

## **Mechanical**

### **General**

- Mechanical rooms shall include sufficient space to allow for coil pull or other maintenance/repair related clearances. Pumps and motors should have 3 feet of working space. Designers should indicate space allocated for access as crosshatched on the plans.
- All mechanical equipment rooms shall be located on the exterior of the building with separate exterior entrances large enough to remove the largest piece of equipment contained therein wherever possible. Preference is for elevator access for removal and installation of equipment.
- Mechanical rooms shall be ventilated or conditioned depending on the specific project but should NEVER be used as a relief or mixed air plenum.
- Cold rooms, MRIs, other process loads, etc. shall have two sources of cooling if water cooled, with automatic change over. Preference is chilled water via dedicated chiller by manufacturer/user, central chw system when installed with duplex plate and frame heat exchangers with two-stage filtration, then city water, with condenser water as a last resort. Typically, duplex two-stage filtration is required with 10 and 100 micron filters. Solutions shall be discussed with user and E&O prior to installation. Non-cancelable alarms for switchover to back-up installed and connected to BAS. Cold rooms also require a separate analog temperature sensor connected to BAS. If city water is utilized (emergency only), provide backflow preventor on the supply, flow control device, and an indirect drain to properly sized hub drain, floor sink, or floor drain. Drain line shall be piped to reclaim water line/system serving central chiller plant wherever possible.
- Color identification for all piping shall match Duke standard. Coordinate latest requirements with E&O.
- No equipment, piping, etc. shall be abandoned in place.
- Do not install anchors into the bottoms or sides of the precast concrete floor and ceiling supports in DHN unless designed by structural engineer and approved by E&O.
- Coordinate with E&O for numbering standards for new equipment. Numbering to work with CMMS, to identify assets.
- Designers should provide an added load summary for all mechanical systems.
- Space needs to be planned for Facilities storage in all new facilities and discussions should be held about capacity of existing spaces in major renovation or expansion projects.
- Pre-final Testing, Adjusting & Balancing (TAB) reports shall be submitted to E&O for review. Final TAB report at time of substantial completion should have addressed all outstanding issues. TAB contractors shall be hired by Duke through projects and shall be Duke approved contractors only. Current approved contractors are Clear Water Balance and Comfort Control Inc. Coordinate with E&O if problems are encountered with existing mechanical equipment that is affecting TAB results.
- Designer shall request pre-design testing of existing equipment and not base designs on as-built or construction documents. **Provide copies of data to E&O.**

Duke University Medical Center and Health System  
Facility Standards

- The need for any sound attenuators shall be proven by engineering calculation. In general, systems shall be designed such that sound attenuation is not necessary. All sound attenuators are to be approved by E&O and FPDC.
- All utility shutdowns should be requested 48 hours in advance. Exceptions to be approved by appropriate E&O Assistant Director.
- All equipment shall be purchased from local representatives and vendors **whenever possible**. Critical equipment shall be serviced within **3-hour** travel distance of site.
- Heat reclaim systems are encouraged but shall not reduce AHU capacities (coils and services should be sized for full load if reclaim system fails).
- Typically attic stock is not needed unless required by code. Designers to discuss attic stock needs with shops prior to completion of construction documents.
- Coordinate with E&O and OESO about requirements for duct cleaning on existing systems.**

**Piping & Specialties (Hydronic and Steam)**

- All service pipe to be seamless, new, first quality, rated for continuous duty and be a product of the United States of America.
- All piping systems to be marked with service provided and flow direction.
- All pipe cleaning and water treatment shall be by Duke water treatment company. Current firm is ChemTreat. Contact Steve Barnette 919 523-0272
- Pipe pressure testing and final flushing shall be witnessed by Duke E&O. Pressure testing shall be for a minimum of 24 hours with a maximum pressure drop of ½ psi below test pressure (test pressure shall be a minimum of 125% of system operating pressure) or as approved by Duke. Insulation shall not be installed until pressure test is accepted by Duke.
- Copper piping 2” – 4” shall be Pro-Press or silver brazed. **Copper piping under 2” may be Pro-Press or soft solder.** All copper piping and fittings over 4” shall be silver brazed. Valves, checks, controls, etc. shall be soft soldered to prevent damaging the device. All adapters (male, female or union) shall be soft soldered or Pro-Press. Copper drainage piping shall be soft solder.
- All piping penetrations through mechanical room floors shall include water tight pipe sleeve and be provided with 4” curbs. All other floor penetrations shall also be sleeved and made watertight for a minimum of 1.5” A.F.F. All penetrations to be fire sealed using the appropriate UL system.
- All steam specialties shall be Spirax Sarco, Hoffman, **Armstrong** or Spence. Do not utilize bucket traps unless approved by E&O shop performing maintenance. Thermodynamic traps similar to Sarco TD52 shall be utilized for MPC and HPC. Float and Thermostatic traps should be used on LPC and process equipment. All steam traps shall be provided with universal mount, where size permits. Test tee’s shall be installed downstream of each steam trap.
- Steam system piping: At minimum all steam piping shall be black carbon steel, ASTM A53B, Schedule 40 wall. All condensate piping shall be Schedule 80. All piping and fittings shall be welded – either butt or socket as applicable to size. Malleable iron and cast iron threaded fittings are not acceptable. Shutoff and isolation valves shall be welded so as to maintain the integrity of the piping system. At connections to equipment and specialties (such as trap stations and regulators)

Duke University Medical Center and Health System  
Facility Standards

provisions for maintenance of the device shall be provided via a union or flange, i.e. at steam trap stations the inlet shutoff valve and outlet shutoff valve shall be welded to the steam and condensate piping. On the trap side of each valve a welded to threaded nipple shall be provided to a union to facilitate removal of all components between the isolation valves.

- Steam valves: HPS & HPC: 2 ½" and larger – ANSI Class 300, cast carbon steel, butt welded. 2" and smaller – ANSI Class 800, forged carbon steel, socket welded. MPS & MPC and LPS & LPC: 2 ½" and larger – ANSI Class **150** cast carbon steel, butt welded. 2" and smaller – ANSI Class 800, forged carbon steel, socket welded. All valves shall include stainless steel trim. Gate valves shall be OS&Y. Other steam valves and appurtenances shall be steel and not brass or bronze.
- Do not utilize steam bypasses for any steam valves at Duke.
- All isolation valves shall be provided with drip leg, dirt leg and steam trap assembly upstream and as close to possible to the isolation valve for safe start-up of the steam system. All wye strainers on steam and condensate systems shall be cast steel or forged steel. On steam systems the wye section of the strainer shall be installed to run parallel with the piping.
- All wye strainers, drip legs and dirt legs on all steam systems shall be provided with a blow down valve to clean out sediment and safely de-energize the system and perform maintenance. **Blow down valves shall be bronze, full port ball valve, 150 psig SWP with steam trim and oval locking valve handle (no lever handles) by Apollo or approved equal.** Blowdown piping shall be routed to floor and terminated with a cap. Blowdown shall not discharge on any piping, valves, or equipment.
- Steam piping systems shall include drip leg, dirt leg, and steam trap assembly every 60' or where there is a rise in elevation to allow for proper condensate removal. Drip leg and dirt leg piping and fittings shall be welded to the first valve on the assembly. Provide full pipe size with a length of 18" minimum.
- All steam condensate check valves shall be lift-disc type with 316 stainless steel body and Inconel spring, threaded ends by Durabla SCV or as approved.
- All screwed fittings utilized on steam and steam condensate services shall be forged steel. Malleable and cast iron fittings are not acceptable.
- Steam pressure reducing valves shall be Spence Type E (**preferred**) or similar by **Hoffman or Armstrong** with cast iron body, pilot operator and Class 250 body and connections. Provide a blow down in between the PRV outlet and isolation valve for the PRV. All PRV's to be at least two stages with typically a 1/3<sup>rd</sup> 2/3<sup>rd</sup> arrangement. Smaller valve shall be installed on bottom of station. Coordinate with E&O and FMD based on steam loads for decisions. Steam PRV's shall be provided with fitted insulation covers (blanket).
- Coordinate with FMD on all steam requirements up to the building PRV station including steam pits (these typically require lighting, sumps, receptacle, high water alarm, hinged access grating, etc.) and where steam moisture separators are required.
- Triple duty valves are not permitted. Provide individual components (check valve, shut-off valve, and flow limiter).
- Thermometers shall be digital with solar collector by WISS or similar.
- Ball valves are preferred for shut off up to 2-1/2". Ball valves shall be bronze, full port, 600 psig WOG Apollo or approved equal. **Coordinate with Duke where**

Duke University Medical Center and Health System  
Facility Standards

- stainless steel trim may be required.** No ball valves shall be utilized on the steam system, except for trap assembly test tees which shall have a Class 600 reinforced Teflon packing oval locking handle ball valve.
- Butterfly valves shall be high performance lug type with stainless steel disc **and wormgear operator** by Dezurik, Bray or **Flow Seal**.
  - Water piping branch connections to mains shall be made on top of piping to avoid sediment, slag or pipe debris from entering branches and causing future problems. Side connections are second choice. Swing joints are not permitted on heating hot water piping.
  - Other valves shall be Stockham, Crane, Powell, Velan, Vogt, and Dezurik.
  - All valves 2 ½ inch and larger and more than 6 feet – 6 inches from floor or platform to the center of the valve stem shall have means provided to access the valve including platform or other means of safe access. Chain operators are not acceptable for steam valves but may be considered on a case by case basis if approved by E&O for other services.
  - Trapped condensate from heat exchangers shall be piped via gravity to receiver. If there is no other option to pipe via gravity than a pressure powered trap may be utilized.
  - Automatic flow control valves by Griswold or Autoflow shall be provided on the following services: hot water reheat coils, AHU hot water coils, fan coil unit hot water coils, and other small loads.
  - Chilled water coils connected to the campus chilled water system shall utilize pressure independent valves, DeltaP by Flow Control Industries with Bray actuator, FDI/Autoflow (up to 5” and carried by James M. Pleasants) or Belimo. Valves 2” and smaller, may also be Belimo or JCI Pressure Independent Valves manufactured by Belimo. Water meters to be installed per FMD selection and be connected to the FMD Siemens metering system.
  - Connections to University steam system shall meet requirements of FMD for materials, metering, etc. Meters shall be connected to FMD’s Siemens monitoring system.
  - Install isolation valves on all risers, mains, and branch lines as well as at all equipment. Isolation valves shall be separate from any other device, i.e. not part of any combo device at terminal unit connections but a separate valve.
  - All valves installed during renovations and new construction shall be identified and tagged. An updated valve tag list shall be issued to E&O.
  - Valves shall be equipped with appropriate means to lock/secure the valve in the closed position to allow for compliance with OSHA Lock Out – Tag Out requirements. Coordinate requirements for each E&O division with Plumbing/HVAC Shop.
  - Provide a 0.25 gallon per minute flow limiting device on the domestic water makeup to any and all closed loop mechanical systems. These may include hot water heating systems, cold room cooling systems, water source heat pump loops, and in some cases chilled water systems (for outlying buildings not connected to the campus system but having water chillers). Bypass should be provided to flow limiter but valve must be lockable in order for lock out tag out to be utilized in keeping this valve normally closed.

