University Services Building
110 Maintenance Road
Saskatoon, SK S7N 5C5

USE OF GUIDELINES

The University of Saskatchewan (USask) Design Guidelines are intended to provide information on systems and design components that must be followed for projects on campus. The information provided herein is considered minimum design standards for any system component noted. Designers are required to meet applicable Codes and standards for all systems and components not specifically mentioned within this document.

The Design Guidelines are living documents and as such, consultants are encouraged to engage the USask PDC team to suggest updates or clarifications to the guidelines as necessary to ensure USask procedures and specifications stay up to date with industry practices. It is the Consultant's responsibility to ensure they are using the most up to date version of each section of the Guidelines for any new projects undertaken. **Latest updates are shown bolded, underlined and in blue.**

SECTION 21 FIRE SUPPRESSION

1. Sprinklers shall be fully recessed in public spaces with ceilings.
2. In all other areas, upright pendants shall be used. Chrome heads shall be used in public spaces.
3. Sprinkler guards for pendant and upright heads shall ULc listed or Factory Mutual approved for the type of sprinkler they are installed on.
4. Where sprinklers are subject to freezing, provide a dry system or non-freeze heads rather than an anti-freeze system.
5. Fire system components shall be installed where they can be easily accessed with permanent drains and or test piping so they can be inspected, tested and maintained as per NFPA 25.
6. All sprinkler piping shall be schedule 40 black iron pipe.
7. All sprinkler head connections to be hard piped, no flexible connections allowed.
8. When fire pumps are installed ensure an external manifold for testing purposes.
9. Fire extinguishers shall be installed in fully recessed cabinets in public spaces.
10. For specialized applications, system type to be used shall be reviewed with USask Engineering group prior to finalization.
11. **Designers shall indicate flow quantities and estimated system volumes on drawings.**

SECTION 22 PLUMBING

General

1. In addition to the information contained here, Consultants are directed to refer to the University of Saskatchewan's Preferred Mechanical Master Equipment List, which is available from the University Mechanical Engineer upon request.
2. The point of entry of utilities to the building shall be selected to minimize the length of the connections back to the utility mains. Final locations will be determined in consultation with Facilities & Operations Group. Responsibility for extension of utilities will be determined on a project-by-project basis.
3. **Where systems are demolished, remove unused lines back to main.**

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Plumbing Distribution

1. Provide approved back flow preventer (BFP) at the water service connection(s) to each building and at interconnections to fire suppression systems and other non-potable water systems. For buildings with only a single water supply, provide two parallel BFPs sized for full flow with necessary bypass valving.
2. All water mains shall be sized for 50% greater future fixture unit load.
3. Hot water recirculation systems are required in all buildings with a central hot water system. Ensure maximum pipe velocity does not exceed 4fps. Connect hot water recirculation system as close as possible to electronic faucets.
4. Plumbing mains shall be routed over unoccupied spaces wherever practical. All system components, where not installed immediately upstream or downstream of a fixture, shall be installed in an accessible location in the ceiling or wall. Route plumbing mains to follow building lines.
5. Provide isolation valve and drain valves on all risers.
6. Provide drain valves at all isolation valves sized 50mm and above.
7. Provide isolation valves on all take-offs.
8. All valves 50mm and above shall be identified on design drawings. Contractor to provide valve tagging and valve location tables.
9. Piping installed to service Washrooms shall be installed in accessible chases.
10. All domestic water lines shall be type L copper pipe.
11. All copper fittings and joints shall be soldered or approved mechanical grooved fittings.
12. Water hammer arrestors to be installed in accessible locations. Do not install behind drywall ceilings or walls.
13. Provide pressure reducing valves on water supplies to low flow fixtures. Outlet pressure shall be 55 psi.
14. Non-freeze hose bibs shall be located so hoses do not cross walkways or roads or use lengths in excess of 50 m to reach all landscaped areas.

