation may accidentally energize all plant or facilities, this Standard requires that ground connections shall be made to the electrode by methods providing the required permanence and ampacity, such as:

.2.1. A permanently effective non-reversible clamp, fitting, brace or exothermic weld.

.2.1.1 Connections at test wells shall be of the reversible type.

.2.3. All non-current carrying metallic structures or steel frame building are grounded.

.2.4 UFER type grounding electrode system.

.2.5 The main purpose of grounding system is as follows:

.1. To maintain low potential difference between metallic parts, ensuring freedom from electric shocks to personnel in the area.

.2. To avoid fires from volatile materials and ignition in combustible atmospheres by providing an effective electric conductor system for the flow of ground fault currents and lightning. The connection between the grounding electrode and the earth should have a resistance less than 5 ohms.

.3 SURGE PROTRECTION DEVICES:

.1 Surge Protective Devices installation shall be coordinated with lightning protection system in buildings so equipped.

.2 Surge Protective Devices, Type 1, shall be provided at service entrance equipment of all new facilities. For existing buildings undergoing electrical renovation or upgrading, SPD's shall be retrofitted to existing service entrance equipment.

.3 Surge Protective Devices shall be provided on the load side of all Transfer Switches per NEC requirements.

.4 If integrated, cascaded surge protection is needed at a facility, additional devices may be placed at downstream equipment.

.5 Surge current capability per phase shall be:

.5.1 Service Entrance: 300 kA.

.5.2 ATS, Distribution Panelboards and MCC's: 200 kA.

.5.3 Branch Circuit Panelboards: 100 kA.

26 42 00. CATHODIC PROTECTION

.1 UNDERGROUND PIPING: Cathodic protection method when such protection is determined to be appropriate. A/E shall retain the services of a Consultant specializing in Cathodic Protection System design.

26 50 00. LIGHTING

.1 LIGHT LEVELS-GENERAL: All new lighting installations shall comply with Ohio Building Code chapter 10 for emergency lighting requirements and chapter 13 for energy efficiency requirements. Lighting levels shall meet current IES Standard recommendations. ~~All new lighting installations at The University shall comply with the Code for Energy Conservation in New Building Construction. (Ohio Building Code, Article 27, O.A.C. 4101:2-27). Lighting requirements for the most common University building areas are set forth in this standard. The referenced light levels are understood to be a maintained light level. Light levels are measured at a 30-inch height from the floor or at the actual work surface, and represent the average level for the area or workstation. Circulation areas beyond workstations should be lighted to one-third the light level of the workstation, but in no case less than 20-foot candles.~~

~~1.1.1 Specify that contractors shall fuse all indoor and outdoor lighting fixtures when installed~~

1.1.2 Utility Tunnels: Provide 2 foot-candles minimum with fixtures spaced 20' to 25' apart down the center of the tunnel on the ceiling. Provide vapor tight ceiling mounted fixtures using ~~compact fluorescent lamps~~ LED illumination

with appropriate globes and wire guard. Use fiberglass conduit with PVC boxes for tunnel lighting.

26 51 00. INTERIOR LIGHTING

.1 RECOMMENDED FIXTURES: LED fixtures with dimming are required. ~~Fluorescent fixtures using 4 foot T8 tubes are generally preferred. Incandescent lighting may be used only with the written permission of the University Engineer. Any department requesting approval of incandescent lighting must be willing to accept financial responsibility for the maintenance of the incandescent lighting. Where incandescent lamps are used as part of an equipment system or alarm, provide a minimum of 12 or 10% (whichever is greater) spare lamps of each wattage.~~

.1.1 INCANDESCENT LIGHTING shall not be used. Incandescent lighting may be used only with the written permission of the University Engineer. Any department requesting approval of incandescent lighting must be willing to accept financial responsibility for the maintenance of the incandescent lighting. Where incandescent lamps are used as part of an equipment system or alarm, provide a minimum of 12 or 10% (whichever is greater) spare lamps of each wattage.

~~The use of High Pressure Sodium (HPS) Lamps in fixtures for lighting large or open areas is recommended by this Standard in combination with metal-halide lamps for greater energy saving. Almost without exemption, the High Pressure Sodium (HPS) lamps shall be the choice for greatest economy and least use of energy, but the use shall be limited to warehouse large areas and high ceilings.~~

.1.2 MERCURY VAPOR lamps shall not be used. Exceptions, for research applications, must be submitted by the A/E for reviewed and approved by the University Engineer.

~~**Commentary:** mercury vapor lamps are no longer in production.~~

.1.3 METAL HALIDE lamps shall not be used.

~~METAL HALIDE lamps shall only be used in areas where there is assurance that they will be turned off at least once a week; this reduces the possibility of an explosion at end of life. Their use should be limited to areas in which network television coverage is expected, accurate color rendering is required, or gymnasiums.~~

.1.4 FLUORESCENT FIXTURES shall not be used. ~~FLUORESCENT FIXTURES: All fixtures shall be independently supported from the structure above. Fixtures shall be all metal with hinged shielding louvers. Recessed fixtures with hinged frame open louvers may be used where required for architectural effect. Two hundred seventy-seven (277) volt fixtures shall be used where this voltage is available. Fixtures shall meet or exceed the requirements of the Code for Energy Conservation in New Building Construction.~~

.1.5 QUARTZ LAMP FIXTURES shall not be used. ~~are not recommended; if used they must have lenses to protect against exploding lamps.~~

~~.1.6 Ballasts: High Frequency Electronic type, specifically designed to use T8 lamps, instant start, to operate multiple lamps in a parallel configuration. Ballasts shall meet minimum performance standards as established by the Certified Ballast Manufacturers Association. Additional requirements shall include a maximum Total Harmonic Distortion of 20 percent, sound rating of "A", shall comply with applicable standards as set by ETL, F.C.C., NEC, I.E.E.E., be listed by UL and carry a five year replacement warranty. Separate ballasts should be provided for each lighting fixture; exception, tandem or cross ballasting of adjacent fixtures is permitted provided the fixtures are directly connected to each other.~~

~~.1.7 Ballasts for compact fluorescent lamps shall be electronic type, and shall have the following characteristics: A. Ballasts to be high Power Factor type. B. Ballasts factor shall be .95 or greater. C. Ballasts for multiple lamps shall be parallel wiring type. D. Minimum starting temperature shall be 50 Degrees F. E. Fixtures with multiple ballasts shall have individual fusing for each ballast. F. Total harmonic distortion shall be less than 20%. G. Ballast shall contain end of lamp life fault mode shutdown protection~~

~~.1.8 LED (Light Emitting Diode) fixtures may be considered for illuminating interior spaces. Provide spare parts for each type LED fixture .1.8.1 If dimming of LED fixtures is desired, it will be the responsibility of the A/E to specify the correct dimmers and provide the correct wring diagrams as part of the contract documents.. .1.8.2 Workable sample fixtures and dimmers will be provided during the design phase and with the shop drawing submittal for review and comment. These fixtures will become attic stock.~~

~~.2 Line Fuses: A line fuse shall be included in the fixture for each ballast in addition to the internal protection of the class "P" ballasts. Line fuses shall be appropriate for the application and wired in place by the fixture's manufacturer. Fusing for fluorescent lighting fixtures shall be non-time delay type similar to Bussmann type GLR with HLR holders.~~

~~.3 Lenses shall not be specified as an alternative for louvers. If lenses are required for the project, the project shall be engineered for these units. Tempered lenses shall be specified on quartz lamp fixtures.~~

~~.4 Fluorescent Lamps: Four (4) foot 32 watt and two (2) foot, 17 watt, T8, instant start lamps with color temperature of 3500K and minimum of CRI of 74. DIVISION 26 – ELECTRICAL 2006 Edition, Published January 1, 2006; Division Revision Date: December 31, 2018 26- 30~~

~~.5 Specify the use of exit signs utilizing Light Emitting Diodes (LED) light source with life expectancy greater than (10) ten years.~~

~~.6 INCANDESCENT LAMPS: When approved by the University, specify the 130-volt, inside frosted lamp for general application.~~

~~.7 LIGHTING SAFETY: Stairwells in buildings shall have sufficient fixtures so that the loss of one lamp or ballast will not leave the area dark. The mounting of the fixtures shall not be at the extreme height but must be accessible for maintenance. Position fixtures only on walls over landings at a minimum height of seven (7) feet to the bottom of the fixtures and a maximum height of eight (8) feet to the top of the fixtures. Fixtures shall have lenses; no bare lamps shall be permitted. Lighting in stairwells shall not be manually switched.~~

~~.8 Provide the following spare parts with the listed quantities for compact and/or T5 fluorescent fixtures for each item and size required: A. Fuses – 10%, minimum of 15 per amp rating B. Fuse Holders – 10%, minimum of 5 per each type C. Ballasts – 5%, minimum of 3 of each type D. Lamp Sockets – 10%, minimum of 10 of each lamp type E. Fixture Lenses – 10%, minimum of 2 of each lens type~~

~~.9 All submittal reviews for Compact and/or T5 Fluorescent fixtures shall include the following: A. Catalog cut sheets. B. Lists of spare parts with quantities to be furnished. C. Samples of fixtures along with a sample of each spare part to be supplied. Turn spare parts over to the university area shop supervisor and obtain signed receipt. A copy of each approved submittal and a copy of each signed receipt shall be included in the Operation and Maintenance Manuals. .10 Spare lamps should be provided as follows:~~

~~Quantity of lamps installed and not fixtures should be calculated for each lamp type and wattage.~~

~~.10.1 Determine the number of spare incandescent lamps of each wattage and voltage for the project with University project manager and operations representative. .11 Incandescent lighting is permitted in dedicated Telephone Equipment Rooms.~~

.2 Specify the use of exit signs utilizing Light Emitting Diodes (LED) light source with life expectancy greater than (10) ten years.

.3 LIGHTING SAFETY: Stairwells in buildings shall have sufficient fixtures so that the loss of one fixture will not leave the area dark. The mounting of the fixtures shall not be at the extreme height but must be accessible for maintenance. Position fixtures only on walls over landings at a minimum height of seven (7) feet to the bottom of the fixtures and a maximum height of eight (8) feet to the top of the fixtures. Fixtures shall have lenses. Lighting in stairwells shall not be manually switched. Provide occupancy sensors to reduce lighting levels in stairwells when unoccupied but maintain a minimum of 1 foot candle per OBC.

.4 All submittal reviews for lighting fixtures shall include the following:

A. Catalog cut sheets.

B. Lists of spare parts with quantities to be furnished.

C. A copy of each approved submittal and a copy of each signed receipt shall be included in the Operation and Maintenance Manuals.

.5 Fixture whips shall be made up of either #12 conductors in ½" flexible conduit minimum or #12 type MC Cable minimum.

.1 MC cable shall be provided with green grounding conductor.

.2 If cable ties are used for support then they must be UV stable cable ties.

.3 Fixture whips below ceilings may be provided with as cords similar to type "ST" rated 600 volts provided the following are met.

.3.1 Limit one cord per fixture.

.3.2 Do not daisy chain fixture cords for exposed fixtures.

.3.3 ST cord shall be provided with green grounding conductor

.3.4 Cord shall not be extended above ceiling other than into outlet boxes

.3.5 Cords are made up of #12 conductors minimum

.3.6 Cords longer than six feet are properly supported

.3.7 If cable ties are used for support then they must be UV stable.

.6 **WEXNER MEDICAL CENTER:** INTERIOR LIGHTING

.1 Battery powered emergency egress lighting, when used, shall be self- diagnosing type (momentary monthly testing and 90 minute annual test). Consideration shall be given to an inverter capable of handling multiple remote heads for those areas with multiple battery powered egress fixtures (e.g., mechanical or emergency power distribution rooms)

.2 Provide brushed aluminum type housing for exit signs.

.3 Operating rooms and Procedure rooms lighting control

.4 Patient rooms with reading and general lighting shall interface with nurse call system. Both general and reading lights shall be controlled individually via both nurse call paddle and room entry momentary toggle switches. Locate relays at room entrances to avoid interference with patient if service is required.

.5 Corridor, waiting area and lobby lighting in patient care areas shall be controlled from nurse station at a minimum.

26 56 00. EXTERIOR LIGHTING

.1 LIGHTING FOR THE ENTIRE SITE, INCLUDING DRIVEWAYS, WALKS, PARKING AREAS, and THE BUILDING PERIMETER shall be included in the contract documents.

.2 FIXTURES: LED fixtures mounted on the building or on suitable standards are required for all exterior site lighting. These fixtures shall be automatically controlled by photocell(s) for a "dusk on dawn off" operation. Lighting output shall be reduced per ASHRAE 90.1 requirements for exterior lighting. More details about exterior lighting or lighting poles may be obtained from Ohio State University Facilities

Operations and Development website at https://fod.osu.edu/resources, click on "Design" tab in Vendor Resources.

.2.1 Light Control shall be provided on all exterior lighting fixtures. The fixture shall be insect proof. Vandal proof fixtures shall be used if the fixtures are mounted 10 feet or less off the ground.

.2.2 Lighting Fixtures with Wi-Fi capabilities. (*Reserved for Future*)

~~High Intensity Discharge (metal halide) fixtures mounted on the building or on suitable standards are required for all exterior site lighting east of the Olentangy River. Exterior lighting west of the Olentangy River shall be high pressure sodium. These fixtures shall be automatically controlled by photocell(s) for a "dusk on dawn off" operation. More details about exterior lighting or lighting poles may be obtained from OSU Facilities Operations and Development website at https://fod.osu.edu/resources, click on "Design" tab in Vendor Resources. .2.1 LED fixtures may be considered as a lamp source for exterior lighting. Additionally the project will be required to provide the university with spare parts for light fixtures and poles. Quantity of spare parts will be determined on a project by project basis. .2.2 Light Control shall be provided on all exterior lighting fixtures. The fixture shall be insect proof. Vandal proof fixtures shall be used if the fixtures are mounted 10 feet or less off the ground.~~

.3 FIXTURE LOCATION: Fixtures shall be located in such a manner that dark voids and excessive glare in windows are eliminated. Accessibility for servicing must be considered in locating fixtures. Consideration must also be given to light spillage onto adjacent facilities (existing or planned) such as greenhouses, which are light sensitive. Use directional or shielded lighting as necessary. Check with the University Engineer for the type of lights. Grounding rods shall be installed in all lighting poles.

.4 Outdoor Lighting Levels shall be designed as follows:

.4.1 Primary Walkways and problem areas - 2 foot-candles (FC) average and .5 FC minimum.

.4.2 Secondary Walkways and other areas - 1 FC and .25 FC minimum.

.4.3 Primary Streets - 2 FC average and .25 FC minimum.

.4.4 Parking Lots - 1 FC average and .25 FC minimum.

.4.5 High Activity outdoor parking areas ~~(i.e. St. John Arena) 2.4 FC average and .6 FC minimum.~~ shall be determined by the University Parking Advisory Committee.

~~.5 Design outdoor lighting to be fed from 100 amp switch, which in turn feeds 100 amp contactor with coil controlled by a photocell. Lighting contactor shall be provided with "hand-off-auto switch. Use twist lock type photo controls to control contactors.~~

~~.5.1 Load side of lighting contactor will be provided with a fusible 100 amp disconnect switch to help with serving of lighting~~.

.6 Run all three phase legs and neutrals to lighting standards and fuse each pole individually. Alternate each pole to different phase legs and balance phases. Conductors used for outdoor lighting shall be full color insulation for the designated voltage. Color tape for conductor identification is not an approved means of identification.

.7 Taps inside poles shall be insulated and molded for precise fit. Connectors with removable access plugs over hex screws... These connectors shall not require cover and taping. Connectors shall be abrasion and chemical resistant and also be UV rated. Connectors shall be rated for 600 volts, 90 degrees C. Split bolt connectors are not acceptable.

.8 The University has no secure storage. Any existing poles, luminaires, concrete collars or screw-in bases removed for relocation at a later date must be stored off campus at the project's expense or in the project's staging area. Luminaires shall be removed prior to pole removal and stored indoors. Any items, except for luminaires, being turned over to the University shall go to the University designated storage location. Contractor shall coordinate storage location with Ohio State University project manager.

.9 All exterior lighting poles shall be provided with color coded tag as noted on the University website. Tags will identify pole number, power source and circuit number and will be color coded to distinguish phase of power source.

~~.10 Outdoor lighting shall be fed with full color conductors.~~

.11 When installing the gullwing poles, provide Quazite box adjacent to pole and provide #10 wire from feed into pole base. Fusing shall be accessible from pole base.

.12 Any conductors removed for outdoor lighting and not being reused shall be turned over to the University. Coordinate storage location with University Project Manager. ~~be taken to the M/E shop at 2560 Kenny Road.~~

26 58 00. LIGHTING CONTROL

.1 AUTOMATIC SWITCHING: All spaces shall comply with the latest currently adopted version by the State of Ohio of ASHRAE 90.1. All spaces shall have automatic lighting off. Spaces where safety is a concern shall be exempt from automatic shutoff of fixtures. Exterior fixtures shall dim to meet ASHRAE 90.1 exterior requirements.