Duke University Medical Center and Health System  
Facility Standards

- Do not utilize dielectric unions but instead utilize dielectric couplings or approved fittings.
- Victualic and other grooved end fittings are not acceptable.
- All preheat and reheat systems installed with Pro-Press fittings shall be protected by both pressure and temperature relief valves. This will avoid exceeding the O-ring temperature ratings of the fitting.

**VFDs**

- VFDs shall be ABB ACH 550 or Yaskawa Z1000. Duke preference is for 6-pulse drives. NEMA enclosure ratings shall match location of installation but typically Type 3R shall be utilized in mechanical rooms with water/steam piping in vicinity of VFD and outdoor locations.
- Provide 2 contactor bypass with service switch (except for direct drive fan motors and toothed belt drives) and input reactors at each VFD.
- All VFDs shall be wired from the bottom. Prior to installation the interior electronics to be sealed with plastic wrap. If VFD is to be used during the construction phase filter media is required to cover and be maintained over enclosure vents. After installation the interior including the electronics to be vacuumed clean of dirt and metal shavings.
- Provide LON card (all safeties hardwired) or Bacnet if Schneider Electric in building – confirm with E&O and SE based on specific application. Bacnet if JCI system in building.
- Provide 3-year warranty with drive. Start-up shall be performed by factory trained technician. Technician shall utilize manufacturer’s software with laptop to upload parameters as required by manufacture to obtain warranty. All drive start-ups shall be witnessed by Duke E&O and appropriate supporting documentation provided for record. VFD start-up shall be completed prior to starting building Test and Balance.
- All fan motors for use with VFDs shall include: Grounding rings mounted in the motor end bell, insulated bearings (**over 100 hp**), and certification that they are inverter duty and not just premium efficiency.

**Insulation**

- All duct insulation shall be external. No duct liner is permitted.
- Reheat coils at air terminal units shall be insulated.
- All piping and ductwork insulation exposed in MERs shall be finished with glass cloth, canvas, or nylon cloth to allow for painting **or be PVC colored covers.**

**Coordinate during design phase.**

- Utilize board type insulation for ductwork in MERs.
- All insulation installed outdoors shall be protected using waterproofing methods recommended by manufacturer. All insulation shall be provided with an aluminum jacket and fitting covers.
- Chilled water piping insulation shall be designed for 38 degree F fluid.

**Pumps**

- Pump preference is Bell & Gossett. **Weinman and Armstrong will be considered.**

Duke University Medical Center and Health System  
Facility Standards

- A single pressure gauge with gage cocks and interconnecting piping from the suction strainer to the discharge sides of the pump shall be provided on each pump.
- Base mounted pumps mounted on housekeeping pads are preferred.
- Steam condensate pumps shall be pressure powered with PRV to supply 25 to 55 psi motive steam depending upon system requirements. Do not use electric pumps except for FMD required main building condensate pump. The pump shall be warranted to a minimum service life of 5 million cycles or 5 years (with cycle counter if required by manufacturer for warranty). Provide gauge glass on pumps and tanks and overflow for package. Provide universal type traps on package, where size permits. The location of steam condensate pumps shall contain a floor drain.

**Coils**

- Maximum face velocity for chilled water coils shall be 400 FPM **unless space conditions do not allow or as approved by Duke.**
- Chilled water coils shall be designed for 48 degrees F leaving air temperature, unless lower temperature is required for humidity control in low temperature spaces. 100% OA CHW coils shall be designed for 100 deg F DB/78 deg F WB.
- Coils shall be Heatcraft, Aerofin, or Trane.
- Coil drain pans shall be stainless steel. Multi-level chilled water coils with intermediate drain pans shall be insulated. All coil installations to provide adequate space to allow cleaning.
- Preheat coils shall be hot water unless approved by E&O.
- Any steam coils for AHUs shall include dual steam traps. Steam coils shall be provided with individual piping, vacuum breakers and traps, and condensate shall be dumped into a condensate header downstream of the traps.
- Size preheat coils for AHUs for 0 degrees F for smoke purge mode where applicable.
- Minimum leaving air temperature for any reheat coil shall **typically** be 20 degrees F above room temperature setpoint per ASHRAE 90.1. Minimum 2-row reheat coils with header.
- Coil condensate drain traps shall be properly sized to overcome unit static pressure to allow proper drainage.
- Coils should be 10 fins per inch or less and 8 rows or less to allow for proper maintenance.

**Air Handling Units**

- All AHUs shall include a minimum of 10% - 20% excess capacity depending on size and age of system.
- Any AHU over 5,000 cfm shall have a return fan (unless it is 100% OA).
- All AHUs over 2,000 cfm shall include separate access sections for each fan or coil section, min. 24" wide.
- All **Level 1** custom built AHUs shall be EAS, AC Corp or Air Enterprises (where approved).
- Custom units shall be double wall with foam panels. All sections shall utilize a true thermal break with no-thru-metal. Units shall **typically** be of welded construction and not bolted. **Discuss level of unit required during design.** Units installed outdoors

Duke University Medical Center and Health System  
Facility Standards

- shall include membrane roof which shall be pitched for drainage.
- All inner linings shall be aluminum or stainless steel.
  - Provide gasketed light and drain in each section.
  - Units shall have welded tread plate floors.
  - Minimum cooling coil tube thickness to be 0.030" with preference for 0.035".
  - New custom AHUs shall be furnished with UV lights in cooling coil section equal to UVR RLM Xtreme. Include: plug in lamps with housing to protect against lamp breakage; lamp/ballast monitor; and remote power supply locations. Necessary warning signs and interlocks to be installed.
  - OR and other critical area AHUs shall be designed for a minimum of dual fans and no more than four. Fan sizing and redundancy shall be discussed with Duke as part of the design phase. Fans shall be capable of isolation via manual shutters/roll-up doors.
  - Drains shall be piped to outside of unit and terminated with ball valves. Drains shall be separate from coil condensate drain. Floor drains to be sump type with removable grate and minimum 2" pipe connection.
  - Steam humidifiers shall be Dri-Steem ultrasorb XV or E&O approved alternate. Provide insulated tubes.
  - Provide access platforms/steps to all AHUs to allow for proper maintenance and to meet OSHA requirements.
  - Fan coil units shall be Daikin/McQuay, Airtherm or Trane.
  - Provide 12x12 view pane window of thermal double pane safety glass at eye level for each access door. UV filtering provided where UV in use.
  - Off campus Duke owned or maintained site – Trane or Daikin/McQuay for use in commercial occupancy buildings. Discuss necessary features for air handlers with E&O in design phase.

**Fans**

- Fans shall be Greenheck (**preferred**), Loren Cook, Twin City, or NY Blower.
- Fans shall be selected for a class number that allows for speeding up of the fan, i.e., if we are within 20% to a Class 1 speed limit the fan shall be designed and constructed for Class 2.
- Exhaust fans shall typically be utility sets and not high plume dilution type or plastic fans. Any exceptions to utility sets must be approved by E&O.
- Do not utilize 3500 rpm motors or specify greater than 2500 rpm fan speeds due to operational issues. No motor rpm in excess of 60 Hz.
- Fans shall typically be belt-driven. However, toothed belt drives and direct drives including EC motors shall be considered upon review by E&O.
- Fan bearings shall be air handling quality, heavy duty grease lubricated, ball or roller type. Bearing shall be selected for a minimum Basic Rating Life (L10) of 80,000 hours at maximum operating speed and horsepower for each construction level. AHU supply, return and exhaust fans shall be L10 – 200,000 hours.

**Filters**

- MERV 14-16 final filters shall typically be bag or cartridge type. Coordinate with E&O during the design phase.
- Pre-filters shall also typically be bag type at Hospital Division buildings and Duke

Duke University Medical Center and Health System  
Facility Standards

Clinic unless space does not allow on AHU replacement projects. Coordinate at other facilities during design. Minimum of MERV 9 pre-filters.

- Carbon filters and associated housing for radiological hoods shall be coordinated with Robert Hart of E&O (919 684-3763).
- HEPA filters shall be knife edge type.