Sanitary Plumbing Systems

1. All main drain lines shall be sized for 50% greater future fixture unit load.
2. Main lines shall be routed below or above unoccupied spaces, where practical.
3. New water closets shall be wall hung.
4. Piping installed beneath structural slabs shall be hung from the structure with stainless steel hangers and protected from heaving with void boxes. Transition to ground supported piping shall be designed with minimum 75mm drop over 1,800mm, but not more than a 10% grade.
5. Cast iron piping and floor drains shall be used in areas where there is potential for high temperature discharge from equipment. High temperature is considered for discharge temperatures above 60°C.
6. Where trench drains are installed, designer shall discuss needs for a flushing system to be incorporated with USask Engineering team.

Storm Drainage Systems

1. Main storm water piping shall not be routed vertically through exterior walls.

2. Flexible couplings are not acceptable for buried piping.
3. Insulate rainwater leaders 3m into conditioned space at each roof drain.
4. Piping installed beneath structural slabs shall be hung from the structure with stainless steel hangers and protected from heaving with void boxes. Transition to ground supported piping shall be designed with minimum 75mm drop over 1,800mm, but not more than a 10% grade.

Plumbing Equipment

1. Refer to University of Saskatchewan's Preferred Mechanical Master Equipment List for detailed descriptions of acceptable products.
2. To reduce potable water consumption, design plumbing systems in accordance with the most recent version of LEED® Canada specification.
3. Water Closets: maximum 6 lpf.
4. Urinals: 2 lpf. Waterless urinals not permitted.
    a. Utilize battery powered sensors.
5. Lavatories for washrooms: Under-mount lavatories shall be constructed of stainless steel.
6. For stainless steel sinks, ensure the overflow is across from the faucet to ensure proper operation of hands-free sensor.
7. Shower Heads: maximum 5.5 lpm.
8. All Drinking Fountains shall be non-refrigerated and include integrated bottle fillers.
9. Pipe access space shall be provided behind fixture walls for maintenance purposes and also to isolate noise from adjoining areas. All valves shall be accessible.
10. **Provide Water Meters at incoming main water service, upstream of hot water equipment and any major process needs.**

SECTION 23 HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

General

1. Refer to University of Saskatchewan Master Mechanical Specification as reference only for preferred materials, methods and owner requirements.
2. Refer to University of Saskatchewan's Preferred Mechanical Master Equipment List for acceptable manufacturers for mechanical equipment. If a manufacturer is not listed or an equivalent is proposed, consultant shall notify and discuss with University Mechanical Engineer.
3. Where specialty equipment not normally within the expertise of local Mechanical *Contractors* is to be installed, start-up and/or installation by factory-trained representatives shall be specified.
4. Detailed parts lists for all equipment, with exploded views and part numbers, shall be provided for in the *Contract*.
5. Vibration control shall be provided in accordance with ASHRAE recommendations.
6. Equipment generating heavy vibration and/or noise shall be located away from occupied spaces.
7. Equipment and mechanical shafts shall not be placed near instructional, office or research spaces.