MULTIPLE SWITCHING: The use of multiple switching shall be evaluated for each space and condition. Where possible, switching shall be circuited to effectively use natural lighting from windows; to permit light reduction during partial occupancy; and to permit reduced lighting for custodial activity.

OCCUPANCY SENSORS shall not be used as the sole means of switching. Manual switches will be provided in all areas with occupancy sensors be limited to areas where automatic on control is allowed per ASHRAE 90.1 requirements. All

occupancy sensors shall be dual-technology. ~~Occupancy sensors shall not be used in mechanical rooms. At installation, set all sensors to maximum sensitivity and maximum time delay.~~

VACANCY Sensors shall be used in all locations where automatic on control is prohibited per ASHRAE 90.1 requirements.

~~.1.1 Occupancy sensor may be used in single person rest rooms.~~ Not used

.1.2 Multi- compartment restrooms shall be provided with at least one night light.

.2 REMOTE SWITCHING by means of a central control shall only be evaluated for new construction and for large renovation projects.

.3 DIMMING CONTROL: Dimming shall be used to meet the ASHRAE 90.1 requirements for lighting level steps between full on and full off.

.3.1 A distributed relay lighting control system with low voltage switches and 0-10V dimming controls is recommended for all general-purpose areas. DMX and DALI are also approved lighting control solutions to spaces. All other systems must be reviewed and approved by the University Engineer.

.3.2 All lighting control solutions shall have a ten years warranty.

~~Where dimming is required it shall be used to control incandescent lighting and may be used for Hi-Lume and approved solid state dimming ballast fluorescent fixtures for low lighting levels. The control panel/panels required for the dimming system shall have the U.L. label. Each dimming module shall be U.L. tested and tested specifically for the type of load it is controlling. Each dimmer module shall possess a means of easily disconnecting power on an individual module-by-module basis. Dimming panels shall be cooled without the use of cooling fans with no exception, and shall be capable of operating as such in an environment of 0 degree to 40 degree centigrade. Satisfactory independent laboratory test results shall be required, that at +40 degree centigrade and at full load, the maximum temperatures of both filter chokes and SCRs/Triacs are not exceeded. There shall be one air-gap positive off relay for dimmer, either integral to the dimmer or mounted elsewhere in the same panel. Other advanced technological approaches that give the same or better operational result is highly recommended by this Standard. All controls shall have the capabilities of reverting back to their previous status after any duration of power outage (power failure memory), without the use of any type of rechargeable or trickle-charge type of battery. LUTRON DIMMING SYSTEMS with ten years warranty meet University standards. Other systems must be submitted to the University Engineer for approval. .3.1 SPECIAL REQUIREMENTS FOR FLUORESCENT DIMMING SYSTEMS: Before specifying fluorescent dimming systems, the A/E shall consider the following: .3.1.1 100 hour "burn-in time is required for the fluorescent lamps when using the dimming ballasts. .3.1.2 the cost of replacing the ballast and lamps when needed is 200-300% more than replacing Standard Systems. Therefore, this Standard requires the A/E to review the application of dimming devices and submit recommendations to Facilities Design and Construction before incorporating into specifications.~~

.4 PARKING RAMP INTERIOR LIGHTING shall be circuited to permit lighting of dark interior areas during the day without lighting those areas that receive sufficient natural light. Automatic control of ramp lighting by photocell is required.

.5 ALL EXTERIOR AREA AND SECURITY LIGHTING shall be "dusk on and dawn off", powered from one location in the building, and controlled from the photo control, with provisions for manual override. Time clock control shall not be used on exterior or security lighting. Exterior lighting shall be reduced per ASHRAE 90.1 requirements.

~~26 60 00 EMERGENCY PHONES~~ (This section has been moved Division 27)

END OF DIVISION 26 – ELECTRICAL

27 00 00. COMMUNICATIONS

.1 INFORMATION FOR DESIGN OF SYSTEM:

.1.1 The Technical Authority (TA) for all Communications, Network, and/or related systems design shall be the Office of the Chief Information Officer (OCIO) for all non-Medical Center projects, and Wexner Medical Center Information Technology (WMCIT) for all Medical Center projects, unless otherwise approved by the aforementioned authorities in writing. Some projects will require authorization and/or coordination with the maintaining and/or operating authority in lieu of, or in coordination with, either the OCIO or WMCIT. Confirm with the PM all parties that shall be applicable where referenced as the TA within this document.

.1.2 All designs shall be in full compliance with University Communications Cabling Standards, unless previously approved in writing by the TA, along with the latest revisions of the following codes, agency best practices and standards:

.1.2.1 The National Electrical Code (NFPA 70)

.1.2.2 National Fire Alarm and Signaling Code (NFPA72)

.1.2.3 Life Safety Code (NFPA 101)

.1.2.4 Ohio Building Code

.1.2.5 ICC A117.1 Accessible and Usable Building and Facilities as amended in the Ohio Building Code ADA Standards for Accessible Design

.1.2.6 Recognized Commercial Building Telecommunications Wiring Standards, e.g. ANSI/NECA/BICSI, ANSI/TIA, etc. 568 series, 569, 598, 606, 607 and 758-B

.1.2.7 BICSI TDMM and Installation Manuals

.1.2.8 Occupational Safety and Health Administration (OSHA)

.1.2.9 **Wexner Medical Center:** Additional Medical Industry Codes and Standards

.1.2.9.1 ANSI/TIA-1179 Standard for Healthcare Facility Telecommunications Infrastructure

.1.2.9.2 Guidelines for Design and Construction of Hospitals and Outpatient Facilities (Federal Guidelines Institute – FGI)

.1.3 Contractor Qualifications:

.1.3.1 Require bidders to be fully compliant with any/all certifications, licenses and/or registration requirements listed in the associated Appendix attached prior to the submission of any bid.

.1.3.2 Bidder responsibility analysis shall be performed in consultation with TA. Ohio State reserves the right to reject any bidder based on experience/lack thereof, current work load, or previous work performed at the university.

.1.3.3 Require certifications from appropriate trade organizations, previous experience and other performance metrics as sited in attached Appendix M.

.1.4 Scope Clarity:

.1.4.1 Perform a scope clarification coordination session to clearly identify under what scope each facet of the design shall fall between the AE and any/all sub-consultants, including but not limited to the Architect, Electrical Engineer and the Technology Engineer. Identify and resolve any/all scope gaps or overlaps.

.1.4.2 Include on the Drawings a scope clarification matrix clearly identifying the purchase, installation, programming, commissioning, etc. Include said matrix on all cover sheets of each discipline's Drawings to identify scope required and assign associated responsibility.

.1.5 Fire Stopping:

.1.5.1 Provide Fire and/or Smoke Protection as may be required under the scope of the project. The AE shall coordinate with the Division 7 designer and/or subconsultant to verify the inclusion of such requirements.

.1.5.2 Where these requirements are not included under the scope of Division 7 work, include requirements for the Division 27 contractor to complete the necessary work caused by the Division 27 scope of work.

.2 OWNER REVIEW:

.2.1 During standard design reviews, and additionally as may be prescribed by the TA, submit for review and approval Drawings, Specifications, related narrative and/or budget estimates for the project.

.2.2 AE/Designer shall provide submission through Facilities Design and Construction. OCIO/WMCIT shall provide comments and/or approval from which the AE/Designer shall correct/update any changes and complete the Documents prior to any bidding or procurement process.

.2.3 During Shop Drawing Submittals and As-Built Document Submittal reviews, provide copies to the TA for concurrent review and approval. Include TA comments in response, assuming the more stringent response between the AE and the TA when replying to said submissions. Require submission of all components required for project completion as well as contractor certifications, testing procedures and test equipment calibration certifications be included by both the technology systems contractor, as well as the electrical contractor supplier various supporting systems. For Shop Drawing submittals require rack elevations, room layouts, faceplate layouts, and cable risers, at a minimum.

.3 SERVICE ENTRIES

.3.1 A minimum of one Service Entry Facility (EF) for non-medical facilities, and (2) diverse Telecommunications Service Entry Room (TSER) for medical facilities, is required per new building structure. The EF/TSER shall not to be located above the second floor.

.3.2 During the initial planning conference for any/all building construction and/or renovations, consult the TA, regarding:

.3.2.1 Expected services and their sources to be utilized;

.3.2.2 Required new Telecommunications Spaces, Enclosures and/or Pathways, or renovation/rework of same;

.3.2.3 Required backbone connection types, locations and potential routes.

.3.3 Provide appropriately sized and provisioned service entry facilities for all new building structures, and any renovation of sufficient magnitude to justify rework of the service entry cabling. Coordinate the required size of such service entries with the TA, and the applicable standards requirements as listed both in the Building Design Standard and the attached Appendix M. Minimum EF shall be 10’ x 14’ for all non-WMC facilities. For all WMC facilities, minimum EF shall be 14’-8” x 21’ and located not more the 50’ from the service entry for the building. Locate the EF/TSER not more the 50’ from the service entry for the building. Provide Rigid metal conduit from

the point of entry to the EF/TSER. Review service entry requirements with the TA for proper sizing and quantities.

.3.4 Provide environmental conditioning and power as described in the section of Telecommunications and Technology Distribution Rooms and Enclosures (27 00 00.4).

.3.5 Provide entry to EF/TSER directly off corridor or other common area. Do not allow access through this space to gain entry to other than related IT/Telecommunications spaces, and provide access control integrated and extended from the campus access control system.

.3.6 Provide service cabling termination, testing and labeling as directed by the TA under the scope of the project.

.3.7 Each project shall be responsible for the provisions of service entry ductbanks(s). Provide service entry ductbanks to each entrance facility from the service source locations as directed by the TA's Outside Plant representative. These pathways shall be coordinated with the Ohio State University Campus Mapping System. Schedule site visits by same to obtain GPS coordinates as required.

.4 TELECOMMUNICATIONS AND TECHNOLOGY DISTRIBUTION ROOMS AND ENCLOSURES:

.4.1 Coordinate with the TA during the Space Programming phase of the design to ascertain the required minimum space and associated dimensions needed to effectively service the area of the project scope. Provide dedicated spaces as described herein. Unless other sited in this Document, or otherwise directed by the TA, all spaces shall be a minimum of 10' x 10' for non-medical projects, and 12'-6" x 14'-8" for Medical Center projects.

.4.1.2 A minimum of one Telecommunications Distribution Room is required per floor. The room shall be centrally located.

.4.1.3 Additional Telecommunications Rooms shall be provided to facilitate all cabling being under the prescribed 295 foot distance limitation established by the industry and required to provide the applicable warranties.

.4.1.4 A Main Telecommunications Room shall be provided for buildings exceeding five or more floors

.4.1.5 Precautions shall be made when locating any/all telecommunications rooms and/or enclosures to provide clearance from mechanical rooms housing large motors, electrical distribution rooms having significant transformers, or

other such sources of electro-magnetic or radio frequency interference.

.4.2 For renovations and expansions, review any existing spaces to determine if such existing space is sufficient, within appropriate distances, needs expansion or other improvements, or if a net new space is required. Meet or exceed any/all expressed space allocation defined by this coordination.

.4.3 Where may be required a localized enclosure may be utilized where approved in writing by the TA no later than the Design Development phase.

.4.4 For WMCIT and Wexner Medical Center facilities, space requirements are not consistent with that of typical industry standards due to the complexity and magnitude of the system required in healthcare applications, as well as similar academic space. Such healthcare-based spaces often require larger space allocation, and for facilities guided by the FGI Design Guidelines, space allocation aligned with those of the FGI Guidelines and as approved by WMCIT shall be provided.

.4.5 Wherever practical and possible, all Technology Rooms shall be stacked and provisioned with connecting sleeves and sleeve seals.

.4.6 No Telecommunications Space shall be utilized for building services other than that required for Voice, Data, Video or other related technology services.

.4.7 Telecommunications spaces shall not be designed such that space shall act as a pass through to other spaces or facilities systems locations, nor act as a storage space for any materials or equipment other that for that of the TA.

.4.8 The AE shall facilitate, and assure, the coordination of the Telecommunications Rooms supporting building services, i.e. electrical and mechanical services, with the appropriate engineering systems designers to effective and efficiently cool, power and light the space.

.4.8.1 Provide air conditioning 24x7x365 to maintain a 65-85 degree temperature with 20-60% relative humidity. Air system(s) shall maintain positive pressure while operational, and neutral pressure while satisfied.

.4.8.2 Provide 50 fc at 3' AFF, on all sides of the racks.

.4.8.3 Provide a double duplex outlet between each rack fed from a dedicated 120VAC, 20A circuit, attached to the cable tray above the rack, attached to the cabletray above the rack.

.4.8.4 Provide a dedicated 120VAC, 20A convenience circuit routed to a duplex receptacle on each usable wall in the room. Location of power shall be coordinated during the design phase so to facilitate that no power outlets are surface mounted. Provide all power in the assigned wall cavity unless directed or approved by the TA.

.4.8.5 Coordinate additional power requirements as may be required with the TA. Coordinate any available emergency power, e.g. generator or other battery backup system. Review same with TA to provide backup power to the telecommunications space or enclosure as may be required by the TA.

.4.8.6 Floor treatment shall be either tile or sealed concrete. Floor treatments shall be applied prior to installation of any/all technology and telecommunications equipment and cabling.

.4.9 All Telecommunications Room walls shall be lined with ¾" x 4' x 8' AC plywood on all sides mounted vertically at 12" AFF.

.4.10 No plumbing or other building services shall be routed through the Telecommunications Spaces unless it is explicitly to service the room. Where plumbing lines are routed into the room to provide services, they shall be panned to protect equipment from leakage. Where required, sprinkler heads shall be provided with guards.

.4.11 Low voltage systems approved to be co-located in the Technology Rooms requiring wall mounting shall be located so as to not impede on the effective and required clearances of any/all racks and rack mounted equipment. The AE shall provide project specific room layouts that shall be approved by the TA during the Design Development phase, and verified by the installing contractor prior to installation. Should deviations from the approved layout be required, such modifications shall be reviewed with the TA prior to implementation.

.4.12 All Telecommunications Spaces shall be provision with electronic locking and access control consistent with and as an extension to the campus access control system.

.4.13 Provide grounding in accordance with the applicable standards, codes and as further defined in the attached Appendix M.

.5 SERVICE CONNECTIONS AND/OR CUT OVERS:

.5.1 The project shall request and fund any/all service connections, disconnections, relocations and/or required cut-overs to/from the campus

communications network, following established guidelines before project commencement. The TA shall be responsible for the performance of the work, or provision and coordination with an outside contractor once the request is received.

.5.2 The project shall be responsible for the removal of any/all cabling disconnected, and associated hardware rendered useless, back to the location determined by the TA. Cable and hardware removal shall be complete, and all label corrections/modifications shall be completed by the project to reflect the resultant condition. Verify determination of usability with the TA prior to demolition

.6 SERVICE ACTIVATIONS:

.6.1 The project contractor shall be responsible to contact the OCIO a minimum of six weeks, or WMCIT a minimum of twelve weeks, prior to installation of any new facilities needing to be placed. Should temporary services be required, such facilities shall also be provided by the TA with the associated costs borne by the project.

.6.2 All requests or communications shall be by phone through the TA's Help Desk or by means of the TA's website, for both installations and removals. Questions can also be directed to The TA's Help Desk. Outside Plant cabling and services must be installed into the building prior to expected service turn up.

.6.2.1 OCIO Contact Info:
.4.1.1 (614) 688-HELP
.4.1.2 https://osuitsm.service-now.com/selfservice/help_splash

.6.2.2 Medical Center Contact Info:
.1.4.2.1 (614) 293-3861
.1.4.2.2 https://osuitsm.service-now.com/wmc/main.do

.7 RECORD/AS-BUILT DOCUMENTATION

.7.1 Record Drawings: Color copies of the field Record Drawings, including all current mark ups, shall be given to the TA at the time of inspection for the Certificate of Occupancy. The field Record Drawings shall include all site drawings, floor plans, riser diagrams and schedules. Documentation shall have clearly indicated all cable counts, Work Area Outlets, and their associated ID's.

.7.2 As-Built Drawings shall be provided to the TA and to the Manager of Data Storage and Retrieval in the native format from within which the

construction documents were created, the latest revision of AutoCAD and pdf. The As-Built Documents shall include all information as prescribed in the field record drawings above

.8 OVERSITE AND INSPECTIONS:

.8.1 The TA shall be afforded the opportunity to oversee contractor activity and/or inspection of work.

.8.2 To facilitate TA awareness of contractor mobilization and activity, provide the TA with project schedules, including any/all updates to same. Schedules shall include separate activity line items for rough-in installation versus cabling/infrastructure installation.