**Sheetmetal**

- All ductwork shall **typically** be pressure and leak tested. **Coordinate extent of duct testing prior to construction.** Test procedure shall be in accordance with SMACNA standards but at pressure and leak classes approved by Duke. Tests shall be conducted by a certified test and balance agency, in the presence of the Owner. Tests shall be performed prior to insulation of duct but after installation of all mains.
- SMACNA Duct Construction standards are minimum requirements that should be modified per the following: Reinforcing, both transverse and intermediate, shall utilize angles and not tie rods. Tie rods should only be utilized on ducts 97" and larger. Minimum duct gauge shall be 24 for 2" pressure class up to 30", for 4" pressure class up to 22", and for 6" pressure class up to 12".
- Provide aluminum or stainless steel duct at any locations with chilled water coils or local humidifiers. Also provide a drain off of those sections and pitch duct to drain.
- Flex ductwork shall not exceed 7'. **Do not utilize flex on exhaust systems.**
- Smoke and Fire/Smoke Dampers shall be Ruskin SD/FSD-60 (JCI equivalent smoke dampers manufactured by Ruskin) Class I or equivalent Nailor damper. Dampers shall be 120V with dedicated disconnect switch. **Also, test panel for visual verification of damper position with lights and momentary contact test button shall be provided.**
- All fire and smoke dampers shall be tested & certified prior to turnover. Do not utilize dampers in a horizontal configuration.
- Duct access doors shall be provided for all required devices to be maintained (dampers, smoke detectors, etc.). Doors shall be sized and placed in appropriate position to allow for access to maintain equipment and not just for visual inspection. Minimum access door shall be 12" x 12" for hand access only.
- Volume dampers shall be minimum 16 gauge and shall include stand off and locking quadrants.
- Spin-in fittings are not permitted in patient care, lab or other similar complex type spaces. Only use spin-in fittings in office type areas.

**Air Terminal Units and Devices**

- All air terminal units and distribution shall be Nailor, Titus or Price with DDC controls. Discuss with E&O prior to proceeding.
- Units shall be provided with appropriate liner to meet the requirements of U.L. 181 and NFPA 90A. Similar to Titus Steri-Loc or UltraLoc. Patient care areas to be provided with double wall boxes with solid liner.
- Provide access door for reheat coil inspection and cleaning. Door to be hinged or with cam lock.
- Allow for proper access clearances for service to terminal controls. Units shall be



Duke University Medical Center and Health System  
Facility Standards

- provided with 120V power and include built-in transformer.
- Inlet ductwork shall be hard duct. Flexible duct to box inlet is not acceptable.
- Minimum terminal unit size shall be 6”.
- Provide terminal unit discharge air temperature sensor for all new DDC units except for cooling only units. Provide in metal boxes mounted after the duct is insulated.
- Diffuser panels shall be 24” x 24” to make removal for maintenance easier. Preferred diffusers are high performance louvered face type similar to Titus TDC.
- All terminal units in interstitial spaces shall be mounted adjacent to catwalks to allow for ease of access. Coordinate mounting height with E&O.

**Controls and FMS**

- Controls shall be by Schneider Electric or Johnson Controls, Inc. Match existing in building if renovated. Coordinate with Duke prior to construction.
- Tie controls into central BAS. Coordinate alarms, monitoring points, etc. with E&O.
- Air flow measuring stations, if approved by E&O, shall be Ebtron Gold Series or equal by VoluProbe and used for monitoring only and not control. Fan inlet type are preferred where needed for monitoring.
- Provide leaving chilled water temperature sensors on all chilled water coils.
- All heating means (i.e. control valves) on HVAC terminals serving animal areas shall fail in place.
- All LIM monitors for isolation panels shall be connected to BAS system for additional monitoring. EC should run the conduit and pull the wire to a location recommended by the control contractor or E&O Controls shop.
- Thermostats shall be mounted at 48” to the top of the device unless otherwise approved by Duke. Public areas shall be provided with blank thermostat cover.
- Oxygen depletion monitors shall be MSA Toxgard II Model A-TOX-14RG021B00000000.
- Ultra-low freezers, FDA required refrigerators and freezers, etc. will require monitoring. Various monitoring systems exist throughout campus. Discussions with user and E&O are required during design to coordinate final requirements and who will monitor. Users to contract separately for monitoring.
- Coordinate BAS monitoring of electrical and fuel oil points with Duke.
- All fire alarm controls to AHUs shall be hardwired. BAS shall not be utilized for fire or smoke control.
- Control wiring shall be run in conduit and meet requirements of Electrical Section and enforced NEC Code. All junction boxes, pull boxes and enclosures for controls tied to emergency power system shall be completely painted red and be per Duke ID Standard.
- Data connections shall to be provided to all controllers by data wiring contractor and coordinated with BAS. IP addresses must be requested through E&O to function properly.
- Control air compressors shall be sized for no more than 6 starts per hour and 25% run time.
- Control air compressor control panel should be field installed on a floor mounted frame with flexible conduit and not mounted to compressor.
- Off campus Duke owned or maintained sites – All control features and monitoring

Duke University Medical Center and Health System  
Facility Standards

shall be coordinated and approved by E&O during design phase of project.

**Laboratory and Animal Holding Areas Only**

- Lab exhaust (hoods, biosafety cabinets, etc.) ductwork shall be stainless steel except for special applications.
- Steam pressure reducing valves shall be Spence E main valve and D pilot valve. PRVs shall include two-stage reduction from high to medium pressure and medium to low pressure.
- At the completion of each project, each animal room should undergo air balancing and documentation to meet the requirements of AAALAC Guidelines. Coordinate all work with DLAR Staff.
- All animal holding areas should include means to monitor air change rates, pressurization, and temperature and should generate alarms when out of range conditions are experienced.
- Each entry to animal holding, housing/lab/OR/dry storage/soiled utility/clean utility shall have signage placed at the entry to include the following: Room number, room volume, supply air cfm, exhaust air cfm, filtration type, humidity control, pressurization (positive or negative).

**Duke Hospital and Duke Medicine Pavilion (DMP) Only**

- Pressure differential in isolation rooms and others shall be monitored by electronic measurement and feedback control or ball-in-tube system similar to Ball-in-tube by Airflow Direction, Inc. Coordinate with Duke during design for latest requirements.
- OR's shall be provided with HEPA filters horizontally mounted in interstitial space. Do not utilize HEPA filter grilles.
- Provide a bag in/bag out HEPA filter on the inlet of any isolation exhaust fan.
- Room pressure monitors currently being utilized for OR's and other pressure critical areas are Setra SRCM-025LB-A2-F-1-B.
- The Engineered Smoke Management System at DMP is a complex system that requires many different components to work in unison to achieve the necessary pressurization levels. Any modifications to the distribution ductwork will have an impact on the system and project scope for renovations, etc. shall include re-verification of the system for all areas of this system that may be affected, even if they fall outside the project boundary. Additional design information is available to the designers and needs to be requested from Duke prior to issue of construction documents.

Duke University Medical Center and Health System  
Facility Standards

**Plumbing/Fire Protection**

**Plumbing**

- All drains shall be metallic except for acid or process waste.
- Designer shall test domestic water pressure and provide any required booster system to ensure a minimum building pressure of 25 psi at the highest point.
- All water service pipe to be seamless, new, first quality, rated for continuous duty and be a product of the United States of America.
- Above grade waste, rainwater and vent piping shall be service weight cast iron with bell and spigot fittings with elastomeric joints, or hubless cast iron with heavy duty couplings. Below grade piping to be extra heavy cast iron with extra heavy bell and spigot fittings. Where providing new connections to existing service weight cast iron below grade, coordinate with appropriate E&O Plumbing Shop prior to installation and ordering of materials to discuss options for tie-ins and materials. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International. All couplings for hubless cast iron soil pipe shall conform to CISPI 310.
- Waste piping (and in some applications a portion of the vent piping) in food preparation areas shall be provided with heavy duty/ acid and corrosion resistant piping similar to Duriron. Coordinate with Duke.
- Acid waste piping shall be: Orion BlueLine polypropylene socket end with fusion joints **or E&O approved equal**. Mechanical joint fittings shall only be utilized under sinks and at other accessible locations.
- Copper piping 2" – 4" shall be Pro-Press or silver brazed. **Copper piping under 2" may be Pro-Press or soft solder**. All copper piping and fittings over 4" shall be silver brazed. Valves, checks, controls, etc. shall be soft soldered to prevent damaging the device. All adapters (male, female or union) shall be soft soldered or Pro-Press. Copper drainage piping shall be soft solder.
- All domestic water piping used for non-potable applications, e.g. HVAC make-up water, shall be labeled non-potable downstream of the RPZ.
- Domestic water booster pumps should only be provided if proved by hydrant flow test and calculation. Pump skids shall be **similar to** Hyfab (part of James M. Pleasants company). Skids shall be a minimum duplex arrangement with close coupled pumps (no vertical turbine pumps), flanged header connection to skid, VFD's with LON card/Bacnet, and check valve. Pump alarm/faults, status, etc. shall be tied into BAS. Isolation valves are required on all sides of skid to allow for repair and replacement without shutting off water to entire building. **Provide lockable disconnect for each pump to allow for Lock out/tag out.**
- RO/DI piping shall be polypropylene with fusion joints – Georg Fisher or equal. RO machine waste must be piped to reclaim system, where available.
- Dialysis boxes shall be provided with their own shutoff valve. Valves in Dialysis boxes shall be supported with a split ring hanger to avoid excessive stress on piping and joints. All dialysis boxes fed by RO/DI shall have BFP (backflow preventer) at water treatment system. Many of our systems are fed by city water for use with portable dialysis equipment. It must also be labeled as non-potable downstream of the