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8. All building equipment shall be accessible for servicing, repair or replacement as necessary. This implies not only provision of service platforms, access panels or doors, but also room within which to work provided in locations where access will not be an unnecessary hardship. Equipment shall be installed indoors. Any roof mounted equipment requires access.
9. In equipment rooms, floor mounted mechanical equipment shall be set on concrete housekeeping pads. Where ductwork or piping passes through floors above occupied spaces, pipe or concrete curb weirs shall be provided. In large mechanical rooms provide adequate floor drains to accommodate future equipment. Generally, mechanical rooms shall not be placed above occupied spaces. Penthouse locations are preferred for air handling systems. All exposed plenums and duct work in equipment rooms are to be painted.
10. All mechanical equipment shall be drawn to scale on plans. Provide drawing sections and elevations to clearly identify equipment location and spacing required for servicing.
11. As the design of a *Project* nears completion and all pieces of equipment have been selected, the *Consultant* shall consult with *USask* Engineers for guidance on the nomenclature and numbering system to be used in scheduling equipment.
12. Design Environment shall meet ASHRAE Standards for all different space types on Campus. Discuss project particulars with USask Mechanical Engineer.
    a. Refer specifically to ASHRAE Handbook – HVAC Applications (current edition) for general temperature and humidity ranges to be followed. For spaces not represented in the Table, Discuss requirements with USask Mechanical Engineer.
    b. Ventilation requirements, both fresh air and exhaust air, shall meet ASHRAE Standard 62.1 (current edition). Control systems shall be utilized to use demand ventilation strategies wherever possible.
    c. Noise requirements shall meet ASHRAE Handbook – HVAC Applications (current edition).
    d. Design decisions shall be made with the intention of providing an energy efficient, robust HVAC design.
13. Use unit heaters at large door entries to replace lost heat quickly. Force flows shall be used in vestibules or at any public entrance to a building. Force flows shall not be installed in ceiling.
    a. Air curtains shall not be used, unless expressly approved by USask Mechanical Engineer.
14. All new ducting systems shall be low velocity, low pressure unless written approval is provided by USask Mechanical Engineer.
15. Control valves, vents, isolation valves, etc., shall be located above accessible ceilings over unoccupied spaces where possible.
16. Heating to critical infrastructure shall be maintained in the event of a power failure.
17. Temperatures in equipment rooms shall be maintained at a reasonable level; any excess heat should be reclaimed for use elsewhere whenever possible.
18. Dual manifold relief valves should be considered for refrigerant systems.
19. Refrigeration equipment and refrigerant types shall be reviewed with USask Engineering Team prior to specification and selection.
20. When tying into existing hydronic systems, water tests shall be performed at the time of design to determine the extent of system cleaning required by the contractor. Consultants shall inform the USask Engineering team of the outcomes of the tests. Tests costs shall be borne by USask.
21. **Where systems are demolished, remove unused components (distribution, terminals, etc) unless noted otherwise.**

22. **Any new district services being fed to a building shall have metering at a building level. This includes steam, condensate, and chilled water.**

HVAC Insulation

1. No insulating materials containing asbestos shall be used.
2. Insulation in contact with airstream shall be close celled.

HVAC Hydronic Systems

1. Isolation valves shall be installed to isolate all components in a piping system.
2. Provide isolation valves on each main branch.
3. Drain valves are required at all terminal units, at the base of all risers and main take-offs.
4. Ensure piping routing does not allow for freezing in spaces with access to the exterior.
5. Install a strainer upstream of every control valve.
6. Air cushion-type expansion tanks complete with gauge glass shall be provided. Pressurized diaphragm-type tanks are not acceptable. Expansion tanks shall have a tire-fill valve for air charging and a compressed air line with fill chuck located nearby. A level alarm system shall be provided.
7. Pumps on water and glycol systems shall be specified with mechanical seals. Provide flexible connectors on suction and discharge of all base mounted pumps. Provide isolation valves on suction and discharge of all pumps.
8. Pumps should typically be installed in pairs and in duty-standby sequence, alternated based on a timed schedule.
9. Designers shall indicate flow quantities and estimated system volumes on drawings.
10. All buildings shall be connected to the central chilled water system, unless otherwise directed by USask Mechanical Engineer.
11. The central chilled water system is in operation during the months May to September only. The characteristics of the central chilled water system at the Building are as follows:
    a. Chilled water supply temperature: ~8.0oC.
    b. Temperature rise between supply and return: 6.7oC.
    c. Flow of chilled water per ton of cooling load: 0.126 l/s.
    d. Minimum differential head at site, to be determined in consultation with USask Mechanical Engineer.
12. Throttling type control valves must be installed on all coils, no bypass type control valves are allowable on any chilled water piping. Clarification on chilled water control can be obtained from USask Mechanical Engineer if required.
13. Drainage points shall be installed at low points in each building.
14. For all types of multi-row coils, fins are to be continuous through the total thickness of the coil.
15. Provide filters ahead of all coils, including exhaust coils on heat reclaim run around systems. Access shall be provided on both sides of coils to permit cleaning or repair.