.8.3 Inform the TA immediately of all design updates, addenda, bulletins, change orders, etc.

.8.4 Schedule inspection/approval of all below grade/slab work with TA AND Facilities Operations and Development before such work is covered. Failure to do so shall be require fully exposing the work down to the exposure of the ducts/buried cabling. Costs for such exposure shall be borne by the contractor.

.8.5 Provide all required access and facilities for inspections with costs for same borne by the project.

27 05 28. TECHNOLOGY PATHWAYS AND ROUGH INS

.1 Technology pathways shall include continuous pathways, such as conduits, cable trays, and raceways. Additionally, non-continuous pathways may be approved by the TA for some applications. However, those applications shall be approved in writing prior to design and bidding.

.1.1 The AE shall design all required pathways and rough ins required for the identified technology termination locations, such as data/voice work area outlets, and audio/visual equipment receptacle stations and include same in the project.

.1.2 Require pull strings be provided by the contractor for the full length of the raceway for all raceways.

.1.3 Refer to, and abide by, all clearances as identified in Appendix M, as well as all applicable standards.

.1.4 All pathways shall be routed parallel and/or perpendicular to building structural elements, and shall maintain all clearances as referenced in the attached Appendix M and the associated standards.

.2 Open Architecture Pathways: Also known as non-continuous pathways shall only be provided where cabling routes are accessible as defined in applicable codes. Such pathway applications shall be specifically compliant with the requirements listed in the attached Appendix M.

.2.1 All open architecture pathways shall utilize either a backbox with a conduit stub up to an accessible ceiling for all new work and renovations exposing wall studs or other back of wall structure.

.2.2 Open architecture pathways cut into existing walls shall utilize standard manufactured faceplate mounting brackets as defined in the attached Appendix M. In such cases, wall cavities must be clearly "fishable". Otherwise the AE shall seek approval for surface mounted raceway aesthetically acceptable to the environment within which it is installed.

.3 Conduits:

.3.1 Minimum size to be provided is 1". Conduits for communications shall be galvanized rigid steel conduit or surface mounted raceway (Wiremold) when exposed below 8' above finish floor. All conduit terminations shall have non-metallic bushings.

.3.2 Conduits run above 8' above finish floor may be EMT up to 4" with compression fittings.

.3.3 OSP (Outside Plant) cable shall be run in galvanized rigid steel conduit when transitioning from the outside of the building to the Main Distribution Frame (MDF).

.3.4 Provide pullboxes in all conduit runs as required by the attached Appendix M and the associated standard.

.3.5 All bends shall follow radius guidelines as outlined in the Bicsi standards. Manufactured bends and LB's are not acceptable.

.3.6 All conduit pathways shall comply with Bicsi/EIA/TIA and Ohio State University Building Design Standard - Appendix M relative to physical restrictions such as number of bends and pull-boxes.

.4 Backboxes: Provide a metallic backbox and finish ring commensurate with the environment within which it is to be installed. Backbox shall be standard trade sizes, unless otherwise recommended by the manufacturer of the equipment mounted to the backbox.

.4.1 All data/voice backboxes shall be a minimum of 4-11/16" square by 2-1/8" deep unless previously approved by the TA. Include a double gang plaster finish ring commensurate with the work area outlet faceplate to be provided.

.4.2 All audio/visual backboxes shall be sized as recommended by the manufacturer of the equipment to be mounted to same. Assure backboxes have depth sufficient to allow proper storage and bending radius of any/all cabling to be routed through and/or terminated at said rough-in. Any backbox having a cover upon which connectors shall be mounted shall be sized appropriately to allow easy connecting and disconnecting of cabling and devices to the connections.

.5 Cabletray: Where utilized, cabletray shall be routed only in code compliant and manufacturer recommended manner in accessible spaces and sized appropriate to both the current and potential future use of the project space. Coordinate potential future cabling considerations affecting cabletray sizing with the TA prior to completion of the Design Development phase. Minimum cabletray size for all usage of same, shall be no smaller than 18" by 4" deep.

.5.1 When utilized, cabletray shall traverse corridors, following the course of same, back to the Telecommunications Spaces associated. Cabletray shall only be routed where accessible after completion of project, e.g. in accessible ceilings or where access panels have been provided to as to facilitate future access to said cabletray.

.5.2 Transitions requiring elevations changes greater than of more than 5' shall utilize conduit pathways to achieve the transition. Firmly and affectively attach the conduit risers to the building structure.

.5.3 Cabletray shall not be notched or otherwise altered accept for changes of direction, and only by means of factory approved methods.

27 10 00. STRUCTURED CABLING

.1 All projects, both renovation and new build shall require a 20-year warranty by the connectivity manufacturer. Warranties provided by the cabling manufacturers shall not be acceptable.

.2 All structured cabling servicing security equipment and devices shall be routed to the associated Telecommunications Rooms and racks within. Terminate all cabling on dedicated patch panels for security services.

.3 Assure that cabling specifications require termination of cabling shall be T568A per University standards.

.4 Provide lightning protection for all cabling required to exit and/or enter a building perimeter.

.5 Single gang faceplates shall be allowed only in those circumstances where a single port is utilized. Should single gang faceplates be provided, verify that backboxes are still sized as defined in the conduit and backbox requirements previously stated. In no circumstance is a single-gang or box smaller than that defined above is allowed.

27 20 00. DATA COMMUNICATIONS

.1 Provide both wired and wireless system and infrastructure design to comply with performance criteria as required by the TA. Review room by room programming with the TA during development of the Program of Requirements and Design Development phases. Coordinate during each design phase with the TA and the Owner of any new or remodel projects to best ascertain both the room by room requirements and optimum deployment.

.2 WIRELESS NETWORK: At the completion of the Design Development phase submit an electronic copy of the project in the current revision of AutoCAD to the Project Manager/OCIO who will return a wireless design. Include said design in the final documents for inclusion by the contractor to install all cabling and associated hardware. Coordinate with the TA as to the delivery method for the installation of the actual access points.

27 30 00. VOICE COMMUNICATIONS

27 32 05. TELEPHONES

.1 TELEPHONES: Consult the Program of Requirements for spaces in which telephones are required. Possible inclusion of other spaces should be discussed at the initial planning conference. Also see Communications Wiring Standard in Appendix M.

.1.1 PROVISIONS FOR TELEPHONE INSTALLATION: Consult the University Architect regarding the source of details for design of conduit raceway systems, telephone equipment rooms, telephone switchgear or switchboard, equipment room ventilation or cooling, and other requirements peculiar to the project. Conform with all stipulated requirements.

.1.2 Provide voice services where required by codes, such as at all elevator machine rooms. Coordinate with the TA any additional life safety voice services. Refer to requirements for notifying the TA for circuit turn up addressed elsewhere in this Document.

.1.3 EMERGENCY PHONES: Provide cabling and pathway to any/all within the scope of the project, including but not limited to, elevator phone, area of refuge assistance and student residence entries.

27 40 00. AUDIO-VIDEO COMMUNICATIONS

27 41 00. AUDIO-VIDEO SYSTEMS

.1 TEACHING SYSTEMS: Provide closed circuit TV and other teaching aids as required by the Program of Requirements.

27 50 00. DISTRIBUTED COMMUNICATIONS AND MONITORING SYSTEMS

27 51 00. DISTRIBUTED VIDEO SYSTEMS

.1 TV SERVICES (CATV/IPTV): During the Programming of Requirements, review and coordinate, on a room by room basis, the services required with the TA to properly assess the means of transport and, in the case of IPTV, inform the TA on the potential impact on both the wired and wireless networks.

27 51 23. INTERCOMMUNICATION AND PROGRAM SYSTEMS

.1 INTERCOMMUNICATIONS SYSTEMS: See Appendix M, Communications Wiring Standard.

.2 OTHER INTERCOMMUNICATIONS SYSTEMS: Refer to the Program of Requirements

.2.1 LOCAL SYSTEMS: Local PA systems shall be capable of operation without a technician in attendance.

.2.2 STORAGE OF EQUIPMENT: Design adequate spaces, properly secured, for storage of portable equipment.

27 52 23. **Wexner Medical Center:** NURSES CALL SYSTEMS: Refer to the Program of Requirements.

.1 SYSTEM ARCHITECTURE: The existing nurse call systems consist of multiple Rauland Borg Responder 5 and Ascom Tellingence systems located throughout the Ohio State University Medical Center complex. Each system type is networked via OSUWMC IT local area networks to central servers located at the Ackerman Road data center location. Systems currently interface with 3rd party wireless devices through Connexall middleware. Program will define need for interface on a per project basis.

.2 FIELD DEVICES: Type and quantity determined by FGI Guidelines. Program requirements may need additional functionality and needs, defined on a per project basis.

.3 PILLOW SPEAKERS: Where required, the system shall be provided with sealed pillow speakers that allow for nurse call, direct communication with nurse call master station, direct digital control of TV's and control of room lighting (one for general lighting and one for reading light). The lighting control relay shall be separate from the light fixture and mounted above the ceiling near entry to the patient room.

.4 SPARE PARTS: Provide 10% spare parts for field devices

.5 WARRANTY AND TRAINING: Supplier shall provide a minimum (1) year warranty with emergency service applicable. Nurse call system manufacturer or associated local representative shall provide maximum (1/2) hour telephone response and (4) hour site response time for emergency calls during the warranty period. Both user and maintenance training shall be provided (including off shift).

.6 SERVICE: All service outside of warranty shall be provided under a separate contract

27 53 13 **Wexner Medical Center:** SUPERVISED CLOCK SYSTEMS: (For Medical Center Projects)

.1 A supervised clock system will be provided only when so required by the building or space program.

.2 Supervised clocks shall be digital type only.

.3 Clock numbers shall be red, 4" numbers with black housing.

.4 Clock shall be controlled via dedicated data drop with power over ethernet – no external power supplies shall be required.

.5 Clocks will have hour and minute displayed. Clocks requiring seconds displayed will be specified by the program.

27 53 19 Distributed Antenna System

.1 Provide a vendor neutral Ohio State University owned distributed antenna system, DAS, compatible with and an extension of the existing campus distribution system. System shall utilize fiber optic distribution to a network of local amplifiers from which a passive distribution shall serve local antennas.

.2 Distribution shall provision 700, 850, PCS and AWS bands. Verify with PM the required service providers to be accommodated. Contact providers and verify any additional bands that may be required.

.3 Verify any University and/or service provider performance criteria with regard to minimum signal level, maximum noise level and isolation from the exterior macro.

.4 Determine with the requisite service providers the type of donor service required and provide all necessary equipment and hardware to fully provision same.

~~27 53 13. CLOCK AND PROGRAM SYSTEMS: .1 SUPERVISED SYSTEM: A supervised clock system will be provided only when so required by the building program. Supervised clocks shall be impulse type only, connected to the University clock system. Clock second hands are not acceptable. .2 CLOCK AND FIRE ALARM SYSTEMS BIDDING PROCESS: Fire Alarm systems and supervised systems are viewed by the University as separate stand-alone systems. They shall not be bid as a combined system by a single manufacturer. Each system shall be bid with a separate cost proposal in projects with Fire Alarm and Supervised Clock systems.~~

~~27 53 15. CLASS BELLS: Provide in corridors of all academic buildings. Bells shall be 10-inch underdome, single stroke, 110-volt a-c, with power obtained from local building supply, and pilot wire control from the campus system. Installation height shall be specified as 80" above the finished floor. It is expressly prohibited to make any additions to the Monitor Dynamics Incorporated (MDI) system.~~

END OF DIVISION 27 - COMMUNICATIONS

28 10 05.2 28 00 00. ELECTRONIC SAFETY AND SECURITY

.1 The Project Manager and the A/E shall meet with Ohio State University Department of Public Safety (DPS) and Facilities Operations and Development's (FOD's) Lock & Key Services (LKS) at the initial planning phases of the project to review with DPS and FOD's LKS the location, use and user of the intended project so DPS and FOD's LKS can consider and provide needed guidance and expectations relative to the security needs of the facility(ies) to be constructed. The AE shall further meet with DPS and FOD's LKS during the Design Development stage and again prior to the release of the Construction Documents to review any changes in program, and provisions of expected security devices. The AE shall receive written approval of the final design prior to public bidding of the project.

.2 The Project Manager shall keep the Department of Public Safety and FOD's LKS apprised of the project's progress, and prior to substantial completion and acceptance by the Ohio State University, shall facilitate a walk-through by DPS representative to assure the approved security measures have been accommodated.

28 10 00. ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION

28 10 05. SECURITY SYSTEM for Security and/or CCTV:

.1 The following situations, but not limited to, for installing security and/or CCTV may be required by DPS:

- .1.1 Building perimeter security and access control
- .1.2 High monetary value property owned by or loaned to The Ohio State University
- .1.3 Property with significant historical, cultural or artistic value
- .1.4 Intellectual Property storage
- .1.4 Where dictated by law or regulations
- .1.5 Where currency is counted or exchanged (these areas shall include CCTV into the security plan)
- .1.6 Any areas where external threats are perceived to be likely (Duress alarms must include CCTV into the security plan)

.2 Security systems shall be installed and connected to the campus-wide Access Control and Alarm Monitoring System (ACAMS), which provides alarm signal to the DPS Communication & Security Technology Division. - Requirements for area security systems shall be discussed at the initial planning conference with the DPS and FOD's LKS. - Reference Appendix Y for the basic security planning design requirements. All security plans shall be reviewed and approved by DPS and Facilities Operations and Development's (FOD's) Lock & Key Services (LKS).

28 10 10. ACCESS CONTROL and ALARM MONITORING SYSTEM (ACAMS): The system shall be based upon, and connected to, the University's existing campus-wide

Access Control and Alarm Monitoring System (ACAMS) The system is applicable to all campus buildings, excluding the University Hospitals. All campus buildings shall require 24-hour remote monitoring and reporting, and shall use this ACAMS system, and shall report to DPS and the Facilities Operations and Development Service Center. The ACAMS system is ~~not~~ supported on the regional campuses. Other additional security system requirements for ~~security systems at~~ the regional campuses shall be determined in coordination with DPS.

.1 MINIMUM REQUIRED INFRASTRUCTURE for LIFE SAFETY: Whether or not there is any access control specified or not, provide the initial basis of an Access Control and Alarm Monitoring Systems (ACAMS). Specify and provide as a minimum all of the following infrastructure for Life Safety, including:

.1.1 Minimum (1) Lenel Intelligent System Controller with a 3300 board, including the following:

.1.1.1 Host communications on path #1, TCP/IP.
.1.1.2 Communication jacks within the controller for path #1 and path #2.

.1.2 Quantity as required Lenel Input Control Module(s) using an 1100 board.
.1.3 Lenel manufacturer's battery backups for the above.
.1.4 (not used)
.1.5 Fire Alarm System auxiliary points to be monitored shall include:

.1.5.1 Fire Alarm (Detection) System Common Alarm
.1.5.2 Fire Alarm (Detection) System Common Trouble Signal
.1.5.3 Fire Alarm (Detection) System Common Supervisory Signal
.1.5.4 Fire Suppression System Common Alarm
.1.5.5 Fire Suppression System Common Trouble Signal
.1.5.6 Fire Suppression System Common Supervisory

.1.6 HVAC system auxiliary points to be monitored shall include:

.1.6.1 HVAC System Common Loss of Heat Alarm.
.1.6.2 HVAC System Common Loss of Cooling Alarm.
.1.6.3 HVAC Loss of Critical Environments Alarm (if any critical environments apply).

.1.7 Emergency Generator auxiliary points to be monitored shall include:

.1.7.1 Emergency Generator Is Running Alarm.

.1.8 This minimum infrastructure must be specified to be consistent with all of the requirements of the below Standards, paragraphs .2 through .11, inclusive.

.1.9 **Wexner Medical Center:** ACAMS Security systems do not monitor the fire alarm, HVAC or Emergency Generator systems for the OSUWMC related facilities unless otherwise specified.

.2 FIELD HARDWARE: The new field hardware shall be manufactured by Lenel Systems, International, Inc., Corporate Headquarters, 1212 Pittsford-Victor Rd., Pittsford, NY 14534-3820, and shall include:

.2.1 Quantity 1 or more, Intelligent System Controller(s) (ISC's), LNL-3300 board using a LNL600-ULX enclosure, minimum one per building, and/or additional one per individual business group if necessary to segregate different costs or different application requirements within any single building. Do not share ISC's between buildings. The primary Intelligent System Controller (ISC) must be mounted within the Main Distribution Frame (MDF) room.
The lock for the 600 shall be purchased by the contractor through the FOD's Lock & Key Services, and shall be field installed by the FOD's Lock & Key Services. Approved lock cylinders and cores shall be per Division – 08 of these standards, part number Best 5E7D1 series Cam Lock, and appurtenances.