Duke University Medical Center and Health System  
Facility Standards

- back flow. This should only be cold water, no hot or tempered water unless approved by E&O and Physician in charge of Dialysis.
- Pipe pressure testing and final flushing shall be witnessed by Duke E&O. Pressure testing shall be for a minimum of 24 hours with a maximum pressure drop of ½ psi below test pressure (test pressure shall be a minimum of 125% of system operating pressure) or as approved by Duke. Insulation shall not be installed until pressure test is accepted by Duke.
  - All piping penetrations through mechanical room floors shall include water tight pipe sleeve and be provided with 4” curbs. All other floor penetrations shall also be sleeved and made watertight for a minimum of 1.5” A.F.F. All penetrations to be fire sealed using the appropriate UL system. **Wall penetrations in block walls must be sleeved.**
  - Provide protective covers, skids, plugs or caps to protect equipment and materials from damage or deterioration during construction.
  - All domestic water heating shall typically include storage. Buffer tanks (stainless steel or glass lined depending on application) where necessary to provide storage to have a minimum storage temperature of 140 degrees F and mixed to deliver 115-120 degrees F (116 degrees F in patient care areas). Cemline semi-instantaneous heaters are preferred. Buffer tanks are not necessary with the Cemline heaters. Discuss equals to Cemline with corresponding E&O Plumbing Shop during design. Horizontal HX’s are preferred.
  - Point of use water heaters shall not be utilized unless approved by E&O.
  - All plumbing products, materials, valves, etc. that are part of the domestic water system shall meet lead free requirements of NSF/ANSI 61.
  - Ball valves shall be bronze, 600 psig WOG, **SS trim**, by Apollo or as approved on domestic cold and hot water. Utilize high performance lug type butterfly valves on 3” and larger. Include stainless steel trim and wormgear operator.
  - All valves installed during renovations and new construction shall be identified and tagged. An updated valve tag list should be issued to E&O.
  - Valves shall be equipped with appropriate means to lock/secure the valve in the closed position to allow for compliance with OSHA Lock Out – Tag Out requirements. Coordinate requirements for each E&O division with Plumbing Shop.
  - A three valve bypass needs to be installed around water filters so the filter can be changed without shutting down. Critical applications to be provided with duplex filters. Pressure and temperature gauges shall also be installed across the filter.
  - Mixing valves shall be Lawler or Leonard. Leonard is preferred at School of Medicine buildings and Lawler at other facilities.
  - Backflow preventers are preferred to be Wilkins due to cost of replacement parts. Watts may be considered upon approval from Duke. Main building backflow drains shall be piped to outside and not to floor drains unless approved by Duke. Floor drains shall also be provided in all rooms with main building backflows for testing and other discharges.
  - All connections to potable water systems shall meet all local and state codes for backflow prevention. ALL connections shall be inspected and approved by maintenance shop plumber responsible for the building (licensed plumber or licensed backflow tester). All backflow prevention devices shall be permitted with the City

Duke University Medical Center and Health System  
Facility Standards

- prior to completion of project and copy of permit provided to maintenance shop plumber. Backflows for 140 degree water systems shall be rated for that duty.
- Flush valves are preferred to be Sloan Royal. **Zurn & Toto also to be considered. Coordinate with appropriate E&O plumbing shop.** If automatic operator, provide side mounted sensor (Due to water conservation efforts, automatic operators should not be installed at this time on water closets). Manual flush valves shall typically be dual flush – coordinate with E&O staff. All patient rooms need to include bedpan washers unless directed otherwise by staff.
  - Plumbing fixtures shall be Kohler or Zurn (DHN), Zurn (North Pavilion), Toto or Kohler (Duke Clinic) or shall match existing manufacturer in other facilities. Typically, Kohler, Toto, Zurn and American Standard are acceptable. Replacement wall hung water closets at DHN shall be Kohler K4330 or Zurn Z5610. Wall carriers shall be provided with Schedule 80 heavy duty nipples. Water closets in patient care areas shall be floor mounted, bottom discharge. Coordinate type for other areas with appropriate Plumbing Shop. Rear discharge, floor mounted fixtures shall never be utilized. Wall hung sinks shall be mounted on a carrier.
  - DHN toilet seats shall be Zurn Z5955SS-EL or Church T95C.
  - Sink traps shall have mechanical joints for removal. Sink traps shall be cast brass or 17ga tube trap.
  - Galvanized and black steel nipples are not permitted on fixture connections. Brass should be utilized.**
  - On back-to-back fixtures do not utilize cross tees. Provide staggered sanitary tees.**
  - All sinks at Health System division buildings to include a clean out installed above the p-trap for servicing the line where feasible. If back to back sinks are installed, one cleanout may service both sinks.
  - Faucets shall be Chicago (DHN, DMP, N. Pav.) or shall match existing manufacturer in other facilities. Typically, Chicago and T&S Brass are acceptable. Provide shut off valves at all faucets. Angle stops similar to Chicago 1017-ABCP shall be provided. Electronic faucets shall be battery operated. Chicago 116.212.AB.1 at hospital buildings and Sloane Optima at Duke Clinic. School of Medicine buildings prefer all manual faucets with no single lever type permitted. In patient care areas, all faucets shall have the ability to install an aerator (2.2 gpm) and/or a filter.
  - Provide a female drop ear 90 that requires a nipple on hot and cold supplies to sinks.
  - Showers shall be Symmons (DHN). Typically, Symmons and Leonard are acceptable. Shower stalls shall be of high quality, one piece, fiberglass construction. Do not install showers with tops. They must be open to ceiling height (CMS issue in patient care areas). Obtain approval for shower from plumbing shop foreman before purchasing.
  - Coordinate latest models for eye washes and emergency showers with Duke OESO and meet OESO requirements for tepid water at showers. Eye washes must have a means for drainage (over a sink or bowl or other type of basin with drain.)
  - Urinals shall be selected for maximum 1/8 gallon per flush with automatic operator, equal to Zurn, unless approved by E&O.
  - Coordinate water fountain types at other locations with appropriate plumbing shop. Provide bottle filler stations on new installations where directed by Duke.**

Duke University Medical Center and Health System  
Facility Standards

- Scrub sinks shall be provided with check valves on the cold/hot supplies. Do not supply with fixture. Also, provide isolation valves on cw, hws, and hwr above ceiling for each sink.
- Scrub sinks hot water shall be recirculated at the fixture. Other fixtures to be recirculated within 20' of hot water mains.
- No piping or equipment shall be abandoned in place.
- Mop receptors shall be built in place with 4' tile surround anywhere that receptor contacts wall, S.S. cap fastened to top of curb, entire room floor and 1' up walls needs to be water proofed, service faucet with support and hose connection and minimum 3" drain. Provide external checks for faucet hot and cold lines. Vacuum breakers must be used. **In mop closets with mop sinks, provide a separate water supply with exposed isolation valve and backflow protection for future detergent dispensers.**
- Hot water recirculation branches shall include automatic flow control valves. Provide ball valves and unions at valves to allow for maintenance as well as wye strainer prior to flow control valve.
- Hot water recirculation pumps shall be Bell & Gossett or Grundfos.
- Natural gas piping and other service piping pressure testing must be witnessed by E&O prior to placing in operation.
- All hoods and biosafety cabinets with natural gas piped to them shall be provided with an external emergency shut-off quarter-turn valve. Units with legs shall typically be piped with valve at the legs – coordinate with appropriate E&O shop prior to installation.
- Provide ball valve shutoffs for all services to lab casework. Grouped one set per bench.
- Gas turrets shall be submitted for Duke for review. ¼ turn ball valve type are preferred.
- Lab air and vacuum in School of Medicine buildings only may be Type L copper. All new equipment being tied into Duke building lab air and vacuum systems must have their added load calculated into the building system capacity and submitted to E&O for approval prior to any work commencing in the field.
- All compressed air tanks shall be installed with electronic auto drain. All compressed air system condensate drains shall be zero-loss type. Solenoid-operated, timer drain valves are not acceptable.
- All water, compressed air, and vacuum storage tanks shall be installed with bypass around tank.
- When renovating areas of DHN, all old house vacuum system outlets and associated piping shall be removed.
- Point of use water polishing system equipment shall not be mounted below sinks. Also, any water filtration housings of these systems shall be stainless steel. No plastic housings are permitted. Duke has specific requirements for piping of these systems including flood stop and tie into BAS. Coordinate with appropriate E&O shop for all requirements.
- Standard room floor drains are to go to sanitary per the COD. A/C condensate and other clear water waste should go to recovery system or storm (project specific).
- All equipment that drains to a floor drain, such as scope cleaning machines, etc. shall be provided with a minimum 4" deep floor sink to capture the volume of water

Duke University Medical Center and Health System  
Facility Standards

- discharged from the machine and to prevent splashing.
- All sanitary and storm lines on new buildings and major renovations/additions shall be inspected via camera prior to acceptance. The camera work should not take place until the lines have been tested and are filled with water.
  - Provide a 0.25 gallon per minute flow limiting device on the domestic water makeup to any and all closed loop mechanical systems. These may include hot water heating systems, cold room cooling systems, water source heat pump loops, and in some cases chilled water systems (for outlying buildings not connected to the campus system but having water chillers). Bypass should be provided to flow limiter but valve must be lockable in order for lock out tag out to be utilized in keeping this valve normally closed.
  - All utility shutdowns should be requested 48 hours in advance. Exceptions to be approved by appropriate E&O Assistant Director.

**Medical Gas**

- Medical gas piping shall be seamless Type K copper only.
- All medical gas piping shall be installed by ASSE 6010 certified brazers.
- Medical gas piping shall be labeled every 10'. All piping shall be labeled "OXY, MED, OXY/MED, OXY/ACR, or ACR/MED".
- Medical gas valves shall be Apollo-Conbraco 82-200/82A-200 series.
- Outlets/Inlets shall only be DISS. Rough-ins shall be Beacon Medaes, Amico or Hill-Rom with model to match faceplates (front bodies). Front bodies (faceplates) are Beacon Series B. Amico PB Console that matches the Beacon Series B pin indexing may be considered. Do not utilize compact bodies.**
- Dual O2 outlets are not permitted.**
- Alarms shall be Beacon "Total Alert 2". Alarms shall have Ethernet connection. IP addresses must be requested through E&O to function properly.
- All medical gas alarm power shall be derived from the Life Safety Branch of the EPSS.
- All area alarm sensors shall be mounted 'local' in the alarm box.
- Zone valve boxes shall be Beacon Medaes or Amico but must utilize Apollo valves.**
- Typically medical gas outlets/inlets are not to be reused and should be replaced with new. Coordinate specific requirements with E&O prior to construction.
- Booms and headwalls shall meet Duke Standards (separate document). Coordinate with FPDC and E&O for standards prior to ordering. All boom DISS demand check valves shall be serviceable without pipe disassembly.
- All booms shall be provided with individual service valves to allow for testing and maintenance on booms without shutting down other areas on the same zone valve.
- Medical air shall ONLY be used for the application of human respiration and calibration of medical devices for respiratory application. Medical air outlets shall only be installed in patient care areas. ANY installation exceptions must be approved by Engineering and Operations.
- Medical vacuum shall ONLY be used for drainage, aspiration, and suction in order to remove body fluids from patients. Medical vacuum inlets shall only be installed in