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Steam and Condensate Systems

1. Steam force-flow and unit heaters shall be installed with a two position control valve operated by a thermostat. An aquastat located on the condensate line shall cycle the fan and act as a low limit protection device. Where it is absolutely necessary to lift condensate out of a heater, no control valve will be used. Instead these units will be on a steam line with a CCMS control valve that will be closed in warm weather.
2. Steam delivery pressure to the Building will be approximately 952 kPa (138 psig). Piping, fittings, etc., on the high pressure side of the pressure reducing station are to be selected for 2068 kPa (300 psig) service.
3. The pressure reducing station is to be located as close to the steam entry point as possible and in a location where the noise will not be objectionable.
4. Relief lines from all safety relief valves on steam pressure reducing valve stations shall be carried to atmosphere above the roof. Each of the heating, ventilating, domestic hot water and steam systems shall be on an individual branch with its own clearly identified isolating valve.
5. Two condensate return pumps shall be used, alternating in operation. The condensate receiver must have an emergency drain connection to the sewer which is above the normal operating level of the receiver, but below the lowest heating coils in the ventilation system.
6. Provide design for the installation of a globe valve upstream of each condensate pump isolation valve for pump flow control.
7. If steam with a pressure above 103 kPa is used for heating or any equipment which returns condensate to the system, a flash tank for reducing the condensate to atmospheric pressure must be provided. Also, the system must be designed so that all the low pressure steam produced by this flashing action is completely used. No steaming vents will be allowed.
8. Gaskets used for high and low pressure steam systems shall be spiral wound steel gaskets tightened to the manufacturer's specified torque.

HVAC Air Distribution Systems

1. The Building ventilation system shall be designed to take advantage of natural cooling by the outdoor air when temperature and humidity conditions are favorable.
2. Ensure ventilation rates for all spaces conform to most recent edition of ASHRAE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality.
3. Energy reclaim techniques must be designed into all systems.
4. Intake and exhaust air installations shall adhere to minimum discharge/intake distances required by ASHRAE 62.1.
5. Fresh air intakes shall be located to at least 5m from ground level and 1m above any horizontal surface to avoid snow buildup. Size intake louver to avoid water penetration. Coarse bird screening mesh (about 25 mm) should be provided.
6. All fan equipment shall be installed in a mechanical room. Centralize equipment where possible.
7. All terminal units shall be equipped with reheat coils.
8. Radiant heat shall be the primary means of heating exterior occupied spaces.
9. Install silencer boots on return grilles where noise transfer from a private space may occur. Position such that sound transmission is not directed towards adjacent occupied spaces.
10. Change rooms and shower rooms shall be under negative pressure to control odor & humidity.

11. Exhaust grilles shall be located to pull either odor laden or vapor laden air from spaces as first priority.
12. Diffuser design and layout shall not allow downdrafts to occur on occupants in space. Designer shall base design on longest diffuser throw rates published by manufacturer. Design shall follow ASHRAE guidance on diffuser installation.
13. Designate air quantities in main ducts, etc. Specify balancing dampers in all duct run-outs in supply, return and exhaust systems.

SECTION 25 INTEGRATED AUTOMATION

Controls Design and Scope of Work

The following process is to be followed on projects where the U of S automated 'Delta' controls system is being installed. The Delta system will be implemented as a standard on most university projects. In instances where stand-alone systems are recommended by the PD&C Controls Design Group, the Controls Group will also advise on appropriate design, procurement and construction processes.

The implementation of controls in new building projects is normally a different process than for other work being carried out on the *Project*. This is because a significant portion of this work is carried out by PD&C forces as well as outside contractors.

1. PD&C Scope of Work - Controls Tender and Cash Allowance

Based on the consulting mechanical engineer's design and sequences of operation the PD&C Controls Design Group creates a set of controls tender documents. The controls tender is issued after the project tender. The reason it occurs after the main building tender is that the controls design group uses the mechanical design from the building tender set as a basis for design of the controls system. Because the controls tender occurs after the main building tender, a cash allowance is carried by the mechanical contractor in the building tender to cover the cost of the separate controls tender. The *Consultant* shall inclusion this cash allowance in the project tender documents, and coordinate with the *Client Representative* and PD&C Controls Group to determine its amount.

The controls tender covers the supply and installation of pipe and wire/pneumatic tubing and the installation and termination of *Owner* supplied field devices. The amount carried for the cash allowance is determined by PD&C's mechanical engineer and controls design manager. The controls tender set includes all the information needed by the controls contractor to do this work, as well as information needed by PD&C controls personnel to program and commission the controls system. The tender set also provides MCC starter circuits for use by the electrical contractor.