.2.1.1 Host Path communication shall be included and enabled:

.2.1.1.1 Host Communication Path #1 shall be TCP/IP communications using Ethernet over the campus-wide OCIO (fiber-based) data communications network, 10/100 BaseT Connecting to the micro serial device in the main Lenel panel.

.2.1.1.2 Within each Intelligent System Controller, provide data jack for connection of the communication network wiring.

.2.2 Quantity as required, Input Control Modules (ICM's), Output Control Modules (OCM's), Dual Reader Interface modules (DRI's), Magnetic-swipe Access Readers, Keypads, and/or Proximity Access Readers. Single Reader Interface modules (SRI's) are prohibited.

.2.3 Provide lithium battery for backup of local event memory and local databases.

.2.4 Provide 12-VDC lead-acid battery for 4-hour backup for local controller and local module operation.

.2.5 Door hardware operation shall remain exclusively on commercial power, and shall 'not' be battery backed-up. Door hardware shall be configured to close and lock upon loss of commercial power, unless rated as a fire door, which will then be required to latch but remain unlocked upon loss of commercial power. Refer to and coordinate with, Division 8, Doors and Windows, Section 08 70 00 - Hardware, of these Building Design Standards plus the FOD's Lock & Key Services concerning door hardware and access control.

.3 HOST-COMPUTER SOFTWARE and FIELD FIRMWARE AND FLASHWARE: The existing system host-computer software is Lenel OnGuard® Access™ manufactured by Lenel Systems, International, Inc., Corporate Headquarters, 1212 Pittsford-Victor Rd., Pittsford, NY 14534-3820. Furnish all firmware and flashware within new field hardware

to be compatible with existing host computer software revisions as currently installed within the existing host-computer.

.4 ADDITIONAL EQUIPMENT: Provide additional equipment within the communications Main Distribution Frame (MDF) room, as follows:

.4.1 OCIO FIBER-to-WIRE MEDIA CONVERTER: For connection to OCIO fiber data communications network, 10/100 BaseT (specific media converter to be provided by OCIO).

.4.2 OCIO PRIMARY ETHERNET SWITCH: For connection to OCIO data communications network, 10/100 BaseT, rack mount, (specific switch to be provided by OCIO).

.5 LENEL AUTHORIZED VAR: The system shall be furnished and installed by a contractor that is certified by Lenel as an Authorized OnGuard® Value Added Reseller (VAR) of Lenel systems, for sales, installation, and service for the Columbus, Ohio area at the time of award of the subcontract for the system. All warranty service shall be by this same contractor.

.6 CARD READERS and CARDS: University standard card readers and cards are magnetic-swipe, using BUCK-ID card or University Hospital ID card, all using Wiegand communications protocol. Proximity readers, which are more expensive to purchase and maintain versus magnetic-swipe readers, shall be used only with the approval of FOD's Lock & Key Services and for specific operational and/or safety requirements only. Cards for proximity readers, which are more expensive to purchase and maintain versus magnetic-swipe cards, are separately available for premium charge through University BUCK-ID Services. Costs for proximity cards shall remain the responsibility of the Using group.

.6.1 Required to use LNL 1320 dual reader interface
.6.2 MAGNETIC-SWIPE CARD READERS: Lenel LNL2010W.
.6.3 MAG-SWIPE CARD READERS with KEYPAD: Lenel LNL2020W.
.6.4 KEYPAD, only: Lenel LNL834S121NN, LNL826S121NN or LNL-CK with a LNL2010W
.6.5 All keypad installations will require LED indicator panel part number RP9 display with red and green indicators and a local sounder.
.6.6 PROXIMITY READERS: Proximity readers shall be used only with the approval of Facilities Operations and Development' Lock & Key Services and for specific operational and/or safety requirements only.

.6.6.1 PROXIMITY READER: HID Corporation, ProxPro II #5455B (N-00_04).
.6.6.2 PROX READER with KEYPAD: HID Corporation, ProxPro #5355A (K-00_09).
.6.6.3 HID Corporation (An ASSA ABLOY Group company),
292 Jeronimo Road, Irvine, CA 92618-1905, USA,
Phone: 949 598 1600 or 800-237 PROX, Fax: 949 598 1690

.6.7 900mhz Wireless Locks: Schlage AD400 (Division 08 – 08 76 00)

.6.7.1 Requires a separate LNL-3300 ISC to support the Schlage AD400 system
.6.7.2 Requires a LNL-400ULX enclosure to house the LNL-3300 ISC
.6.7.3 Requires PIM400-485 900mhz access points
.6.7.4 Requires a 12V 7AH Backup battery to support the LNL-3300 ISC
.6.7.5 Conduit is only required between the LNL-3300 ISC and the building network switch; no downstream devices require conduit.

.7 MONITORING CONTACTS: Door monitoring contacts, and wiring and conduits thereto, shall be concealed and invisible when the door is closed. Externally applied door monitoring contacts, externally applied conduit or Wiremold, and wire without conduit are prohibited.

.8 AUXILARY POINTS to be MONITORED/ALARMED: Provide monitoring and alarming of the following minimum auxiliary points, including:

.8.1 ACAMS system auxiliary points to be monitored:

.8.1.1 Door Tamper Switches from any-and-all enclosures for ACAMS controllers, ACAMS modules .
.8.1.2 Power Failure Status, for Commercial 120-VAC power, from any-and-all power supplies for ACAMS controllers and ACAMS modules.
.8.1.3 Power Failure Status or Low-Battery Status, for 12-VDC, Lead-acid Battery Backup, from any-and-all power supplies for ACAMS controllers, and ACAMS modules.

.8.2 Fire Alarm system auxiliary points to be monitored:

.8.2.1 Fire Alarm (Detection) System Common Alarm
.8.2.2 Fire Alarm (Detection) System Common Trouble Signal
.8.2.3 Fire Alarm (Detection) System Common Supervisory Signal
.8.2.4 Fire Suppression System Common Alarm
.8.2.5 Fire Suppression System Common Trouble Signal
.8.2.6 Fire Suppression System Common Supervisory

.8.3 Building Automation System auxiliary points to be monitored:

.8.3.1 HVAC system Common Loss-of-Heat Alarm.
.8.3.2 HVAC system Common Loss-of-Cooling Alarm.
.8.3.3 HVAC system Common Loss-of-Critical-Environments Alarm (if any critical environments apply).

.8.4 Emergency Generator points to be monitored: It is important to never exceed 500-hours run time on any emergency generator within any 12-month period, to minimize operating hours, maximize generator life, and to avoid additional EPA permits for the generator.

.8.4.1 Emergency Generator Is Running Alarm. Provide a remote annunciator panel, required by NFPA 110-5.6.6 Remote Controls and Alarms, located next to the fire alarm system's remote annunciator panel as approved by the DPS.

.8.5 **Wexner Medical Center:** ACAMS Security systems do not monitor the fire alarm, HVAC or Emergency Generator systems for the OSUWMC related facilities unless otherwise specified.

.

.9 CABLE AND WIRE:

.9.1 All fiber optic cable shall be specified and provided consistent with all requirements of Appendix M, The Ohio State University Communications Wiring Standard.

.9.2 All TCP/IP communication wire shall be specified and provided consistent with all requirements of Appendix M, The Ohio State University Communications Wiring Standard, 'and' consistent with all requirements of the manufacturers.

.9.3 All communications wiring between the Intelligent System Controller and all downstream modules, shall be specified and provided consistent with all requirements of all sections of Division 26 and 27 specifications, 'and' consistent with all requirements of the manufacturers. All communications on the ACAMS system using RS-485 communications protocol must use 2-pair twisted/shielded wiring, Belden #9842 or Belden equivalent.

.9.3.1 Belden #9842, or Belden equivalent
.9.3.2 Numbers of pairs - 2.
.9.3.3 Total numbers of conductors - 4.
.9.3.4 AWG - 24.
.9.3.5 Outer Jacket PVC - polyvinyl chloride.
.9.3.6 NEC/UL specification CM, NON-plenum.
.9.3.7 Outside diameter, .340 inches.
.9.3.8 (24 AWG stranded (7x32) tinned copper conductors, twisted pairs, polyethylene insulated, overall 100% Beldfoil® shield plus a 90% tinned copper braid shield, 24 AWG (7x32) tinned copper drain wire, PVC jacket.)

.9.4 All power wiring, and all control wiring to-and-from controllers, modules, readers, powered latches, etc., shall be specified to be in conduit and shall be provided consistent with all requirements of all sections of Division 26 specifications, 'and' consistent with all requirements of the manufacturers.

.10 EXCEPTIONS: Temporary independent security systems outside the University ACAMS system require approval from DPS and FOD's LKS to meet the following requirements: -

.10.1 Call-in alarms from Remote Central Station providers within Ohio State University Police primary jurisdiction shall identify DPS as their primary point of contact for all incoming alarms: fire, intrusion, duress, etc.

.10.1.1 Approval excludes service or maintenance calls for independent security systems.

.10.2 Alarm Subscribers / Remote Central Station providers shall annually submit an up-to-date copy of the "Ohio State University DPS Alarm Registration" form to DPS. The form can be found on the DPS's website https://dps.osu.edu or by calling 614-292-2121.

.11 PROHIBITIONS:

.11.1 Single Reader Interface modules (SRI's) are prohibited.
.11.2 Externally applied door monitoring contacts, externally applied conduit or Wiremold, and wire without conduit are prohibited.
.11.3 Splicing of power and control wiring and cables and the use of wire nuts are prohibited.

Commentary: *Splicing of wire and cables and the use of wire nuts often cause ground faults and are difficult to trace.*

28 23 23 VIDEO SURVEILLANCE SYSTEMS / CLOSED CIRCUIT TV (CCTV)

.1 ~~The system shall be based upon, and connected to, the University's existing campus-wide video surveillance system.~~

.1.1 All security equipment shall be reviewed for system compatibility by DPS and in consultation with the project team.
.1.2 All security equipment shall report all signals to DPS. Any signal sent out beyond DPS will be monitored and approved by DPS.
.1.3 Locations of security cameras indicated in the project documents are schematic only, final field locations of security cameras shall be approved by DPS prior to installation.

Commentary: *Final security camera locations are to be functional. Coordinate with other trades to avoid conflict with, but not limited to, light fixtures (obstructions and glare), exposed ductwork, architectural clouds, and FF&E, etc.*

28 30 00 ELECTRONIC DETECTION AND ALARM

28 31 00. FIRE DETECTION AND ALARM

.1 GENERAL: Design the fire detection and alarm system to minimize risk to the University's Customers (students, patients, residents, researchers, staff, and visitors), minimize risk to the University's property, reduce the University's support costs, and allow for cost-effective future expansion by the University. Design a complete system including:

.1.1 Control panels,
.1.2 Annunciators,
.1.3 Initiating devices:

.1.3.1 Manual pull-stations,
.1.3.2 Automatic smoke detectors,
.1.3.3 Automatic heat detectors,
.1.3.4 Carbon monoxide detectors
.1.3.5 Local emergency alarms (hazardous materials)
.1.3.6 Automatic rate-of-rise detectors,
.1.3.7 Automatic flow and tamper switches, and
.1.3.8 Other initiating devices (dry contacts, etc.) as required

.1.4 Notification appliances:

.1.4.1 Horns: Horns shall be allowed only with existing horn systems when the renovation project is limited in scope. The use of horns requires early project review for approval by FOD's Technical Services Group and DPS~~;~~
.1.4.1 Speakers,
.1.4.2 Strobes,
.1.4.3 Other notification appliances (dry contacts, etc.) as required;

.1.5 Other device types:
.1.5.1 Electromagnetic Fire & Smoke Barrier Door Holder releases,
.1.5.2 Fire Exit/Security Egress Doors with Electrically Locking /Unlocking Door Hardware provide Fire Alarm Input. The building's fire alarm system shall provide normally closed contacts which open on alarm.

Commentary: *The input disables the electrical locking device (fail safe) upon a fire alarm.*

Fan Shutdown Relays, and any other items as required for a complete system.

.1.1 SINGLE SYSTEM FUNCTIONS:

.1.1.1 Within any single building, design a complete system that integrates the existing and new systems into a single Fire Alarm Control Panel (FACP) system at one common location. For systems that are to be integrated with existing systems request the University Project Manager confirm with FOD's Fire System Shop that the existing system is operating normally, prior to and following construction. Integrate and update to current technology the following into one system:

.1.1.1.1 Existing common alarms from existing systems,
.1.1.1.2 New common alarms from new systems,
.1.1.1.3 Existing common trouble signals from existing systems,
.1.1.1.4 New common trouble signals from new systems (all trouble and alarm resets are to be located at one point),

.1.1.1.5 Single-button building system, common alarm silence, silences existing and new systems in parallel, and

.1.1.1.6 Single-button building system, common reset, resets existing, and new systems in parallel.

.1.1.1.7 All panels shall be by the same manufacturer.

.1.1.2 The A/E shall review with FOD's Technical Services Group the acceptable Fire Alarm System manufacturers for a project.

Commentary: *-Examples of acceptable basis of design fire alarm system manufacturers:* Ohio State University *Wexner Medical Center: Johnson Controls; Student Life Residence Halls: Siemens Fire Finder XLSV; Academic and Facility Operations & Development buildings: Notifier ONYX Series NFS2-640*

The installation of voice fire alarm systems on all campuses is intended to enhance the DPS's ability to communicate in an emergency.

.1.2 COMPLIANCE: All new systems and components shall be Underwriters' Laboratory (UL) listed as compliant with all applicable codes and standards, including the edition of National Fire Protection Association (NFPA) Standard 72 as adopted by the Ohio Building Code (OBC) and Ohio Fire Code (OFC), and shall be installed in accordance with the OBC and the OFC. Initiating devices for ventilation systems shall be installed in compliance with NFPA Standard 90A. Initiating devices for water flow shall comply with NFPA 13 (Sprinkler Systems) and other appropriate or pertinent NFPA Standards regarding the installation, locations, and sensitivity of flow alarms and annunciation. Each piece of equipment shall be approved, listed, and labeled with the UL label and installed in accordance with the limitations of the listing and manufacturer's written instructions, including environmental limitations.

.1.2.1 Surge Protection Device (SPD) shall be specified for all new fire alarm systems and existing systems that do not have SPD installed. Verify that adding SPD to existing fire alarm control panels will not void the UL Listing.

.1.3 Special requirements:

.1.3.1 All fire alarm systems shall also be capable of functioning as an emergency communication system (ECS).

.1.3.2 The emergency communication system (ECS) must provide an automatic voice message in response to the receipt of a signal indicative of a fire emergency. The Fire Alarm Voice Evacuation Standard Message shall be: (Pre-alarm tone Slow Whoop) ---- "May I have your attention please, a fire alarm has been reported in the building please exit the building by the nearest exit or stairwell, do not use the elevator."

.1.3.3 Manual control with the capability of making live voice announcements must also be furnished to provide occupants notification on either a selective or

all-call basis. The capability for making live voice announcements on a selective or "all call" basis shall be provided both at the main fire alarm control panel for the building and remotely from Blankenship Hall (DPS). All new fire alarm control panels installed must include all hardware and software required for making remote live voice announcements.

.1.3.4 With the exception of mass notification, a fire alarm and emergency communication system are not permitted to be integrated with other building systems such as building automation, energy management, security, and so on. Fire Alarm and emergency communication systems must be self-contained, standalone systems able to function independently of other building systems.

.1.3.5 Fire alarm and emergency communication system control equipment that is installed in non-high-rise buildings, is desired to be located within a room separated from the remainder of the building by not less than a one-hour fire resistance-rated fire barrier. The room should be provided in a location approved by DPS ~~the Division of Emergency Management & Fire Prevention Representative,~~ the University Architect and University Engineer after consultation with the local fire department.

Student Life: Note that not all existing buildings nor Student Life buildings will be required to meet this requirement.

.1.3.6 Fire alarm and emergency communication system control equipment that is installed in high-rise buildings shall be located in a Fire Command Center as required by applicable codes.

.1.3.7 NFPA 72 survivability level shall be specified by the A/E based on applicable codes and evacuation scheme for all fire alarm system designs. Where a partial evacuation scheme is employed, all notification circuits and associated equipment serving the fire/smoke zones shall be protected until it reaches the fire/smoke zone served. Fire rated cable must be provided as required by this specification, regardless of NFPA 72 survivability level. Reference .2.1.9 (Network Riser Cable) and .2.1.7 (Network Access Control Panels).

.1.3.8 Provide IP and RS-232 / RS-485 interface connection at the FACP for the emergency communication system.

.1.3.9 Provide all required monitoring I/O to enable the monitoring and Fault Condition Reporting ~~annunciation~~ of the Emergency ~~First~~ Responder Radio System when provided in the scope of the project.