Duke University Medical Center and Health System  
Facility Standards

- patient care areas. ANY installation exceptions must be approved by Engineering and Operations.
- WAGD inlets shall be installed to capture and carry away gases vented from the patient breathing circuit during the normal operation of gas anesthesia or analgesia equipment.
  - Laboratory (nonpatient use) vacuum inlets that are attached to the medical vacuum system shall be connected to a dedicated line that is piped directly to the receiver tank.
  - Medical air compressor shall be duplex (minimum) oil-free reciprocating or scroll type, with each compressor sized to deliver the full SCFM. Pumps shall be Beacon Medaes. Other manufacturers may be considered
  - Vacuum pumps shall be a duplex (minimum) rotary vane or claw type, with each pump sized to deliver the full SCFM. Pumps shall be Beacon Medaes.
  - All purging and testing shall be performed using Type NF Nitrogen (oil free, dry).
  - All medical gas low voltage wiring shall be installed in conduit. Wiring shall be a minimum of 22 AWG shielded, twisted pair. Multiple pairs within a shielded bundle are acceptable.
  - All new piping shall be verified by a third party agency prior to tie-in. Final verification shall be performed after all components have been installed and all work is complete. Verifiers shall be ASSE 6030 certified.
  - All installations shall meet NFPA 99 (latest edition) standards and DUMC specifications.
  - All piping shall be delivered capped or plugged. Plugs shall not be pulled from the pipe. The ends of plugged pipe shall be cut so that the pipe containing the plug is also removed. All piping and fittings shall be visually inspected prior to installation.
  - Where three (or more) piping systems are run together, uni-struts shall be used to support the pipes. These piping systems shall be spaced appropriately (minimum 5” OC) so that valves shall not interfere with or obstruct each other. All medical gas piping shall be installed on its own pipe rack separate from any water or other pipe.
  - All medical gas valves shall be accessible for proper operation.
  - Provide clear access at point of connection to medical gases at all medical gas columns and booms.
  - Underground med gas piping shall be schedule 40 steel piping with metal spiders and encased in concrete.**
  - Coordinate all work and latest requirements with Rick Teta (681-5346).
  - Testing shall be witnessed by DUMC. Provide 48 hours notice prior to all testing. Pressure testing shall be a minimum **duration** of 48 hours.

**Fire Protection**

- Owner insurance carrier is FM Global. Submit all plans and shop drawings to FM Global for review. Minimum recommended submissions are at Schematic Design, Design Development or 50% Construction Design and final Construction Design. Contact FPDC for current FM Global representatives.
- DUMC shall be notified 48 hours in advance of all testing.
- Fire pump preference is Aurora with Firetrol controller. Controller shall be also be tied to Blue Pillar system to test transfer of controller via remote transfer option. Controller shall also meet requirements for other ATS accessories. Coordinate necessary interface with Blue Pillar. Elastomeric fire pump couplings are not



Duke University Medical Center and Health System  
Facility Standards

permitted. The connection of the normal feeder to the fire pump controller shall include a disconnecting means and overcurrent device, meeting all requirements of NEC 695.4(B).

- Sprinkler floor/zone control valves should be accessible without ladders.
- All service pipe to be new, first quality, rated for continuous duty and be a product of the United States of America.
- Piping mains shall be tested for 4 hours.
- Main drains and inspector's test drains shall not discharge on loading docks or sidewalks and should be piped to outside, preferably to storm sewer per code. Hoses should not be utilized for drain downs.
- Minimum schedule 40 for piping from building entrance to fire pump or 1<sup>st</sup> 100 feet, whichever is greater.
- Provide protective covers, skids, plugs or caps to protect equipment and materials from damage or deterioration during construction.
- All sprinkler head runouts shall be connected to top or side of mains/branches. Use of flexible **braided piping similar to Victaulic Vic-Flex Series AHE will be considered on a case-by-case basis.**
- All piping mains shall be labeled with direction of water flow. All valves shall be labeled. Sprinkler valves above ceilings shall be labeled on the grid for location.
- Typical Duke installations require sprinkler heads within a zone to be fed by the corresponding zone valve. Sprinkler zones should match fire zones. Fire zones should not be fed from multiple feeds. Coordinate with Duke Fire Safety and E&O.

Duke University Medical Center and Health System  
Facility Standards

**Electrical**

**General**

- All projects adding load to the facility shall include required NEC 220.87 load summary for the major equipment.
- Primary power, rated at 12,470 volts, is provided by the Duke University Facilities Management Department (FMD) via their High Voltage Department. All project requirements for service point of entry, equipment rating, equipment types and equipment selections and arrangements are to be coordinated and approved through this department. Early engagement and coordination with this department is highly recommended. E&O or FPDC can provide the point of contact.
- All electrical equipment shall be identified with permanently attached color coded phenolic plates. Coordinate with E&O for nameplate color schedule.
- Nameplates shall include equipment name, source, voltage and phase, load, and branch of electrical system as applicable. Arc Flash labels shall also be provided on electrical equipment to meet all NFPA 70E requirements. Duke standard label and associated information shall be utilized.
- Duke Identification and Labeling specification available upon request.
- Coordinate with Duke E&O concerning naming standards for new equipment.
- All junction boxes, pull boxes, and enclosures for emergency power system shall be completely painted red.
- Main electrical rooms shall be conditioned to 78 degrees F and 50% RH.
- All service disconnects, motor starters, etc. shall have compression rain tight fittings.
- All disconnects in wet areas, outdoors, and in isolated power areas shall be stainless steel NEMA 4x enclosures.
- All pneumatic tube equipment shall be on emergency power and all associated data cables shall be installed in conduit.
- Decommissioned conduit, wiring, and data cables to be removed.
- Fire alarm panels and associated equipment, control panels, and other low voltage system components are not permitted to be installed in electric closets. These systems shall be placed in vendor telecomm closets or separate signal and comm closets.
- Equipment that supports nurse call and other low voltage systems shall not be installed in interstitial spaces. Closets shall be included in the occupied spaces for equipment support.
- UPS units shall include stand alone maintenance bypass switch similar to Cutler Hammer MHBE or equivalent Schneider Electric type. Preference is for UPS to include same input and output voltages. UPS shall include communications board for monitoring by users (typically DUMC BAS Room does not monitor these systems) and shall be provided with maintenance contracts as E&O typically does not maintain these systems for users.
- All shutdowns should be requested 48 hours in advance. Exceptions to be approved by appropriate E&O Assistant Director.
- Motor starters for all equipment at DHN shall be Eaton Freedom Series Motor Insight Starters with C440 overload relay with Ground Fault, LED lights and “Push to Test”.
- Motor control bucket connections will be terminated to the factory supplied

Duke University Medical Center and Health System  
Facility Standards

- connections. Alterations to the factory control wiring of a bucket is not allowed to be made in the field under Any Circumstance.
- Unistrut/supports over 6" shall be supported by at least (2) threaded rods. Cantilever supports shall have (2) points of connection.
  - Do not install anchors into the bottoms or sides of the precast concrete floor and ceiling supports in DHN unless designed by structural engineer and approved by E&O.
  - All ductbank concrete shall be provided with red dye.
  - All equipment shall be purchased from local representatives and vendors **wherever possible**. Critical equipment shall be serviced within 3-hour travel distance of site.
  - Any contractor working on energized electrical equipment shall follow NFPA 70E for PPE adherence. Provide Duke supervisor responsible for the facility with Hazard/Risk Evaluation Procedure as well as Energized Electrical Permit. PPE equipment shall have been tested within the last 6 months prior to use.
  - O&M Manuals should include PO #'s to purchase lighting and other equipment that has a warranty that extends beyond a year.**
  - No panel board shall be located behind door swing space.

**Raceways/Conductors**

- Minimum size shall be 3/4". 1/2" flexible conduit may be utilized for lighting fixture and device whips where approved by E&O.
- All feeder conduit 2-1/2" and larger shall be GRS rigid or IMC **where exposed or subject to abuse**. When IMC is utilized, furnish and install standard couplings and fittings. All feeder conduits shall have metal ground bushings with ground wire installed at the switchboard and all junction boxes. Do not pull in any feeder conductors until all conduit bushings are installed. All conduits and conduit systems will be installed burr free and or deburred by the use of a mandrel upon completion. All other system (non-electrical power) conduit 2-1/2" and larger may be EMT with insulated throat connectors with compression fittings. All conduits 2-1/2" and larger shall have at least 3/8" rod for strapping.
- All raceways installed exposed outdoors subject to weather and/or in a wet location shall be GRS rigid with watertight connectors.
- Conduits in equipment rooms shall be IMC **if subject to abuse**. Controls conduit may be EMT with steel compression raintight fittings with insulated throat connectors in areas not subject to abuse.
- EMT when used shall be installed with steel compression fittings and insulated throat connectors.
- Only utilize steel fittings.
- Flex connectors shall be steel.
- A pull box shall be placed every 100-150'. Feeder raceway shall have no more than 270 degree bends between pull boxes.
- Liquid tight flexible metal conduit shall be used for final connection to motors, rotating or vibrating equipment and any and all devices installed outdoors and/or subject to liquid spray or stream. Maximum length shall be 72".
- Flexible metal conduit shall be used for final connection to lighting fixtures, transformers and any and all devices installed concealed in dry locations and/or

Duke University Medical Center and Health System  
Facility Standards

- protected dry areas. Maximum length shall be 72". Aluminum flexible conduit is not permitted.
- Pre-manufactured fixture whips and hospital grade "MC" cable assemblies for lighting fixture connection shall be considered on a case by case basis subject to E&O approval. Maximum length shall be 72".
  - At NO time at any Duke facility shall normal and emergency power be installed in the same raceway or junction box. Also, junction boxes shall not tie two same source panels or two sources together in the same box.
  - PVC shall only be used below grade. All conduit elbows that transition up from below grade shall be rigid steel unless otherwise authorized by E&O. No conduit shall be installed in the slab. In the case of cast in place floor boxes, E&O shall be contacted for assistance in coordinating the type of raceway to use and the routing of the raceway.
  - All conduit 1-1/2 inches or larger, label the conduit as to the system it contains. If it is an electrical feeder then it needs the panel and circuit number that it originates from. If it is other systems conduit then it needs to identify the system. Color code the labeling for the system it services. Label on each end and every 25' thereafter. Also, label on each side of wall and floor penetrations.
  - Horizontal conduit inside of walls shall only serve a maximum of 3 outlet boxes at approximately the same elevation for receptacles at counter height or 18" A.F.F. Shall be confined to area of need with no feed through to other devices.
  - In Duke Hospital – No conduit is to be installed on hand rails in interstitial areas. No more than 10 EMT conduits or box supports for a total of 10 supports shall be mounted off the triple tees in the interstitial areas. 1" EMT is the largest size conduit allowed to be attached to the tees. No conduit shall be installed lower than 6' in the interstitial spaces above the catwalks.
  - Large power junction/pull boxes shall be feeder specific (one circuit) and mounted as such that access is maintained at all times. Multi-circuit power junction/pull boxes are unacceptable.
  - Large branch circuit junction/pull boxes that can't be accessed through a single ceiling tile are not permitted and size is limited to 18" x 18" maximum.
  - Large tel/data junction/pull boxes shall be limited to a maximum of 4-4" conduits in and out and mounted as such that access is maintained at all times.
  - Junction boxes 6" x 6" up to 12" x 12" shall be supported by two rods. Boxes 12" x 12" and larger shall be supported on all 4 corners. Preferred minimum box size shall be 4-11/16" x 4-11/16".
  - Helicopter straps are not permitted to support conduit and j-boxes.
  - Junction & pull boxes shall not share feeds from two different panels, distribution boards, ATS's, or motor control boards.
  - Solder all joints in patient care areas and in all of Duke Hospital for branch circuits. Utilize Scotch Super 33+ brand tape minimum on all joints. Other facilities where soldering is not required shall utilize wing nuts as opposed to standard wire nuts to allow additional torque to be applied during install to promote more solid connections. #8 and above will be split-bolted, or as approved by E&O.
  - Feeder distribution design shall allow for the use of either the standard or alternate lug available for the circuit breaker being used. Parallel 600 MCM feeders are typically a

Duke University Medical Center and Health System  
Facility Standards

- problem and should be avoided. Clear taps installed in panelboard gutters are not to be utilized unless approved by Duke and AHJ.
- All feeder conductors shall be installed splice free unless conditions so prohibit. The quantity and location of splices require authorization by E&O. If splices are necessary: Duke must be present when connections are made, proper access must be provided to these locations for future inspection, if installed underground cold shrink used to insulate the connection must be rated for voltage, Field testing of feeder must be completed prior to being placed in service and Duke must witness.
  - Feeder cables #2 and larger shall be crimped to lug or butt splice unless a mechanical connection is the only connection available for that purpose. The crimp shall be circumferential hex or diamond shaped compression (not simple indent) utilizing a die. If a crimp is not available, a split bolt may not be used for connections of more than 2 conductors.
  - All motor connections to utilize T&B Motor Pigtail Connectors or as approved by E&O.
  - All wiring shall be color coded for its full length and not just taped on ends.** At DHN, color code for 480Y/277 shall be Brown, Yellow, Orange to match existing building.
  - No multiwire branch circuits shall be installed for 120 volt outlets or for 480/277 and 208/120 volt lighting circuits. Each circuit serving any of these types of services should originate from a single pole circuit breaker and include a neutral conductor serving just that load.
  - Equipotential grounds shall be installed in all intensive care areas or areas fed from isolation panels. Minimum #10 AWG stranded, continuous with no splices. This will not replace bonding bushings. Provide 2' of spare cable every 5' for future extensions of system.

**Devices**

- Receptacles shall be minimum 20 amp hospital grade at all Duke buildings. Hubbell HBL8300 Extra Heavy Duty type shall be utilized at DMP, DHN, Children's, Eye Center, & North Pavilion. Cooper/Eaton and Pass & Seymour shall be considered at other facilities if approved by Duke.
- In Duke Hospital – horizontal receptacles to have ground pin to the right. The ground pin shall be on top for all other receptacles.
- GFI receptacles shall be hospital grade and shall include indicator light and be self-testing. All GFCI receptacles installed in the hospital buildings will be Hubbell “Autoguard”.
- Combination USB/Power receptacles are not acceptable.**
- In Duke Hospital – device plates shall be stainless steel.
- Corridor convenience receptacles shall be circuited separately.
- Rough-in boxes, gang boxes and branch circuit raceway junction boxes shall have KO's sized for the installed raceway. Avoid the use of boxes having eccentric and/or concentric KO's.
- Where floor boxes are required, the preference is for the “poke-thru” type as submitted and approved for use. Cast in place floor boxes and limited raceway shall be reviewed and approved by E&O prior to installation.

Duke University Medical Center and Health System  
Facility Standards

- Commercial grade plugmold is not acceptable at any Duke facilities.
- Receptacles and switches on essential electrical system shall be “red” in color. Painting of devices in the field is not acceptable.
- Provide panel and circuit identification on each wall plate for receptacles served by normal and emergency power.
- Standard lighting switches to be heavy duty type at all Duke buildings. Hubbell HBL1221 at DMP, DHN, Children’s, Eye Center, & North Pavilion and approved equal at other facilities.

**Transformers**

- Transformers shall be rated for continuous operation at 130% of rated kVA with maximum of 80 Degrees C rise above 40 Degrees C ambient. Windings shall be copper. Terminations shall be suitable for copper wiring.
- Install transformers on 4” high concrete housekeeping pad, or suspend from ceiling on trapeze mounts with vibration isolators.

**Panelboards**

- All panelboards shall **typically** be **minimum** 42 circuit with a minimum of 10 spares. Panels shall typically be rated for 225A except for life safety panels where 100A are acceptable.
- Provide full copper bussing.
- All circuit breakers shall be bolt in type. Provide breaker lock out devices on all circuit breakers to allow the breaker to lock/secure in the off position for compliance with OSHA Lock Out – Tag Out requirements.
- Panelboards in Duke Hospital shall be Eaton/Cutler Hammer. Panelboards in Eye Center, Children’s and North Pavilion shall be Square D. Panelboards in Medical Center buildings shall be Square D or Cutler Hammer but should match type used in existing buildings.
- All electrical panels located in positive or negative pressurized areas shall have conduit sealed with duct seal.
- All panelboards shall be labeled as to their NFPA 70E Arc Flash PPE ratings on the outside of the panel. Markings should include the minimum level of protection required.
- Provide engraved breaker numbers in all panelboards. Stick-on labels will not be accepted.
- Panels shall be provided with door-in-door trims such that devices, lugs and gutters may be exposed without completely removing trim. The exterior covers should all be hinged. Panel covers are not to be painted on site.
- Provide typewritten panel directories. Room names and numbers shall be based on direction from Owner’s staff or Architect to incorporate final room names and numbers. Designations on plans are for construction use only. Certify all circuit identification is correct and provide certification document with certifier’s name. Any change to the directory requires the directory to be re-typed. Also, provide an electronic copy of all panel directories using the Duke Medicine standard directory. Contact E&O Electric Shop Supervisor for templates.

Duke University Medical Center and Health System  
Facility Standards

**Lighting**

- Exit lights shall be edge-lit LED type with die-cast aluminum housing and field mounted chevrons. Utilize Chloride Caliber Series CA6RMA2IC with mirror insert at Duke Hospital.
- Operating Room and other procedure room emergency battery powered lighting fixtures shall be Chloride # S250NH20FWIC-DU with Remote # ICIR to provide testing via manual remote control. All other areas requiring battery powered lighting shall incorporate self-testing feature of the above Chloride fixture. In general, battery powered lighting shall be avoided where emergency power is available except as required by code or AHJ. No other lighting shall be placed on the battery powered light fixture circuit to avoid turning off general lighting when testing batteries. All battery powered lights have to pass a witnessed 90 min annual test before being accepted by Duke.
- All emergency battery powered lighting fixtures and egress lighting fixtures shall be wired to common circuit breakers for testing purposes and shall be labeled as such.
- Fixtures recessed in other than lay-in grid ceiling systems shall be either capable of ballast removal through the fixture aperture, or the contractor shall provide an access door. Ballast removal shall be designed so as not to require special tools.
- 2 x 4 fixtures shall be supported on all 4 corners. 2 x 2 on opposing corners.
- All fixtures must carry UL or other 3<sup>rd</sup> Party labeling.
- All animal holding rooms should include emergency lighting unless advised otherwise by DLAR staff.
- Design of fixtures in ceilings above 10' shall be discussed with E&O prior to final design to coordinate fixture maintenance. Preference is that pendant hung (chain or wire) fixtures are not to be utilized due to increased maintenance time.
- Lighting in lab spaces shall be designed to be in aisles and not over directly over lab benches. It has been proven that lamps cannot be changed out in labs with fixtures directly over benches.
- Do not allow end-to-end mounted fixtures to be wired using through fixture wiring. Each fixture shall have its own flexible conduit feed. Feed through can only be used in hard ceilings, and will only feed the next light in line. E&O has to approve all areas this method is to be used.
- Exterior building lighting shall be controlled via BAS and not through photocell or timeclock. Coordinate with FMD on exterior site lighting control.
- No lighting fixtures should be installed at top of stairwells. All lighting should be at the landing and be no higher than 8'. Provide 2 separate circuits (1 normal/1 emergency or other solution) so that on loss of a circuit, panel, etc. that lighting remains in the stairwell.
- All general area lighting controls and control systems are to be straightforward, robust, repairable and easily maintained. Any combination of dual-level switching, occupancy sensors, relay/contactors control and/or lighting branch panels with integral remotely controlled breakers will provide the required energy savings for off-peak or unoccupied periods and simplified interface with BAS. Electrically held normally closed contactors shall be utilized with BAS interface and where required. Large centralized building lighting control systems are not preferred and the use of same shall be reviewed prior to design. Any and all lighting control systems shall be

Duke University Medical Center and Health System  
Facility Standards

- reviewed prior to design.
- Occupancy sensors shall be Wattstopper, Sensor Switch, or Lutron. Default setting of 30 minutes for the occupancy sensors shall be utilized unless approved by Duke.
  - Aircraft obstruction lights shall be similar to Crouse Hinds, EOL series part #50021-116-GR . This is a double light with single feed. It is used in conjunction with the OLR General use Obstruction Lighting Relay, part # 70020-x4. With this configuration there is a primary with a backup when the primary burns out. It also provides contacts that allow an alarm circuit that would go to a panel with push to test indicator lights to advise which lights are out. This alarm shall report to BAS.