.1.4 TECHNOLOGY: Each system shall have indicator's showing zone location, zone alarm, zone trouble, and system trouble. The new systems shall be analog addressable with adjustable pre-alarm level, with analog addressable notification

devices, and addressable appliances. Panels, devices, and appliances shall be based upon EEPROM memory (electrically erasable programmable read only memory) or "flash" memory, for address, sensitivity, and pre-alarm levels, and shall be programmable in the field by the University. (Panels, devices, and appliances limited to PROM memory, EPROM memory, or RAM memory are not acceptable).

ALTERNATIVE: Upon written exception from the University Architect, you may design an addition to, or expansion of, any existing system using technology matching the existing hardware. All other performance requirements, with the exception of analog addressable technology, shall be included.

.1.5 ACCEPTANCE BY THE UNIVERSITY

.1.5.1 Acceptance by the University: The system must be scheduled by DPS to be demonstrated in the presence of the State of Ohio Fire Marshal (the authority having jurisdiction), A/E, University Project Manager, the University's Director of Maintenance, and their designated representatives, Fire System Shop. During acceptance, the contractor shall demonstrate the following to the University's designees:

.1.5.1.1 Alarm Verification: - Report by device - Pinpoint location Device type identification and address
.1.5.1.2 Alarm/Trouble per device and component
.1.5.1.3 Full field programmability via a laptop Windows-based personal computer:
- .1 Address verify and change,
- .2 Sensitivity verify and change,
- .3 Pre-alarm level verify and change,
- .4 Field changes shall upload to central panels
- .5 Field changes shall download from central panels

.1.5.1.4 Single-button building system, common alarm silence, silences existing and new systems in parallel.
.1.5.1.5 Single-button building system, common reset, resets existing and new systems in parallel.
.1.5.1.6 Battery power capacity.

.1.5.2 System will not be accepted until all components and functions are demonstrated to be in full operation for a minimum of seven (7) consecutive days without trouble conditions, before claiming substantial completion.

.1.6 WARRANTY:

.1.6.1 Provide full 2-year parts and labor warranty for the entire system including batteries. Warranty shall include telephone response within 30 minutes and site response within 4 hours for emergency calls during the warranty period.

.1.6.2 Warranty period shall commence at date of signed University Acceptance. All service outside of warranty shall be under a separate contract.

.1.6.3 For small renovation projects provide the standard 1-year parts and labor warranty.

Commentary: *Date of manufacture, date of shipment, date of delivery, date of installation, etc. shall not constitute date of warranty commencement for the purpose of the project.*

.1.7 TRAINING FOR DAILY OPERATION: The amount of training required will vary with the size of the project and extent of installation. Specific requirements need to be verified with Ohio State University Project Manager prior to finalization of design documents. All training shall be scheduled by the contractor in coordination with Facilities Operations and Development, Training Officer, and their designated representatives. All training shall be video recorded. The A/E shall consult with FOD's Fire System Shop and Technical Services Group on the appropriate level of training requirements for each project.

.1.8 TOOLS: Provide OEM hardware tools and documentation, OEM software tools and documentation, and password(s)

.1.9 TRAINING FOR SYSTEM MAINTENANCE: For New Fire Alarm System Models or significant changes to existing models that require manufacturer certification training to be authorized to work on the system:

Commentary**:** *The University desires to become self-sufficient and skilled to perform regular preventive maintenance, annual system inspections, remedial maintenance, and small renovations.*

.1.9.1 The A/E and University Project Manager shall consult with Facilities Operations and Development's Fire System Shop and Technical Services Group on the appropriate level of training requirements for each project.

.1.9.2 In addition to the above training for daily operation, an allowance may be established for system maintenance training, including the OEM manufacturer's certification standards for:

.1.9.2.1 OEM training on the use of the OEM hardware and software tools, and OEM certificate of "Authorized Warranty Service Technician" or equivalent.

.1.9.2.2 All training and diagnostics shall be identical to that as provided and available to the factory authorized service representatives. The training shall allow the University to perform all maintenance and inspection functions. The hardware tools shall include EEPROM programmers using industry standard laptop personal computers. The software tools shall perform on industry standard Windows-based laptop computers, using industry standard MS-Windows

operating systems. The training shall be conducted by the manufacturer's trainers, and shall include classroom hands-on training.

Commentary: *Training budget to consider travel allowance for two (2) University employees - including per diem expenses for hotel room(s), meals and incidentals based on Federal Government GSA rates (www.gsa.gov) in addition include an allowance for a rental car*.

.1.10 ANNUAL INSPECTIONS: The system, devices, and applications, along with OEM training of the University's Operations personnel, shall allow the University to perform the "One Person Walk Tests" by area, location, device, address, or system. The tests shall include:

.1.10.1 Full System
.1.10.2 Area
.1.10.3 Alarm/Trouble
.1.10.4 Silent/Audible Modes
.1.10.5 Printed Record of All Tests
.1.10.6 Audible Appliance Type & Identification
.1.10.7 Auto "Timed-Out" With Warning

.2 SYSTEM TYPE AND FUNCTIONS: System shall be analog, addressable, adjustable pre-alarm level, non-coded, continuous alarming type. An alarm shall continue to notify until the initiating device has been restored, and the single-button common building system reset switch has been operated.

.2.1 WIRING AND POWER: This Standard requires the following:

.2.1.1 All wiring for the Fire Alarm Systems shall be color coded.
.2.1.2 Each wire shall have a numbered tag at both ends.
.2.1.3 All fire alarm wiring shall be run in a ¾" minimum conduit size and conduit system separate from all other systems. Conduit compression couplings shall be required to be used for all fire alarm system conduits. The use of full wall flexible conduit shall be limited to short lengths where fire alarm appliances are mounted on suspended acoustical ceilings, tamper and flow switches and Type LA Liquatite Flexible Conduit for wet, oily conditions (e.g. fire pump motor leads) both types shall be UL listed for use in accordance with the NEC.

Commentary: *Provide compression couplings per all UL Listed tested assemblies and as a requirement to reduce the opportunity for water to entry the conduit system and cause damage to fire alarm panels.*

.2.1.4 All Power-Limited Fire Alarm Circuit (PLFA) system wiring shall be stranded and/or solid copper, minimum 75 degree C insulation, Type FPLP, FPLR,

and XHHW-2 for Utility Plant applications, and shall be used for initiating and communicating devices as permitted by National Electrical Code (NEC - 760). All Non-Power-Limited Fire Alarm (NPLFA) circuits shall be stranded and/or solid copper Type THW or XHHW and XHHW-2 for Utility Plant applications as permitted by National Electrical Code (NEC-760). The A/E is required to witness the wire type on site prior to the wire being pulled.

.2.1.5 Nylon insulation jacketed cables are prohibited. THHN/THWN cables are prohibited for use in fire alarm systems.

.2.1.6 Flame retardant PVC jacketed cables are required. Cable must have resistance to flame spread and reduce smoke generating properties.

Commentary: *Purpose of the rating is to lessen the transmission of fire and visible smoke to unaffected parts of the building.*

.2.1.7 Cabling for the floor's fire alarm system devices, <u>including power for 24V door holder:</u> The cable shall not penetrate floors or ceilings (i.e. cable may only be used within a single floor).

.2.1.8 Grounding: All fire alarm systems shall be grounded. The grounding shall be connected to the building's electrical grounding system. Refer to Building Design Standards 26 20 06.

.2.1.9 Network Riser cable shall have a two-hour fire-resistive rating. The A/E shall review the method to be used to achieve the rating with FOD's -Technical Services Group.

<u>Commentary:</u> *<u>It is recommended not to encase fire alarm cabling in concrete floor slabs to achieve the two-hour fire-resistive rating.</u>*

.2.1.10 Final connection between equipment and the wiring system to be made under the direct supervision of a representative of the manufacturer.

.2.1.11 All wires shall be terminated with ring or split terminal crimp on connectors.

.2.1.12 All fire alarm system wiring shall be plenum rated.

.2.1.13 Firefighters two way communication, when required shall be by a Distributed Antenna System. <u>Consult with DPS for listing of supported public safety RF frequencies.</u> <u>A/E shall design the system in compliance with the current OBC, OFC and applicable editions (as referenced by OBC and OFC) of NFPA 72 and 1221 requirements for Emergency Responder Radio System (ERRS) Guidelines.</u>

.2.1.14 Splicing of power and or/or control wiring and the use of wire nuts is prohibited.

.2.1.15 Cable Taps: Use numbered screw terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made. Use split terminal crimp on connectors.

.2.1.16 Wiring within enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire

alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams.

.2.1.17 Network Access Control (NAC) Panels are to be wired as a circuit to the Fire Alarm Control Panel with 2-hour Fire Rated Cable. Buildings with multiple Fire Alarm Control Panels and/or Transponder Panels shall be wired as a circuit to the Command Center's Fire Alarm Control Panel with 2-hour Fire Rated Cable.

.2.1.18 Multi-conductor Non-Power-Limited Fire Alarm Cables are permitted to be installed as wiring within buildings for the following locations:

.2.1.18.1 Space used for Environmental air-handling purposes.

.2.1.18.2 In exposed or fished in concealed spaces.

.2.1.18.3 Where passing through a floor or wall in metal raceway.

.2.1.18.4 In rigid non-metallic conduit, such as over hung ceilings and for wiring in ducts and plenums. This does not include habitable rooms or areas of buildings, in which the main purpose is not air handling, or the joist and stud spaces of dwelling units. It shall be used or permitted on Fire Alarm circuits operating at 150 Volts or less. All initiating devices, all notification appliances, and all panels shall be under constant electrical supervision by the fire alarm system. An open or ground in any wire shall cause a trouble alarm to operate. The systems shall include battery standby power. Systems shall indicate a trouble alarm upon loss of battery standby power, and shall close a separate dry contact output. When commercial AC power is restored, the systems shall automatically revert to AC power, without operator intervention. Batteries shall be sized to provide a minimum of 24 hours of monitoring, plus 15 minutes of 100% full alarm output. Recharging systems shall be sized to recharge all batteries to 100% capacity within 12 hours. When the system is operating on battery for one minute, the fire door relays shall release to conserve battery power. Locate trouble alarms in a public area.

.2.1.19 All field wiring for Fire Alarm Control Panel and accessory control panels shall enter a 4 x 4 duct (min.) located to the side or bottom of the panels. No connections other than through the side or bottom of panels and through the 4 x 4 duct shall be permitted.

.2.2 CLASS of CIRCUITS:

.2.2.1 Initiating Device Circuits shall be Class A.

.2.2.2 Signaling Line Circuits shall be Class X.

.2.2.3 Notification Appliance Circuits shall be Class A, except OSUWMC, which can be Class B where separate circuits are provided for each smoke zone.

.2.3 INDIVIDUAL INITIATION CIRCUITS: Design the initiation circuits to be zoned and separated as follows:

.2.3.1 Manual devices (all pull-stations) shall report independently from automatic devices (smoke detectors).
.2.3.2 Water flow switches shall report independently from other devices.
.2.3.3 All other devices shall be zoned as required per codes and application.
.2.3.4 Address assignments on any single circuit shall not exceed 75% of the address capacity of the circuit, to allow for future expansion.
.2.3.5 Power draw and/or voltage drop on any single circuit shall not exceed 75% of the power and/or voltage limitation of the circuit, to allow for future expansion.

.2.4 MANUAL DEVICES: Manual devices (all pull-stations) shall be addressable, surface mounted or semi-flush mounted as conditions dictate. New stations shall be double-action, with a key reset. Within any single building, new stations shall be keyed alike, such that a single key will function for both existing and new stations. The contractor shall include necessary labor and materials to unify key requirements within any single building. New stations shall be so arranged that they cannot be reset to normal without the use of a local key. The use of a local key shall not include code wheels, or code devices.

.2.5 AUDIBLE NOTIFICATION APPLIANCES:

.2.5.1 Speakers shall be located so that their operation will be heard clearly in all areas regardless of the ambient level. Alarm appliances shall be designed for parallel connection, Class A circuit, DC operation, except OSUWMC, which can be Class B where separate circuits are provided for each smoke zone.

.2.5.1.1 Notification devices on any single circuit shall not exceed 75% of the capacity of the circuit, to allow for future expansion.
.2.5.1.2 Power draw and/or voltage drop on any single circuit shall not exceed 75% of the power and/or voltage limitation of the circuit, to allow for future expansion.
.2.5.1.3 Where emergency communication systems are provided, fire alarm speakers must be installed in elevator cars and exit stairways; however, they must only be activated to broadcast live voice messages (e.g., manual announcements). The automatic voice messages shall - be broadcast through the fire alarm speakers on the appropriate floors, but not in stairs or elevator cars.

.2.6 VISUAL NOTIFICATION APPLIANCES: All audible alarms shall be equipped with a flashing strobe light. It is also required that the strobe shall be equipped with synchronized light bursts. Visible notification appliances are to be installed in public and common areas including public rest rooms, reception areas, building core areas, conference rooms, open office areas, mechanical rooms and so on and shall be part of an audible/visual device. Visible notification appliances are not permitted to be installed in exit enclosures or elevators (e.g., exit stairs). Visible notification appliances shall be of the same manufacturer and capable of being synchronized.

Wexner Medical Center: All notification appliances installed in OSUWMC shall be addressable.

Commentary: *There may be occasions where an independent speaker is required (e.g. elevators, stairways). Synchronization of visible notification appliances is an important consideration for additions to buildings and when partially updating an existing fire alarm system. Verify that the new visible notification appliances can be synchronized with the existing visible notification appliances.*

.2.7 ANALOG ADDRESSABLE DEVICES

.2.7.1 HEAT DETECTORS: Heat detectors shall be field-restorable, and may be either fixed temperature or rate-of-rise type, as the need requires. The selection and location of these detectors shall include consideration for ambient temperatures, and area to be covered. The devices shall be analog, addressable, and shall permit the University to adjust address, sensitivity, setpoint, and pre-alarm levels.

.2.7.2 SMOKE DETECTORS: Smoke detectors shall be two-wire and multi-sensor detectors with both photoelectric and thermal inputs, subject to the approval of the University. The devices shall be analog, addressable, and shall permit the University to adjust address, sensitivity, and pre-alarm levels. Examples of acceptable sensitivity test methods are as follows:

.2.7.2.1 Analog Addressable systems: Access the system's "Test" function at the main control panel and request a test report for detector address, sensitivity and pre-alarm setting.

.2.7.2.2 Non-Addressable systems: Place a test magnet on the detector and the detector shall then respond with a series of coded beeps and/or flashes that indicate a certain sensitivity range.

.2.7.2.3 When smoke detection is installed in rooms having high voltage equipment, the smoke detection shall not be installed directly above high voltage equipment.

.2.7.2.4 Existing smoke detectors scheduled for demolition that contain radioactive material cannot be disposed as demolition waste. Contact the Hazardous Waste Supervisor for the Office of Environmental Health and Safety (EH and S) for specific instructions regarding proper storage, to make arrangements to obtain containers, as well as pickup and disposal arrangements. There is no charge for these services; seven days advanced notice is required to schedule with EHS (separate notice for container delivery and also for pickup).

.2.7.2.5 Aspirating Smoke Detection Systems: Review the appropriate use and application of this type of system with the University Architect and University Engineer.

.2.7.2.6 Provide addressable module for non-addressable devices as required.

.2.7.3 DUCT DETECTORS: Only UL listed detectors shall be used. Sampling tubes shall be steel and extend the full length of the duct, regardless of duct size, and equipped with an end cap. Installation of plastic sampling tubes is prohibited. Installation of open area detectors inside of ducts of prohibited.

.2.7.3.1 Duct smoke detectors shall report only as a supervisory signal and not as a fire alarm. They shall not be used as a substitute for required open area detection

.2.7.4 CARBON MONOXIDE DETECTORS: Install carbon monoxide detectors as required by applicable codes for fuel-burning appliances in specified occupancies. All carbon monoxide detectors shall be supervised by the fire alarm control unit and initiate a separate and distinct alarm from fire alarm (i.e. temporal 4). Combination detectors may be used provided these performance criteria are met.

.2.7.5 LOCAL EMERGENCY ALARMS: Local emergency manual alarms shall be provided as required by applicable codes and standards for all high hazard (Group H) occupancies. The manual stations shall be push button or other approved type. The local emergency alarms shall initiate a local alarm in the location of the hazardous materials emergency and be supervised by the fire alarm control unit and initiate a supervisory signal. The local alarm shall be distinct from all other alarms.

.2.7.6 LED's FOR HIDDEN DETECTORS: When detectors, including duct detectors, and flow switches are installed hidden from plain view, remote LED notification lights must be installed at the ceiling line or along the wall, visible from the floor in an approved location to show the location of the hidden detectors.

.2.7.7 ACCESS AND TESTING FOR DUCT DETECTORS: Access must be provided for testing all detectors, including duct detectors. Provide access panels in ducts as required to access duct detectors for inspection, testing, and maintenance. Duct detectors shall be equipped with a test port for testing. Pressure differentials shall be recorded as required by NFPA 72.

.2.8 REMOTE MONITORING: The University has centralized the monitoring of all security and other critical alarms. The Access Control and Alarm Monitoring System (ACAMS) uses a proprietary remote monitoring system based upon Lenel Intelligent System Controller equipment. The remote monitoring communication panels are

located at the buildings. The System shall be installed and comply with Section 28 10 10 of this Standard. All Columbus and regional campus buildings, excluding the University Hospitals ~~and regional campuses~~, shall require 24-hour remote reporting and monitoring, and shall use this system, and shall report to DPS Communications & Security Technology Division Central Alarm Center and the FOD's Service2Facilities ~~Center.~~ ~~The regional campus buildings shall report to their respective security centers.~~

.2.8.1 The fire alarm system shall report the following (via dry contact output) to the remote monitoring system:

.2.8.1.1 Common Building Fire Detection Alarm
.2.8.1.2 Common Building Fire Detection Trouble

.2.8.1.3 Common Building Fire Suppression Alarm

.2.8.1.4 Common Building Fire Suppression Trouble

The Designer shall make certain that the existing and new Fire Alarm System are integrated into the Lenel Intelligent System Controller (LISC) as one common building Fire Alarm System. The Lenel Intelligent System, also reports Building Intrusion Detection Alarms and troubles. The Designer shall follow the guideline and direction of Section 28 10 10 of this Standard.

.2.8.2 ADDITIONAL REMOTE MONITORING FOR STUDENT LIFE BUILDINGS: All **Student Life** buildings shall be monitored by the Student Life Building Automation System, where it is applicable, in addition to remote monitoring by Lenel. Note that Lenel is ~~not~~ available on the regional campuses:

.2.8.2.1 Common Building Fire Detection Alarm

.2.8.2.2 Common Building Fire Detection Trouble

.2.8.2.3 Common Building Fire Suppression Alarm

.2.8.2.4 Common Building Fire Suppression Trouble

.2.9 Batteries:

.2. 9.1 Batteries shall be sealed lead acid with a nominal life expectancy of 5 years, minimum. Batteries shall be manufactured in the USA, stamped with ship date from the manufacturer and stamped with the date of system activation. Batteries shall not be stored in excess of one month without having a continuous trickle current applied to maintain charge. A/E and University Representative shall witness the fact that the batteries are being charged.

.2.9.2 Batteries shall not be shipped and installed in the panels until the system pre-test is to be done by manufacturer's technician.

.2.9.3 Perform and record a battery load test after Fire Life Safety Inspection is completed and submit this information to the A/E.

.2.9.4 At the end of the two (2) year warranty period all batteries will be retested by the -manufacturer and witnessed by FOD's Fire System Shop representative. The batteries that have amp-hour capacity below 80% of the original manufactured ratings shall be replaced, material and labor, at no additional cost to the University.

.2.9.5 Provide battery-charging circuitry for each standby battery in the system. The charger shall be automatic in design, adjusting the charge rate to the condition of the batteries. All system battery charge rates and terminal voltage shall be read using the fire alarm control panel LCD display in the service mode, indicating directly in volts and amps. Meters reading in percentage are not acceptable.

.3 ADDITIONAL COMPONENTS:

.3.1 CONTROL UNITS: Control unit shall be installed in a suitable steel cabinet with hinged cover, secured with lock and key. The control cabinet shall include:

.3.1.1 Line terminals for 120-volt single-phase power.

.3.1.2 Single-button building system, common alarm silence switch, silences existing, and new systems in parallel.

.3.1.3 Single-button building system, common reset switch, resets existing, and new systems in parallel.

.3.1.4 Remote signaling relays shall function with the Fire Alarm Control Panel (FACP) for:

.3.1.4.1 Release of fire doors,
.3.1.4.2 Shutdown of ventilation systems,
.3.1.4.3 Remote annunciation
.3.1.4.4 Elevator recall

Commentary: *Elevator smoke detector recall shall not be a standalone function, but shall function with the FACP that reports alarms and troubles to DPS.*

.3.1.5 Power to the control unit shall be limited to not more than 75 percent of the supply circuit capacity (power and/or voltage) rating.

.3.2 ANNUNCIATORS: Annunciators and remote annunciators shall be equipped with identical displays. All annunciators and remote annunciators shall be fully supervised by the system, and the system shall audibly and visually indicate the fault of either component. Remote annunciators shall be a UL listed component as a UL listed control unit. Annunciator signals shall remain locked in until the annunciator is manually reset from the remote single-button building system common reset. Include annunciators to provide location/address identification where any of the following conditions exist:

.3.2.1 Automatic devices are connected to the fire alarm system.
.3.2.2 A building has four or more fire zones. Each area on a floor separated by a firewall shall be considered a zone.
.3.2.3 Type: Lighted window type, operated from the zone controls of the fire alarm panel. Separately wired annunciator circuits are not approved. Signals on the annunciators shall remain locked in until manually reset.

.3.2.4 Location: Locate annunciator at the control panel and at other locations in the building that serve as the immediate access for the Fire Department and DPS to that building. The A/E shall consult with the DPS and FOD's Technical Services Group for the purpose of determining the building entrances that will customarily be used by the Fire Department and DPS. At the determined building entrance provide a Security LockBox, and a Building Service Master Key Core in the entrance door hardware. Contractor to purchase Security LockBox from FOD's Mechanical Electrical Shop. Buildings that already have a Security LockBox that are not located by the Fire Alarm Remote Annunciator are to be relocated as well as the Building Service Master Key Core, by the project, to the Fire Alarm Remote Annunciator's location.

.3.2.5 For additions to existing systems, the added annunciation shall be located at the same location as the existing annunciator panels.

.3.3 SPARE MATERIALS, SERVICE STOCK: Spare initiating devices (smoke detectors, heat detectors, rate-of-rise detectors, manual pull stations, flow switches, valve tamper switches, contact monitoring units, bases, etc.) and notification appliances (horns/strobes, speaker/strobes, relays, bases, etc.) shall be furnished to the University by the contractor. Quantities shall be the larger of:

.3.3.1 No less than 1 of each item, or
.3.3.2 Minimum 10 percent of each item, whichever is the greater quantity.
.3.3.3 Deliver spare materials to the Fire System Shop.

.3.4 AS-BUILT DRAWINGS: Provide a set of as-built drawings, plastic covered, of the fire alarm system indicating wiring layout, and manufacturer's device data sheets in a three ring folder. Provide an additional set of record fire alarm drawings and data sheets in a folder to Facility Operations and Development's FOD's Fire System Shop. Include the fire alarm drawings and manufacturer's data sheets in the operation & maintenance manuals, and in PDF format as well. Provide a copy of the original software program and all updates of the program to FOD's Fire System Shop on a USB Flash Drive or other agreed method.

.4 SPECIAL REQUIREMENTS FOR FIRE ALARM SYSTEMS INSTALLATION AND REVIEW.

.4.1 The A/E shall consult with the DPS and Facilities Design and Construction Technical Services Group during the early planning phase and prior to any meetings with the Authority Having Jurisdiction.

.4.2 Architect/Engineer shall make certain that device locations are shown and listed for review on the drawings. A/E shall provide the fire alarm system riser diagram and function matrix on the Bid drawings. A/E shall include the room number locations for the fire alarm control panel, annunciator panel, and PAD, NAC and Transponder panels, and Lenel panel. A/E shall review all fire alarm shop drawing submittals and after corrections have been made submit to the Authority Having Jurisdiction. A/E shall coordinate room numbers with the University Project Manager and shall include the following statement in the specifications:
"Prior to final programming of Fire Alarm System room numbers shall be verified for correctness."

.4.2.1 A/E shall require contractor shop drawings to comply with all of the requirements of OBC, OFC, and NFPA 72

.4.2.2 Preliminary shop drawings shall be prepared by the fire alarm contractor and shall require review and acceptance by Ohio State University in coordination with the Ohio State University Project Manager prior to installation.

.4.3 Program buttons on all main Fire Alarm panels shall be programmed as required.

.4.4 Specify that room(s)/area(s) with multiple devices have higher priority.

.4.5 Specify that the Contractor shall provide a copy of Fire Alarm program in every installation on a USB Flash Drive or other agreed method to the Architect/Engineer as part of closeout documents.

.4.6 Record Documents including Controls, Fire Alarm Riser Diagram for the building's complete fire alarm system, etc. shall be on AutoCAD and shall be submitted to the University at substantial completion of the project and before the final payment shall be made by The University.

.4.7 A/E shall specify the requirement for a "SYSTEM RECORD DOCUMENTS" cabinet, as required by NFPA 72, to be located by the Fire Alarm Control Panel or at another location approved by DPS at the protected premises. All record documentation required by NFPA 72 shall be stored in the documentation cabinet (USB drive; files organized). Cabinet key shall match the Fire Alarm Control Panel's key.

.4.8 Fire Alarm Systems shall be capable of providing a single BACnet communications output with IP Connection, but do not provide this equipment unless specifically requested by FOD's Fire System Shop.

.4.9 WORK ON EXISTING SYSTEMS: Prior to fire alarm work on an existing system, contractor must verify, in the presence of personnel from the respective department (FOD, Student Life, or OSUWMC), that there are no troubles on the system. All troubles shall be reported to DPS prior to the start of work. Contractor will be responsible for all system troubles not reported.

.4.9.1 FIRE PROTECTION SYSTEM IMPAIRMENT FORM: A/E and University Project Manager shall identify how the project's scope of work will cause an impairment to an existing fire alarm system or other system designated

to maintain the fire resistance of the building elements or structure if taken out of service, either wholly or in part, planned or unplanned. University Project Manager shall complete the Fire Protection System Impairment form and e-mail the completed document to emergencymanagement@osu.edu

.4.9.1.1 Link to form: https:///dps.osu.edu/sites/default/files/impairment.doc

.4.10 WORK DURING CONSTRUCTION: Where heat detectors are used instead of smoke detectors during construction, contractor shall provide them and be responsible for all system programming required to change heat detectors to smoke detectors and vice versa at the end of the project to avoid any additional troubles/alarms on systems.

28 47 53 EMERGENCY RESPONDER RADIO SYSTEM:

.1 All buildings shall be required to provide code compliant Emergency Responder Radio System (ERRS) coverage. The requirements shall include submission of all required documentation to all applicable authorities, and related testing and inspections. The ERRS – DAS system central distribution hub shall be located and monitored by the building's fire alarm control panel.

Commentary: *The A/E and University Project Manager shall look for opportunities to network the ERRS – DAS system with other buildings.*

.2 Request the required public safety frequency schedule through the DPS for submission to the AHJ. Verify performance criteria to meet or exceed that which is defined in the latest revision of the code. Provide system compatible with 700/800 Public Safety, as well as any/all required frequency listed in the frequency schedule provided by the AHJ. Include all in designed coverage.

.3 Provide all necessary submissions as required by both the authority having jurisdiction for review and approval, as well as completion of all application forms, etc. for submission to the FCC or other required agencies.

.4 Coordinate review and testing with the AHJ.

.5 Require testing by authorized and appropriately certified personnel.

.6 Coordinate both the appropriateness of the budget as well as the desired delivery method with the University Project Manager and the Construction Manager.

END OF DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

31 00 00. EARTHWORK

31 10 00. SITE CLEARING

.1 STRUCTURE REMOVAL: Include structure removal in DIVISION 02, Section 02 41 00 DEMOLITION.

.2 EXPLOSIVES: Use of explosives or blasting as a construction practice is prohibited, except when approved in writing by the University Architect for special cases.

31 11 00. CLEARING AND GRUBBING

.1 CLEARING: All objectionable growth shall be stripped. Debris resulting from stripping and clearing operations shall be promptly removed from University property so as to prevent this material from accumulating on the site. Clearing exercises on Columbus Campuses shall follow City of Columbus Item 201. Clearing exercises on Regional Campuses shall follow ODOT Item 201.

.2 GRUBBING: Removal of trees and shrubs shall include the removal of stumps and roots to the extent that no root greater than 3 inches in diameter remains within 5 feet of an underground structure or utility line or under footings or paved areas. Grubbing in open areas shall include removal of stumps and 3 inch roots to 2 feet below finish grade elevations. Grubbing exercises on Columbus Campus shall follow City of Columbus Item 201. Grubbing exercises on Regional Campuses shall follow ODOT Item 201.

.3 PROTECTION OF TREES: Existing trees indicated to remain, or where local permit requirements warrant them to remain, shall be protected by boxing. Boxing shall be 4 inch by 4 inch posts with two 2 inch by 4 inch rails, approximately 8 feet by 8 feet centered on the tree trunk, to a height of approximately 5 feet. Some specimens will require fencing at the drip line of the branches. Do not store anything within the drip line of any trees. Protection of Trees on Columbus Campus shall follow Columbus Item 655.

.4 PROTECTION OF SPECIAL TREES AND SHRUBS: Trees and shrubs are of such value that special attention of the contractor must be directed to protection for them. The University Landscape Architect shall be consulted by project specific document notes and details for protection of trees. A monetary value has been assigned to every tree on The Ohio State University property. The contractor will pay the listed value for any tree that dies as a result of the construction process. Consult the University Landscape Architect for current tree values. Protection of Trees on Columbus Campus shall follow Columbus Item 655.

.4.1 Occasionally, protection of a specimen will require fencing at the drip line of the branches; or, if the specimen is in danger from objects falling on it, a sturdy roof over the tree or shrub may be required.

31 22 00. GRADING

.1 Unless otherwise specified by these standards and regulations, all site grading shall be designed to meet the following standards:

.1.1. Planting/Lawn Areas

a. Minimum Slope: 2%

b. Maximum Slope: 33%

.1.2. Parking Lot Pavement

a. Minimum Slope: 1.5%

b. Maximum Slope: 4%

.1.3. Pedestrian Plaza Areas

a. Minimum Slope: 1%

b. Maximum Slope: 2.5%

31 23 00. EXCAVATION AND FILL:

.1 MATERIALS FOR FILL AND BACKFILL: Specify only materials which can be compacted, without containment, to the densities specified by Architect/Engineer (A/E).

.1.1 Common Fill (Subsoil): Excavated material, graded free of:

.1.1.1 Lumps larger than 6 inches.

.1.1.2 Rocks larger than 3 inches.

.1.2 Select (Premium) Bed and Fill Materials:

.1.2.1 Aggregate Base: Crushed stone or Gravel. Angular, crushed or washed natural stone. Free of shale, clay friable materials, and debris. Complying with ODOT CMS Item 304. Graded within the following limits (slag will not be allowed):

Sieve Size	Percent Passing
2 Inches	100
1 Inch	70 to 100
3/4 Inch	50 to 90
No. 4	30 to 60
No. 30	9 to 33
No. 200	0 to 15

.1.2.2 Coarse Interlocking Aggregate: Natural stone. Free of clay, shale, and organic matter. Complying with the material requirements of ODOT CMS Item 703. Slag will not be allowed. Coarse aggregate shall be of size number 6, 67, 68, 7, 78, or 8, and graded in accordance with ODOT CMS Table 703-1.

.1.2.3 Low Strength Mortar Backfill: A flow-able fill composed of a Portland cement, fly ash, and/or sand mixture, in accordance with ODOT CMS Item 613.

.1.2.4 Sand: Natural river or band sand. Washed, free of silt, clay, loam, friable or soluble materials, and organic matter. Graded in accordance with ASTM C-136 within the following limits:

Sieve Size	Percent Passing
No. 4	100
No. 14	10 to 100
No. 50	5 to 90
No. 100	4 to 30
No. 200	0

.2 DEWATERING: Where existing high water tables are encountered, a dewatering system shall be provided that effectively reduces the hydrostatic pressure and lowers the groundwater levels below excavation levels as required for safe and proper execution of the work.

.3 SOIL COMPACTION CONTROL: Compaction control shall be provided for all fill, backfill, and embankments, both inside and outside the perimeter of the structure. Field compaction tests and related laboratory analyses shall be performed by a qualified independent laboratory (a member of the American Society for Testing and Materials), under the supervision of a registered professional engineer specializing in soils engineering. Soils proposed for fill, backfill, and embankments shall be analyzed by the soils engineer to determine acceptability; no soil shall be placed until it is approved by the soils engineer. A representative of the testing laboratory shall provide continuous inspection during placement and compaction operations; tests shall be made in a quantity that will assure uniform compaction and density of each course, or lift, of fill.

.3.1 UTILITY TRENCH: Minimum utility trench cut width shall be 2' to allow for proper compaction. A/E shall show a detail of utility trench cut with the minimum with of cut being called out on the plans or make reference to City of Columbus Standard Drawing 1441 DR.A "Pavement & Utility Cut Repair Standards".