**Substations, Switchgear and Switchboards**

- All breakers in substations shall be draw-out type with winch provided for removal. Winch shall be overhead lifting device, track mounted at the top front of switchgear and complete with hoist and lifting yoke.
- All unit substations shall have hinged covers in lieu of bolt on covers on both front and rear on low voltage sections only.
- Transformers in double ended switchgear shall be impedance matched. No fan cooled transformers shall be utilized. Auxiliary Fans will be installed with a manual/off/auto switch for additional cooling. Oil filled with campus standard fill shall be utilized for all high voltage transformers.
- All unit substations with main-tie-main configuration shall have a kirk key interlock system. Each individual substation shall be keyed alike but does not match other unit substation kirk keys.
- Provide Infrared windows on electrical distribution equipment to allow for use of thermal imaging camera without opening or removing of doors or covers. Coordinate with Duke for location of windows and type of thermal imaging camera being utilized in a specific location. Infrared windows will be Square D, 4” H.VIR Comet Infrared window. Any other IR window would have to be approved by E&O prior to installation.
- Power meters shall be provided and shall be Square D ION 7650 series with all wiring and connections to monitor status of breakers (position and the load side values of that breaker) and provided with emergency and UPS power. Feeder breakers shall be PM8000’s. All commissioning of meters shall be by Square D. Tie into existing system with further info provided by E&O. Graphics page should be updated where new meters are added. All Square D power monitoring monitors shall have the capability of monitoring at least 6 inputs from external devices such as breakers and ATS switches. Square D power monitors require 1 Ethernet connection per max of 15 meters daisy chained together in the same room.
- All proposed medium voltage equipment and design shall be reviewed by FMD. The current point of contact is Aurel Selezeanu.
- Main switchgear in a building shall have a minimum of 2 spare or space sections as well as extra hardware kits. All breakers shall have CT’s for power monitoring. High Voltage gear breaker status shall also be tied to BAS. Manual/Automatic hold switch shall also be tied to BAS.
- All drawout breakers shall have 2 spare sets of COM-NC-NO dry contact switches



Duke University Medical Center and Health System  
Facility Standards

- wired to an accessible terminal strip.
- All breakers in substations, switchgear, and distribution boards shall be provided with mean of providing lock out/tag out on devices as part of equipment installation.
  - All distribution boards shall be Square D I-Line or Eaton/Cutler Hammer equivalent series. Up to an 800 amps rating the board shall be a panelboard enclosure. Any board from 800 amps through 1200 amps rating shall be in a switchboard enclosure. Any board over 1200 amps shall be a drawout main breaker switchboard (current maximum size for I-Line is 1200 amp).
  - Any breakers with a category greater than an ARC rating of 4 will have remote switching to allow sufficient distance that breaker can be safely operated.
  - The connection of the normal feeder to any fire pump controller shall include a disconnecting means and overcurrent device, meeting all requirements of NEC 695.4(B).
  - Motor control centers with starters shall include a wiring diagram within its compartment.

**Emergency Power System**

- Generators to be Cummins or Caterpillar. All generators shall be prime rated (critical facilities) and 2/3 winding pitch. Coordinate Duke requirements during design. Some typical requirements include: fuel filter bypass, oil level regulator, crankcase vapor collection boxes, and NiCad batteries with lockable battery disconnect, etc.
- All new generator installations and modifications to existing **may** include Blue Pillar Secure monitoring system. **Coordinate with E&O during design.** The A/E team shall contact Mr. Paul Schuler (paul.schuler@bluepillar.com) 1-888-234-3212 to coordinate the requirements for this system so they can be incorporated into the Contract Documents. Other monitoring on BAS, remote annunciators, etc. are to be discussed with E&O and be incorporated into the project as required.
- All generators shall be full load bank tested in the field and provided with NFPA 110 installation certification. After NFPA 110 test, continue the test for a total of 24 hours utilizing the building load and a reactive load bank. All emergency power system components (generators, transfer switches, etc.) shall be commissioned by an agency that specializes in that type service.
- All emergency generator and emergency distribution locations (EPSS equipment rooms) must include battery powered lighting in addition to lighting powered from the emergency system.
- EPA Emissions ratings of all new generators shall be coordinated with OESO prior to specifications being issued.
- Fuel oil storage system shall comply with the requirements of NC DENR, OESO, and FM Global requirements. Utilize double-wall fiberglass tanks unless approved by E&O. Fuel monitoring system is required for system. Coordinate model with Duke to allow for proper monitoring and paging. Include data line for connections to data and telephone services. Discuss fuel storage capacity during design – typically 96 hours is minimum storage capacity.
- Provide a quick connect switchboard at the generator for load bank testing and/or the ability to connect another generator at large generator locations. This would include quick connect terminals located outside the switchboard to avoid opening up the

Duke University Medical Center and Health System  
Facility Standards

- panels to make these connections. Preference is Leviton Cat# 16R22 (400 amp rating) for the female connectors when CAT generator is being utilized as Gregory Poole uses the matching Cat # 16R21 male plug. On smaller generators, generator disconnect will likely be sufficient. Discuss with Operations staff prior to installation.
- An equipment layout and system one line must be posted under a protective clear cover in the emergency distribution location (EPSS equipment room).
  - ATS shall be ASCO (DHN and DMP), Russelectric (Wadsworth) and as directed at all Med Center buildings. All ATS's shall be closed transition with dual bypass unless other approved by Duke. All ATS shall be provided with front access and rear **or side access based on the ATS model** as well as drip proof tops. Conduits shall be run using Myers Hub fittings at penetrations. ATS shall be also connected to Blue Pillar and BAS. Provide ASCO Power Manager (Option 85L) on ASCO ATS or equivalent on the Russelectric equipment and other features to properly communicate with Blue Pillar.
  - Provide Square D PM 8000 power meter with shorting blocks for the CT's and disconnect for the voltage monitoring with all wiring and connections to monitor status and provided with emergency and UPS power. Meter shall be installed either downstream of the ATS on the distribution panel or on the ATS. All commissioning of meters shall be by Square D. Tie into existing system with further info provided by E&O. Graphics page should be updated where new meters are added. All ATS field installed control wiring must terminate on terminal strips; starting circuits looped through ATS gear not terminating on terminal strips must be soldered joints. Square D power monitors require 1 Ethernet connection per max of 15 meters daisy chained together in the same room.
  - All DHN ATS switches shall have a color code and number system for identifying the control wiring. Coordinate with DHN Electric Shop.
  - All distribution breakers installed in the emergency paralleling gear are to be breakers with accessories to match existing gear.
  - Main breakers shall be provided in all boards over/equal to 400 amps connected to the EPSS.
  - All distribution boards feeding normal power to the EPSS shall include draw out breakers.
  - All distribution boards on the load side of an ATS shall be Square D I-Line or Cutler Hammer equivalent series with a main breaker. Up to an 800 amps rating the board shall be a panelboard enclosure. Any board from 800 amps through 1200 amps rating shall be in a switchboard enclosure. Any board over 1200 amps shall be a drawout main breaker switchboard (current maximum size for I-Line is 1200 amp). Any board that is rated 400 amps or greater that is a sub-distribution panel off the main board from the ATS shall be I-Line or Cutler Hammer equivalent. All emergency distribution boards, if not an I-Line type, shall be provided with spare breakers, breaker mounting hardware, etc. for future to avoid a shutdown of the board after it is energized.
  - Any breakers with a category greater than an ARC rating of 4 will have remote switching to allow sufficient distance that breaker can be safely operated.
  - Coordinate all BAS tie-ins for ATS's, generators, fuel system, etc. with E&O prior to construction documents.

Duke University Medical Center and Health System  
Facility Standards

- When new fire pump controllers are put in service, the generator service tech shall be on site to assure that the controller is tied into the generator controls and has the necessary options to work with the generation system.

**Isolation Panels**

- Isolation panels shall be Square D. Post Glover LifeLink shall be considered an alternative with a non-vented cover, their Mark 5 LIM unit, with type DRA remote indicators. Utilize bolt on breakers. Panels at DMP shall be 277 Volt feed.
- Duke typically uses (SIP) Standard Isolation Panels for all applications. There are no in panel provisions for receptacles and/or ground jacks and no circuit control.
- All conduits in isolation panels shall include bonding bushings. Conduit openings are to be sealed upon completion with “duct seal” to control lint transfer.
- Design should allow for two duplex receptacles per circuit as recommended by the manufacturer.
- One circuit per conduit is the Duke preference and be continuous and unbroken from breaker to device. Length of run to devices should be as short as possible (+/- 75 ft) to minimize total leakage.
- Duplex isolated power panels are acceptable for use.
- All isolation panels installed in occupied areas shall have stainless steel covers.
- In DMP – areas requiring isolation panels such as anesthetizing and critical care areas shall be provided with two sources of critical power fed from separate ATS’s.
- LIM monitors shall be Square D Isoguard with Isoguard IG2000P remote alarm indicators. This is a 3 wire (Common, Safe, Hazard) connection only. Test and Mute are not to be connected.
- LIM monitors shall be connected to the BAS system for additional monitoring. Check with the Controls contractor for requirements. LIM remote monitors and BAS monitors are to be piped separately and not utilize house cable tray.
- Equipotential grounds shall be installed in all intensive care areas or areas fed from isolation panels. Minimum #10 AWG continuous with no splices. This will not replace bonding bushings. Provide spare cable for future extensions of system.