.4 PAYMENT FOR LABORATORY SERVICES: The testing laboratory shall be made responsible to the A/E. All costs for tests and analyses performed shall be paid from Project Funds on an actual cost basis without fee mark-up. The testing laboratory shall be made responsible to the A/E. Written reports of field tests shall be submitted directly to the A/E, the responsible contractor and the University Project Manager.

.5 COMPACTION REQUIREMENTS: Specify that soils be compacted to the following densities, as determined by modified Proctor Tests:

.5.1 ROAD BEDS: Compaction shall conform to requirements specified in the latest edition of the City of Columbus, Ohio Construction and Material Specifications, Item 204 for all work within Franklin County and the State of Ohio, Department of Transportation Construction and Material Specifications, Item 204 for work outside of Franklin County. Compaction is required for the entire subgrade area for the full width and depth of slope of the embankment supporting the berm and pavement.

.5.2 INSIDE STRUCTURES:

.5.2.1 UNDER NON-STRUCTURAL SLABS ON GRADE, with normal loading: 95 percent, modified Proctor test procedures (ASTM D-1557).

.5.2.2 UNDER SPECIAL FOUNDATIONS, ISOLATED PADS, AND FOOTINGS: 100 percent, modified Proctor test procedures (ASTM D-1557).

.5.3 OUTSIDE THE STRUCTURES:

.5.3.1 TRENCH COMPACTION Under paved surfaces shall be as described below except that shallow trenches shall be filled with low strength mortar (LSM) per City of Columbus and ODOT specifications 613 and topped with 3 inches of City of Columbus Item 404. Deep large volume trenches under paved surfaces shall be benched 12" back form the face of the excavated trench and filled and compacted as described below and at least the top 15 to 18 inches of trench shall be filled with 12 inches of material control density fill and topped with 3 inches of City of Columbus and ODOT Item 401.

.5.3.2 PARKING AREAS: The top 1 foot of subgrade shall be compacted to 100 percent of maximum dry density.

Remainder:

Maximum Laboratory Dry Weight (lbs./cu. ft.)	Minimum Compaction Percent of Laboratory Maximum
90.0 - 104.9	102
105.0 - 119.9	100
120.0 and more	98

.5.3.3 FOUNDATION BACKFILL UNDER PLANTING BEDS AND LAWN: The upper 2 feet of soil below finish grade - 92 percent maximum. Remainder of backfill - 95 percent if depth is less than 10 feet; - 100 percent if depth exceeds 10 feet.

.5.3.4 FOUNDATION BACKFILL UNDER PAVEMENTS: 95 percent, modified Proctor test (ASTM D-1557).

.5.3.5 UNDER PAVED PEDESTRIAN WALKS AND COURTS: 95 percent, modified Proctor test (ASTM D-1557).

Specify that extreme care be exercised to obtain proper compaction under edges of walks which abut walls, stairs, curbs, adjacent slabs, and other structures where use of mechanical compactors is made difficult.

.5.3.6 BACKFILL AROUND MANHOLES AND OTHER UNDERGROUND STRUCTURES: 98 percent if depth is less than 10 feet; 100 percent if depth is more than 10 feet.

.5.3.7 UNDER LAWN AND PLANTING AREAS WHICH ARE NOT ADJACENT TO STRUCTURES: The upper 1 foot of soil below finish grade - 92 percent maximum. Remainder - 95 percent. Exception shall be taken for the areas designed as storm water best management practices (BMPs) which may have different compaction requirements.

.5.3.8 DENSITY OF TRENCH BACKFILL shall be equal to densities specified for all adjacent fill and backfill.

.6 DISPOSAL OF EXCESS: Excess fill material or topsoil which is not required nor permitted as fill shall be removed from University property at the contractor's expense.

31 25 00. EROSION AND SEDIMENTATION CONTROLS

.1 TEMPORARY SEDIMENT AND EROSION CONTROLS

.1.1 Reference the City of Columbus (COC) Construction and Material Specifications Item 207 for temporary sediment and erosion control materials and requirements for work within Franklin County. Reference local codes or the State of Ohio Department of Transportation (ODOT) Construction and Material Specifications Item 207 (See ~~2005~~ ODOT Construction and Material Specifications) for work outside Franklin County, whichever is more stringent.

.1.2 Inspect, repair, and clean erosion control blankets after each rain event.

31 60 00. SPECIAL FOUNDATIONS AND LOAD-BEARING ELEMENTS

.1 TYPES OF FOUNDATIONS: Wood piles, helical piers and push piers shall only be used with permission from the University Engineer. ~~The A/E, in consultation with his structural consultant, shall determine the type of foundation best suited for the structure, as indicated by soil conditions and other conditions at the site. Before a decision is made to use pile foundations, the A/E shall make a thorough examination of structures and occupancies adjacent to the site to determine what effect vibratory forces will have on such structures, occupancies and equipment. At the A/E's option, foundations may be a system of precast or cast-in-place concrete piles, steel piles, concrete caissons, or a combination of piles and caissons. Wood piles, helical piers and push piers are prohibited.~~

~~.2 DESIGN: Design shall be by a professional engineer, registered in the State of Ohio, and drawings shall bear the seal and signature of the engineer.~~

~~.3 LABORATORY SERVICES: An independent laboratory shall be employed to devise tests, in cooperation with the A/E's consultant, to perform testing of piles and to provide continuous inspection of pile driving and caisson construction to assure conformance with the drawings and specifications.~~

~~.3.1 PAYMENT FOR LABORATORY services shall be as specified for soil compaction control in paragraph 31 23 00.2.~~

~~.3.2 TEST PILES: Specify that the laboratory, in cooperation with the consultant, locate piles and employ the contractor to drive a minimum of 3 test piles before any other pile driving is started. Location of piles shall be such that, if tested piling meets requirements specified, these piles may be used in the building foundation system.~~

~~.3.3 TEST REPORTS FOR ALL PILES SHALL INCLUDE: Date of driving; locations; grade designation and dimensions of pile; pile point reinforcement and description, if any; total penetration; starting and finishing times, and total~~

driving time; number of blows required for each foot of penetration, total number of blows, and resistance in blows per inch for the last 6 inches of driving. Include a record of driving equipment used: hammer make and model number, stroke, weight of ram, and rated driving energy, driving cap weight and description, actual rate of operation of hammer during driving.

.4 PAYMENT: Specifications shall contain statements that the base bid price for the work be based on depths of piles, or caissons, as shown on the drawings and on soil boring data. The Bid Form shall contain spaces for amount per linear foot to be added to or deducted from base bid for depths differing from those indicated. A statement must be made that payment to the contractor will not be made for extra pilings which are driven for his own use while conducting the work. The A/E must certify the depths of pilings, or caissons, upon which the contractor's cost is based. A statement must also be made about the method of calculating the adjusted cost for pilings actually driven. Method of calculation should be that which is least expensive for the University since bidders usually indicate lower amounts for deducted than for added footage.

31 63 26. DRILLED CAISSONS

.1 INSPECTIONS: The testing laboratory and the A/E's consultant shall make continuous inspections of all operations during excavation, casing installation, and placement of concrete.

.2 DATA REPORTS SHALL INCLUDE: Date; weather; time; identification mark; shaft diameter; bell diameter; top elevation; bottom elevation; bearing strata description; nature and location of obstructions; and water conditions during drilling and concrete placement.

END OF DIVISION 31 - EARTHWORK

32 00 00. EXTERIOR IMPROVEMENTS

~~32 10 00. BASES, BALLASTS, AND PAVING~~

1. GENERAL PROVISIONS: Specify that construction of roads, drives, service courts, and parking areas, including subgrade and other related work, must be performed by a contractor fully qualified and equipped to construct roads.

.2 DESIGN DETAILS:

.2.1 MINIMUM TURNING RADII FOR STREETS, DRIVEWAYS, & LOADING DOCKS: 20 feet for automobile traffic; 30 feet for truck traffic, and 50 feet for bus and garbage truck traffic. When possible, or appropriate, use greater radii. Loading dock radii should be determined using the largest possible vehicle and must be approved by the University.

.2.2 SPECIAL DRAINS: In stairwells, areaways and similar locations where leaf clogging of conventional drains would be expected provide scupper type drains at the junction of the wall and pavement or walk. Piping size shall be 6” in diameter minimum.

.2.3 MANHOLES AND CATCH BASINS: Refer to City of Columbus (COC) Construction and Materials Specifications Item 604 and Standard Drawings for manhole and catch basin materials and requirements for work within Franklin County. Refer to the more stringent jurisdiction between local codes or State of Ohio Department of Transportation (ODOT) Construction and Materials Specification Item 604 and Standard Drawings for work outside Franklin County. Manhole lids shall be a minimum of 30” in diameter.

.3 PROHIBITED CONSTRUCTION:

.3.1 Mortar joints between unit pavers. ~~See Appendix K.~~

.3.2 CHIP SEALING or shoot and chip surfacing for permanent parking lots, walks, streets or drives.

4 WALKS: Minimum width shall be 8 feet. See The Ohio State University walk policy in Appendix P (https://fod.osu.edu/sites/default/files/app_p_06fin.doc). Bollards, sign posts, light poles and other permanent structures must be installed in a manner that provides no less than 6’-6” clearance width for snow plows and maintenance equipment access.

.4.1 University policy dictates concrete walkways in the absence of overriding considerations. Any deviation from concrete walks requires the approval of the University Landscape Architect. Pavers, such as 4”x8” clay brick pavers or natural stone pavers, shall be used as adjunct surfaces for appropriate areas to provide for improved drainage, to protect the viability of plant materials, or for design purposes.

.4.1.1 Deviations from the policy above shall be permitted in those areas where a predominant character has already been established for walkways by use of other materials.

.4.1.2 Deviations from the policy shall also be permitted in especially defined areas (field areas, gardens, natural areas, special feature sites, etc.) where the use of concrete walkways or masonry pavers would clearly be inappropriate or where structural considerations apply.

32 12 00. FLEXIBLE PAVING

32 12 16. ASPHALT PAVING

.1 GENERAL PROVISIONS: Specify asphalt paving materials by reference to City of Columbus (COC) or State of Ohio, Department of Transportation (ODOT), Construction and Materials Specifications (CMS) with the exception that limestone aggregate, only, be used in asphalt concrete.

.2 PAVEMENT DESIGN REQUIREMENTS: Architect/Engineer shall employ a geotechnical engineer to conduct subsurface exploration and follow the recommendations with regards to subgrade preparation and pavement composition. Pavement design shall meet the latest COC and ODOT published methodology with a design life of 30 years.

.2.1 Design Considerations:
- a. Average Daily Traffic Projections
- b. In-situ subgrade soil conditions
- c. Construction traffic impact
- d. Bus/Heavy Truck impact
- e. Life Cycle Cost analysis
- f. Location of utilities
- g. Recycled properties of materials
- h. Heat Island effect
- i. Cost of Materials
- j. Additional section to be considers, based on importance of road

.2.2 Estimating Guidelines:

.2.2.1 Parking Lots without heavy loads
- a. No bus, loading docks, through traffic, and/or trailer parking
- b. Less than 300 spaces
- c. Composition ~ 8” of aggregate, 2 ½”” of ODOT Item 441, asphalt concrete intermediate course, type 2, (448),1 ½” ODOT Item 441, asphalt concrete surface course, type 1, (448)

.2.2.2 Parking Lots with heavy loads
- a. Bus and/or trailer parking
- b. More than 300 spaces

c. Composition ~ 12" of aggregate, 3 ½" of ODOT Item 441, asphalt concrete intermediate course, type 2, (448), 1 ½" ODOT Item 441, asphalt concrete surface course, type 1, (448)

.2.2.3 Entrance drives and side roads without heavy loads
a. No bus, construction, loading dock, and/or garbage truck traffic
b. Composition ~ 10" of aggregate, 4" ODOT Item 301, asphalt concrete base, 1 ¾" ODOT Item 441, asphalt concrete intermediate course, type 2 (448), 1 ¼" ODOT Item 441, asphalt concrete surface course, type 1 (448), PG64-22

.2.2.4 Roadways with heavy loads
a. Bus, construction, and/or garbage truck traffic
b. Composition ~ 6" of aggregate, 8" of ODOT Item 305, concrete base, 1 ¾" of ODOT Item 441, asphalt concrete intermediate course, type 2, (448), 1 ¼" ODOT Item 441, asphalt concrete surface course, type 1, (448), PG70-22M

.2.3 Approval:
a. Parking Lot
1. Transportation and Traffic Management
2. University Engineer
3. University Landscape Architect
4. CampusParc

b. Roadway and Sidewalk
1. FOD - Operations
2. University Engineer
3. University Landscape Architect

.2.4 BASE DRAINAGE: Perforated underdrain shall be specified along the edges of pavement as well as at the catch basins in the paved area to help drain the subbase.

.2.5 PROTECTION OF SURFACE COURSE: After completion of surface course, no vehicular traffic or parking shall be permitted on the pavement until the surface is ready to receive traffic without damage.

~~2.5.1 SEALER FOR PARKING AREAS: If the budget will permit such expenditure specify that parking areas be sealed with 2 coats of coal tar emulsion conforming to U.S. Air Force and Federal Specifications RP-00355 (GSA-FSS), or an asphalt rejuvenating agent of a petroleum resin oil conforming to ASTM D-244, ASTM D-2006-70 and ASTM D-92.~~

.2.6 REPAIRS: Depressions and abutments to existing pavement shall be repaired by cutting out the surfacing to a minimum depth of one inch with vertical cuts,

filling, and rolling the areas. Feathering of patches and abutments to existing pavement is prohibited.

.2.7 JOINT SEALERS: When new pavement abuts existing, the joint shall be sealed per City of Columbus Item 409 for Main Campus and ODOT Item 448 for Regional Campuses. This applies to all trench repairs.

.3 WALKS: Asphalt walks, when permitted, shall be a full 2-inch compacted thickness of No. 404 on a 4-inch compacted thickness of No. 304 base. The base and the bituminous material shall each be compacted to 98 percent, modified Proctor test procedures (ASTM D-1557).

.3.1 Consider possibility of walks being used as drives, snow removal, etc.

.4 PAVEMENT REPAIR DUE TO UTILITY TRENCHING: Comply with City of Columbus Standard Drawing 1441 DR. A "Pavement & Utility Cut Repair Standards".

32 13 10. RIGID PAVING

32 13 13 CONCRETE PAVING

.1 PAVING: The use of concrete for roads, drives, service courts, and parking areas is desired if the budget permits such construction. Trash dumpsters ~~for construction debris~~ must be parked on concrete pads. All loading docks, bus pad, bus circulation and ramps shall be constructed with concrete.

.2 WALKS: Thickness shall be 5-1/2 inches minimum over 4 inches of compacted No. 304 gravel base. Thicken the edge to 18"x18" where the sidewalk abuts the curbing. The concrete shall have tooled edges which are then disguised by a light/medium broom finish. Except where required for structural purposes, reinforcing bars or welded wire fabric should be omitted. Use City of Columbus Class C or ODOT Class C concrete with clean sand, limestone aggregate, and 4 percent to 8 percent entrained air. Recycled concrete material that meets COC item 304 requirements may be used as the gravel base.

.2.1 CURING COMPOUNDS: Specify only non-staining type. It has been found that clear chlorinated rubber compounds cause staining which cannot be removed.

.2.2 CONCRETE SEALER: A concrete sealer shall be applied to all new concrete to better protect it from freezing and thawing.

.3 PAVEMENT REPAIR DUE TO UTILITY TRENCHING: Comply with City of Columbus Standard Drawing 1441 DR. A "Pavement & Utility Cut Repair Standards".

32 13 14. UNIT PAVING

.1 UNIT PAVING: Where installed within vehicular paths of travel, unit pavers shall be installed over concrete. Where installed outside of the vehicular path of travel, unit paver system cross-section shall be discussed with the University Landscape Architect.

32 16 00. CURBS AND GUTTERS:

.1 CURBS: Cast-in-place concrete shall be used unless other design is required per specific instruction from University. Comply with City of Columbus or O.D.O.T. Items 499 and 609. Concrete shall be Class C using No. 57 aggregate at 600 lbs. per cubic yard. Slump shall be 4 inches and minimum 28-day strength shall be 4000 psi with 4 percent to 8 percent entrained air.

.1.1 EXPANSION JOINTS shall be specified and shall be shown on the drawings. Color of the joint sealer shall match that of the concrete.

.1.2 FOUR INCH DRAIN CONDUCTOR in porous backfill shall be installed under all ~~combination~~ curbs and gutters. Conductors shall extend to drainage basins. Combination curb and gutter may be used only to match or repair existing work.

.2 CURB RAMPS FOR PERSONS WITH DISABILITIES: ~~See the ADAAG requirements.~~

.2.1 COMPANION RAMPS: State laws require that when a curb ramp is built on one side of a street, a companion ramp is required on the opposite side of the street. When project limits would normally end within a street intersection, the limits must be extended to allow construction of a companion ramp on the far side of the intersection. For projects in which Federal funding is involved, this requirement must carefully be coordinated with Federal requirements regarding limits of Federal participation. Ramps on University property shall match COC accessible ramp design guidelines.