**Lightning Protection**

- Master label shall be provided where lightning protection is required. When the new work attaches to any part of an existing structure the lightning protection system in its entirety needs to meet the LPI standards and be repaired as required for certification.

**Fire Alarm**

- All devices for Fire alarm systems for additions or renovations shall be U.L. listed, matching existing devices or approved compatible devices for use with the existing fire alarm control panel (FACP).
- Fire alarm/strobe levels in animal care/holding areas are critical to animal welfare. Coordinate with DLAR and E&O for latest requirements.
- Coordinate all work and latest requirements with the Communications Shop (Robert Kerr or Scott Adcock 681-6058).
- For addressable systems, all devices shall match the brand of FACP installed and these devices shall be addressable analog devices.

Duke University Medical Center and Health System  
Facility Standards

- All fire alarm system devices that are located on any exterior surface of the building shall be weatherproof as defined by the National Electric Code, article 100.
- The Fire Alarm System contractor shall provide any special equipment, tools, and programming devices required in the operation, maintenance or repair of the installed fire alarm system.
- Fire Alarm Contractor shall specialize in fire alarm system installation, be factory trained and certified, and a minimum of five years documented experience installing and maintaining fire alarm system for similar installations.
- On conventional systems (i.e. not addressable), all initiating devices shall be labeled with their respective zone and sequence number.
- On intelligent addressable systems, all initiating devices and modules shall be labeled with their respective addresses; including loop and point number. Coordinate all addresses with Comm Shop prior to programming.
- All device labels shall be made using an electronic labeling system with red letters on white background. Write-on labels are prohibited. Notification appliances shall be labeled to identify what type of device it is, i.e. audio/visual, visual, speaker strobe, etc. if it cannot be determined from visual inspection of device from floor.
- All fire alarm wiring must meet Duke University standard for color and type of wiring.
- Contractor shall provide to DUMC, all software required for full system maintenance and upgrades to fire alarm system including any device changes, additions, or deletions.
- Contractor shall provide to DUMC, without cost, all software updates during the warranty period and free upgrades to software following the warranty period that address system operating failures or known defects during the life of the system.
- Contractor shall provide to the DUMC, device address drawings located at the FACP and drawings shall be turned over to Communications shop in electronic format.
- The main FACP shall have buttons or switches for overriding system outputs i.e. Horn/Strobes, Door control, Ahu control, and disabling inputs i.e. Waterflow bypass for weekly fire pump testing, (coordinate with Comm. Shop).
- Fire phones, where required, shall be key operated metal insert style and not break glass style.
- Fire alarm speakers at Duke Clinic to be 8" ceiling mounted type.
- Please place all duct detector Test/Indicators in main corridors (wall mount) where they can easily be found and identified.
- Provide 20% spare on all circuits and panels.
- All fire alarm systems must be pre-tested by Comm Shop. After all systems are confirmed to be operating correctly, OESO-Fire Safety and CoD fire marshal may be contacted for final testing.
- New fire alarm systems on campus shall be Edwards EST-3, FCI Intelligent Addressable System or Fenwalnet unless approved in design phase by Comm. Shop. Off campus locations shall be coordinated during design phase.
- All existing smoke detectors to remain in renovated spaces shall be thoroughly cleaned prior to being reactivated.**
- EST systems shall include Fireworks software and necessary equipment in new and existing applications to tie into existing system. All graphics and navigation

Duke University Medical Center and Health System  
Facility Standards

operation of the Computer Graphics shall match the existing system in appearance and function.

**Clock Systems**

- Clock systems shall be the Primex Wi Fi system at DUH/DC buildings.
- Any new clock systems to be reviewed by DHN E&O to coordinate with existing clock system.
- All wall clocks that require 120 volt power shall be direct wired and not by cord and plug. Primex clocks above are not required to be supplied with 120V power.
- All digital clocks shall have red LED's.

**Testing & Studies**

- Fault current analysis, arc flash study and coordination study shall be completed for all projects that impact the electrical systems for Duke facilities. Analysis shall be completed utilizing SKM software. Where the existing facility has base building studies in place, the project shall be responsible for having the study updated to include all modifications to the electrical system.
- Specify appropriate tests (megger tests on feeders, load test, ground fault test, etc.) to have a completely operational system at time of final inspection. Submit all test reports to E&O prior to final inspection for review.
- All impedance testing shall be performed by an outside approved vendor. All copies of readings shall be transmitted to the electrical supervisor responsible for that area.

**Elevators**

- All elevator controllers shall be MCE, **GAL or Smart Rise**. Ensure that any controller installed shall not require a proprietary tool or like to access ALL of the functions, settings, configuration, etc.
- Each elevator shall be configured for and connected to the Lift-Net system at DHN. If is also preferred that elevators at Medical Center and other buildings shall also be tied into Lift-Net (Lift-Net is the computerized, networked elevator monitoring and control system).
- All hydraulic elevators shall be supplied with environmentally safe oil.
- Elevator specifics: Elevators in Duke North shall be 500 FPM (other locations shall be discussed with DUMC Elevator Shop during design). Each elevator shall have a combination position indicator/hall lantern at every landing which shall match existing. All button lights and indicators shall be LED. Fireman's recall keys shall be FEOK1 with all other keys being BEST to match existing. Emergency phones shall be Talk-A-Phone to match Duke Police requirements. Fire phone and not jacks shall be installed in each elevator where required (high rise). All door equipment for car and hoistway (tracks, hangers, locks, rollers, and door operator) shall be GAL. Light-rays should not be utilized for detector edges. The Centralized Control Panel (COP) shall open and close with key locks and not screws. On the cab's COP under the PI, engrave the elevator's number in one inch tall black letters and number (ELEVATOR 1). All additional features such as independent service, inspection, lights, and fan shall be on toggle switches behind a panel and not keyed switches.
- For 2 speed center opening doors only, install the doors so the elevator will not

Duke University Medical Center and Health System  
Facility Standards

- operate until all four doors are closed.
- Elevators serving mechanical areas shall be controlled via card reader or key switch for that floor.
  - Machine Roomless elevators are not preferred at Duke Medicine.
  - Floors in elevator machine rooms and pits to be painted cruise gray and walls white.**

Duke University Medical Center and Health System  
Facility Standards

**General Construction**

- Room numbering is extremely important to each project and as soon as a firm floor plan is developed the A/E Team needs to contact the Medical Center and Health System Architect's office (MCHSA) to receive and coordinate the final room numbers.
- All door hardware, frames, doors or materials associated with egress shall be reviewed by the University Key Shop and the appropriate E&O Carpentry Shop.
- Automatic door operators shall be Horton. 4100 automatic easy access surface applied electro-mechanical swing operator in public areas requiring patient and staff disability access. Activated by manual push plates for most applications. Includes a BEA DK-12 header mounted presence detector and presence stick unless otherwise approved by E&O. Provide Von Duprin QEL Panic Hardware with surface mounted vertical rod latching for any door with an automatic door operator.
- Coordinate latest requirements for all locksets and closers with University Key Shop. Closer bodies shall be secured to doors utilizing thru bolts and a backing plate. Mechanical rooms and storage rooms shall include self-closers.
- Panic hardware shall be Von Duprin 99 L-26D. Stainless steel guards shall be provided in high traffic areas and where deemed necessary by E&O.
- Stairwell and fire rated doors at Duke Hospital shall utilize stainless steel continuous hinges.
- Preferred exterior doors at Duke Clinic are special lite doors with lever to exit device locksets and stainless steel continuous hinges.
- Fire rated doors shall meet NFPA 101 requirements for door, frame, gaps, and undercuts.
- Access doors in sheetrock shall be equal to Williams with baked enamel finish, screw access and continuous hinge. Doors in public areas or subject to tamper shall be provided with locks keyed to the DUMC Engineering Master. Access doors shall be provided in acoustical ceilings where access is needed above ceiling for preventive or corrective maintenance and tiles cannot be removed due to interference. These doors shall be similar to Williams TB 1200 drop-in access door.
- Overhead coiling doors: Gravity or loss of power type doors should not be used because of entrapment possibilities. Battery back-up option should be provided to avoid problems due to power issues. Preferred type for automatic closure type should include a safety announcement that warns anyone of the door closing at the 10 sec delay before it shuts. Push button or key reset shall be provided for all doors.
- Lockers shall be set up for use of personal locks and not facility locks.
- Toilet accessories shall comply with latest EVS standards.
- Bathroom partitions shall be floor mounted. Material for partitions shall be reviewed and approved by Duke prior to specifying.
- ADA compliant showers shall be constructed in place with tile. Surround shall be tile to ceiling height and extend at least one foot beyond sides of shower. Shower room floor (outside of shower) shall be slip resistant tile with tile base board. Water proofing shall be used under and behind all tile. No drop in ceilings to be used above showers.

Duke University Medical Center and Health System  
Facility Standards

- Provide wall protection systems, similar to Korogard or Acrovyn, or high density laminate chair rails in corridors and areas where wheelchairs, stretchers or mobile material carts are utilized. Stainless steel wall protection to be provided where deemed necessary by Operations or Administration.
- Expansion joints at all areas subject to pedestrian traffic shall be Belzona 2211 system furnished and installed by Triangulations, Inc. All other proposed systems to be reviewed with E&O prior to start of construction.
- Wall shelving rails and brackets shall be installed to meet fire code for safe storage. Users are responsible for identifying the height of material that will be stored on top shelf before shelf assembly installation in order to comply with fire codes. 18" of clearance between top of stored material and ceiling in sprinkled area. 24" of clearance required between top of stored material and ceiling in non-sprinkled areas. Shelves shall be KV heavy duty shelf standards and brackets with toggle bolts top and bottom.
- Floors in washer, sterilizer, and other similar rooms shall be epoxy type.
- Space above cold rooms must be accessible to maintenance personnel. Care needs to be taken in design and installation to provide ceiling access to this area as well to avoid future issues with damage of ceiling tiles and grid. Preference is to have a maintenance vestibule with permanent access to area above cold room.