.2.2 ADA RAMPS at roadway intersections shall maintain positive drainage away from the ramp to prevent ponding water. Construction Plans shall provide ample spot grading at ADA ramps to provide contractors with appropriate direction.

.2.3 DETECTABLE WARNING PLATES shall be cast iron and remain unpainted.

32 17 00. PAVING SPECIALTIES

32 17 23. PAVEMENT MARKINGS:

.1 PAVEMENT MARKINGS: All pavement markings shall conform to the City of Columbus and ODOT Item 641. Parking lot lines shall be white per COC Item 642. All roadway striping, turn arrows, cross walks, stop bars etc. shall be per COC Item 644-Thermoplastic for asphalt pavement and per ODOT Item 646 – epoxy marking for concrete pavement.

.2 PARKING LOT MARKINGS:

.2.1 Standard Parking Stall: 8.5' x 18'

.2.2 Standard Parking driveway: 24'

.2.3 Accessible Parking Stall: 8' x 18' with either an adjacent 5' loading space or 8' van loading space.

.3 CROSSWALK MARKINGS: Comply with University crosswalk marking details which can be obtained through University Project Manager.

32 30 00. SITE IMPROVEMENTS

.1 SITE AND STREET FURNISHINGS: The Ohio State University has standards for a variety of site and street furnishings. Consult a representative of University ~~Architect~~ Landscape Services for a list of acceptable products and the required installation methods.

.1.1 Refer to Division 12 FURNISHINGS, Section 12 93 00 Site Furnishings https://fod.osu.edu/sites/default/files/div_12.pdf

32 34 00. FABRICATED BRIDGES:

.1 Engineering drawings for all bridges shall be sealed by a Professional Engineer registered in the State of Ohio.

.2 Unless the structural elements of the bridge are wood, wood for the bridge deck shall not be used to avoid periodic maintenance problems and damage by snow removal equipment. Asphalt is to only be used with the permission of the University Architect.

.3 Bridge live load is to be designed for a minimum of a non-reducible 100 pounds per square foot, unless actual design factor requires more.

.4 Bridge width is to accommodate snow removal equipment.

.5 Bridges shall be ADA accessible.

.6 Weathered steel finish is not to be used if any element of the bridge could be in contact with soil or vegetation, exposed to winter salting of the deck, or any part of the bridge is capable of trapping moisture. The preferred bridge finish is hot dipped galvanized.

.7 Minimum design standards shall be per ~~OSHA~~ ODOT and AASHTO requirements.

32 80 00. IRRIGATION

.1 TURF AND PLANT IRRIGATION: Provide a permanent irrigation system if determined necessary by a representative of a representative University ~~Architect~~ Landscape Services for all new or renovated turf areas and planting beds designed and constructed by the project. All site irrigation system controls shall be compatible with Rainbird IQ central control system. Controllers must include components necessary for communication with central controller. Irrigation system design shall be reviewed by a representative of university Landscape ~~Architect~~ Services prior to submittal of final drawings.

32 90 00. PLANTING

.1 CONSULTING SERVICES: Refer to ~~PART ONE~~ Division 00, paragraph 00033 for possibility of the services of a professional Landscape Architect being required. All proposed Planting Plans shall follow the current Design Guidelines for Building and Landscape.

.2 PLANT MATERIALS: Selection of plant materials on the Campus is extremely important. Since this is a teaching laboratory, the varieties selected must be made from a broad range of stock indigenous to the specific locations. Persons selecting materials must not only be knowledgeable about the plants that will survive in the specific area of Ohio but also be able to select those appropriate for the northwest part of Columbus, for example. Be similarly selective for regional campus and OARDC plant materials. A pre-installation meeting shall be conducted with the University Landscape Architect regarding site and landscape work to address the site development and landscape requirements. Refer to the University Landscape Architect for approvals and assistance. See Tree Grading Standard in Appendix Q.

.3 PLANT LISTS should contain both common and technical names, quantities, and notation of planting delivery method (B & B, bare roots, etc.).

.4 KEYS: Indexes or keys identifying plants on drawings are prohibited. All planting must be individually identified without the use of code letters, numbers, etc.

.5 MULCH: Premium grade single shredded hardwood mulch. Exceptions may be taken for the mulch used in storm water best management practices (BMPs). Consult University Landscape Architect for appropriate mulch types used in BMPs.

.6 PROHIBITED MATERIALS: Landscape steel, plastic, or aluminum edging and weed-control plastic mats or film under mulch beds may not be used without specific approval of the University Landscape Architect.

.7 PLANTING SOIL: Blended soil mix consisting of ASTM D 5268-92(96), pH range of 6-8 ~~5.5 to 7~~, ASTM C33 course sand, and a minimum of 4 percent organic material content "Com-Til" (or a University approved organic amendment), tested to determine fertilizer and lime recommendations; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

.7.1 Planting soil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

Planting soil shall be subject to inspection and approval by University Representative at the source of supply.

.8 STRUCTURAL SOIL: Any tree planted in a tree pit situation and/or surrounded by pavement shall use structural soil in a minimum 8'x8'x3' depth planting area.

32 91 00. PLANTING PREPARATION

.1 SOIL PREPARATION: Specify that areas to be seeded or sodded will be properly prepared with a rototiller to the depth of 6 inches. If the area has been compacted during construction, rototill 4 to 6 inches depth to break up the pan, grade level, and apply topsoil (see 32 91 00.2 for acceptable topsoil). ALL ROCKS, GRAVEL, DIRT AND TURF CLODS are to be removed prior to seeding. Grade area 1 to 1-1/2" above grade of existing turf; blend edges to existing turf and sidewalks. Over seed areas with seed the rate indicated in 32 92 00.2 and for proper seed selection. The University Landscape Architect must approve any alternate method. Proposed preparation shall be in conformance with the current Design Guidelines for Building and Landscape (https://fod.osu.edu/sites/default/files/buildings-landscape.pdf).

.2 TOPSOIL PLACEMENT AND GRADING: Specify a 6-inch depth of acceptable topsoil for seeded areas and 12-inch depth for planting areas. Acceptable topsoil is defined as a blended soil mix consisting of ASTM D5268-92(96) soil component, ASTM C33 course sand and "Com-Til" – or a University approved organic amendment, tested to determine fertilizer and lime recommendations. Specify a 4-inch depth of acceptable topsoil with an additional 2-inch depth of "Com-Til" for seeded areas or a 10-inch depth of acceptable topsoil with an additional 2-inch depth of "Com-Til" for planting areas.

.2.1 Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depression to meet finish grades. Soil abutting walks should be compacted to 98 percent, modified Proctor test procedures (ASTM D-1557), to prevent settling.

.2.2 Moisten prepared turf areas before planting soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

.2.3 Restore areas if eroded or otherwise disturbed after finish grading and before planting.

32 92 00. TURF AND GRASSES

.1 TURF: Specify that all unpaved areas not indicated to receive planting be considered as turf areas and shall be seeded or sodded. No sod or Hydro-mulch seeding is acceptable on the University grounds without the approval of the University Landscape Architect. Hydro-mulch seeding will only be considered for large areas or sloping terrain. All debris (rocks, bricks, concrete, clods stumps etc.) will be removed and the area graded before area will be approved for Hydro- mulch seeding.

.2 TURF GRASS SEED SELECTION: Seed selection is dependent on the site. Timing of the seeding is determined by the date; see 32 92 19.1 for details. If seeding is to be split because of the time of planting, multiply each of the following percentage by 2 for the proper mix at each seeding.

.2.1 TURF SEED shall be a clean, weed-free mix (a combination of 2 or more different species of turf grass) or blend (combination of 2 or more cultivars of a single turfgrass species); delivered in sealed containers with labels bearing the producer's name and formula of the mix at each seeding.

.2.1.1 FOR NON-IRRIGATED AREAS: 100% turf type tall fescue with at least 3 different varieties in the mix and 0% weed seed. Apply at a rate of 6-8 lbs. per 1000 sq.ft. No annual rye accepted under any conditions.

.2.1.2 TURF SEED FOR IRRIGATED AREAS: Standard bluegrass mix with 85% bluegrass with at least 3 different varieties and 15% Perennial Ryegrass and 0% weed seed. Apply at a rate of 6-8 lbs. per 1000 sq.ft. No annual rye accepted under any conditions.

Label must be approved by University Landscape Architect and actual labels from bags should be given to The Ohio State University for both the seed and fertilizer. Proposed improvements shall follow the current Design Guidelines for Building and Landscape.

OARDC: For areas with full sun exposure: use the current "Champion" mix prepared by the Oliger Seed Co. 1-330-724-4810 in Akron, Ohio. Substitute vendor is allowable as long as see mix matches the requirements set forth below or specific permission is granted by the OARDC Grounds Manager.

Special Mix: 50/50 Bluegrass/Perennial Rye: (4-5 ibs/1.000 sq.ft.)
25% Brooklawn Kentucky Bluegrass
25% Camas Kentucky Bluegrass
15% Home Run perennial Ryegrass
15% Paragon GLR Perennial Ryegrass
10% Beacon Hard Fescue
10% Kentucky Bluegrass

OARDC: For areas with less sun exposure: use the current "Champion" mix prepared by the Oliger Seed Co.
20% Intrigue Chewings Fescue
15% Edgewood Creeping Red Fescue
15% Zodiac Chewing Fescue
15% Cardinal Creeping Red Fescue
10% Beacon Hard Fescue
10% Kentucky Bluegrass

32 92 19. SEEDING & MULCHING

.1 SEEDING shall be done either between August 15 and October 15, or between March 15 and May 20. The early fall period is preferred. If seeding must take place after May or October and the turf requires a perennial rye and bluegrass mix, the seeding will be split. The perennial rye seed will be sown at the time scheduled and the bluegrass seed will be split, seeded over the same area in September. Proposed seeding improvements shall follow the current Design Guidelines for Building and Landscape. City of Columbus and ODOT Item numbers 659 will be used for Columbus campus and regional campuses, respectively.

.1.1 Seed: Seed with approved seed mix and rate (see 32 92 00.2 for seed selection); water if necessary for proper rate of germination. Areas that do not germinate must be reseeded and watered for establishment.

.1.2 Starter Fertilizer: Apply starter fertilizer prior to seeding, whether turf area is irrigated or non-irrigated. Apply at a rate of 1 ib. of nitrogen per 1000 sq.ft. Two weeks after seed germination another application of 1 ib. of nitrogen per 1000 sq.ft. should be applied to turf area.

.1.3 Mulch: Straw must be clean, free from seedbearing stalks or roots of noxious weeds, evenly distributed at an approximate thickness of two straws with no piles of straw. Any area that has had too much straw must be redone with the removal of the straw, touch up grading, if necessary, and the proper depth of straw applied.

.1.4 Cleanup: Clean off sidewalks of soil; sweep walks clean of straw, seed and fertilizer.

.2 "MAINTENANCE: Seeded, sodded and planted areas shall be contractor maintained (including watering, mowing and weed control) until acceptance by the University. Total cover of planted areas shall be guaranteed by the contractor.

.2.1: Begin maintenance immediately after each area is planted and continue until acceptable turf is established. Maintenance period shall be a minimum of 28 days or to final acceptance.

.2.2: When full maintenance period has not elapsed before the end of the planting season, or if turf is not fully established, continue maintenance during next planting season.

.2.3: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting and other operations. Roll, regrade and replant bare or eroded areas and remulch to produce a uniformly smooth turf.

.2.4: In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

.2.5: Provide and maintain temporary piping, hoses and turf watering equipment to convey water from sources. Keep turf uniformly moist to a depth of 4 inches.

.2.6: Schedule watering to prevent wilting, puddling, erosion and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas. Water turf daily for the first two weeks.

.2.7: Provide turf protection fencing around all newly seeded turf.

.3 University Final Inspection and Acceptance:

.3.1. Upon completion of the work and fulfillment of the requirements of the Section, 32 92 19, notify the University Landscape Architect in writing that the work is ready for final inspection. Request a definite date for final inspection.

.3.2. Notify the University Landscape Architect five (5) days prior to the requested final inspection date.

.3.3. Acceptance of seeded turf areas shall be based upon the following criteria:

a. Terms of the maintenance period, as defined in this paragraph have been executed. Seeded turf areas shall be healthy, uniform and a close stand of grass shall be established.

b. The seeded turf areas shall be free of weeds and surface irregularities.

c. In any 10 square foot area within the seeded turf, coverage shall exceed 95%.

d. Scattered bare spots shall not exceed an area 4 inches by 4 inches.

e. Grass shall not exceed 3” in height at time of acceptance.

.3.4. Acceptance of sodded turf areas shall be based on the following criteria:

a. Sodded turf shall be free of weeds and surface irregularities. All ends are butted tightly against each other and there are no overlapping joints. A clean edge will be made by using a mechanical sod cutter where sod abuts existing turf. Edge of sod must match the grade of existing turf. Sod will not be installed over existing turf, weeds or un-tilled soil.

b. Grass shall not exceed 3” in height at time of acceptance.

32 93 00. PLANTS

.1 GROUND COVERS: must be weeded during the establishment period by the contractor to prevent perennial weeds from becoming established the University takes over the maintenance of the beds. Proposed improvements shall follow the current Design Guidelines for Building and Landscape.

.1.1 A pre-emergence shall be applied at the time of planting to prevent the seeding in of new weeds.

.1.2 Perennial weeds must be sprayed with an herbicide to completely eradicate them from the bed.

.1.3. Spacing of the plant should be 3" - 6" o.c. to achieve coverage of the area during the first growing period. Planting should be watered and fertilized regularly to promote establishment prior to acceptance by the University.

.2 SHRUBS: must be planted on appropriate spacing. Proposed improvements shall follow the current Design Guidelines for Building and Landscape.

.2.1 All twine must be removed from the stems.

.2.2 Burlap must be pulled away from the stems and down 1/2 the ball.

.2.3 Nylon burlap must be totally removed.

.2.4 Backfill amendments (see trees .3.6)

.2.5 All shrubs must be evaluated and approved by or the University Landscape Architect prior to planting.

.3 TREES: will be planted according to the planting detail in the appendix. No tree wrap is to be used. All mulch must be 2" away from the trunk of the tree. Mulch should be no thicker than 2". See 32 90 00.5 for type of mulch. The lip of the mound around the tree is to be no higher than 3". Forked trunks on trees are not acceptable; each tree must have one strong leader. Street trees must be limbed to 8 feet minimum. Proposed improvements shall follow the current Design Guidelines for Building and Landscape.

.3.1 All trees that come in wire baskets must have the basket removed. All twine must be removed from the trunk of the tree.

.3.2 All trees that have burlap and are bound with twine, must have twine cut and the burlap pulled away from the trunk down to half of the ball.

.3.3 All trees and shrubs that are bound in nylon burlap must have the burlap totally removed.

.3.4 The stakes of all trees will be removed at the end of the guarantee period by the contractor.

.3.5 No tree will be planted within 10' of a building or overhead structure unless approved by the University Landscape Architect.

.3.6 Backfill amendments: Mix a starter fertilizer (high phosphorus, low nitrogen ratio) and terra-sorb (or equivalent) acrylamide copolymer for water retention; use product's rate of application per tree size.

.3.7 All trees must be watered in thoroughly untill the acceptance by the University.

.3.8 All trees must be evaluated and approved by the University Landscape Architect prior to planting.

32 98 00. EXISTING TURF AND PLANT RESTORATION

.1 EXISTING TURF: Existing turf must be restored when compacted during construction. Repair any ruts or depressions left by equipment or storage of material. Remove topsoil containing foreign materials resulting from contractors operations including oil drippings, fuel spills, stone, gravel and other construction materials, and replace with new topsoil. Mow, dethatch, core aerate at a rate of 9 holes per square foot and rake existing turf. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides. Till stripped, bare and compacted areas to a soil depth of 6”. Apply 1” Comtil over entire surface to be repaired. Slit seed using seed mix and rate

appropriate to area (see section 32 92 00, Turf Grass Seed). Apply straw (see section 32 92 19, Seeding).

.2 EXISTING SHRUBS: Existing shrubs within the construction area or staging area: replace or correctively prune if damaged during construction; prune to the height at the beginning of construction; weed/spray if weeds have grown up within the construction area and /or shrubbery.

.3 EXISTING TREES: Existing trees: original grade maintained, no top fill greater than 2" from the original grade out of the drip line; minimal to no grading under the drip line.

.4 RELEASE: Release of the restored area will be approved by the Superintendent of Grounds-Plant Material Section and the University Landscape Architect. The contractor will be recalled to provide a proper growing environment for the plant material.

END OF DIVISION 32 - EXTERIOR IMPROVEMENTS