The mechanical contractor receives the bids for the controls tender and the *Consultant* administers the tender process and awards the controls contract in consultation with PD&C. The mechanical consultant then issues a price request and subsequent *Change Order* for the controls contract to be applied against the cash allowance. The successful controls contractor acts as a subcontractor to the mechanical contractor.

Aside from the cash allowance carried by the mechanical contractor a separate line item is carried in the project budget to cover PD&C's controls costs. These costs include controls design, controls equipment purchase, controller installation on terminal units, panel installation and terminations, programming, graphics creation and commissioning. The amount carried for this budget line item is determined by PD&C's controls specialist assigned to the *Project*. Below is a further breakdown of the tasks included in this budget amount:

- Controls Design: is performed by the controls specialists in the controls design group. It is the process of creating the controls tender set. It also involves the selection of controls equipment as required to satisfy the mechanical consultant's sequences of operation (SOP), and meet University standards.

- Controls Equipment Purchase: The Delta controls equipment and field instrumentation is purchased by PD&C to ensure that we are using equipment that has a proven track record and can be serviced by PD&C personnel or replaced when necessary with parts that we stock in PD&C stores. Equipment purchase is coordinated by the controls specialist.
- Controller Installation: PD&C's controls shop mounts the room controllers, transformers, fuses and damper actuators on the terminal units before the terminal units are installed in the ceiling space by the mechanical contractor. Note: terminal units refer to mixing boxes and air valves.
- Panel Installation and Termination: An PD&C electrician mounts the main system controllers in enclosures provided by PD&C. The enclosures are typically located in mechanical rooms and are mounted by the controls contractor. Termination of field devices to panel mounted controllers is performed by the PD&C electrician as well as installation of all panel mounted equipment. This includes transformers, power supplies, relays, solenoid valves, pressure transmitters, differential pressure switches and current to pneumatic transducers (I/P).
- Programming of the Delta System: is performed by the controls specialist. The programming must satisfy the sequences of operation and conform to the controls standards so that there is consistency from one project to the next.
- Graphics Creation: is the task of creating graphics for the system which provide information and controllability for the central operator and other campus users in a clear and consistent manner. The graphics are created by the controls specialist.
- Commissioning: is the task of testing to ensure that the controls function as specified by the sequences of operation and to the standards specified by the university. Commissioning is performed by the commissioning agent, the controls specialist and the controls shop with assistance from mechanical, electrical and controls contractors as required.

2. Mechanical Contractor's Scope of Work (from base tender)

As part of the building tender the mechanical contractor is typically responsible for the following: (The mechanical contractor typically sub-contracts this work to a controls contractor)

- Supply and installation of the central mechanical system control valves and steam stations.
- Supply and installation of terminal units
- Rough-in of room thermostats and humidity sensors to above ceiling. Note: This is included in the mechanical tender because if it were included in the separate controls tender block walls may already be in place.
- Installation of room control valves (radiation, reheat and cooling). Supplied by PD&C.
- Supply and installation of air flow monitoring stations
- Supply and installation of motorized control and isolation dampers
- Supply and installation of instrument air compressors and filtration along with distribution lines to mechanical rooms
- Assist with integrated system tests

3. Controls Contractor's Scope of Work

- This scope of work is defined in the controls tender. Note that the controls contractor acts as a sub-contractor to the mechanical contractor.
- Pipe and wire of room thermostats and field devices from room controllers to rough-ins above ceiling.

- Installation and termination of room control devices.
- Termination of room controls devices and communications at room controller.
- Pipe and wire of the controller communication trunk. Contractor must assist the controls specialist to make sure communication wiring is correct.
- Installation of damper actuators (supplied by PD&C). Also supply and installation of jackshafting and linkages on fan system dampers.
- Mounting of enclosures for Delta controls equipment (enclosures supplied by PD&C).
- Installation of all field instrumentation on building fan systems. (Instrumentation mounted in PD&C supplied enclosures is by PD&C).
- Tubing and conduit for pneumatic systems for central mechanical systems over and above the basic rough-in included in the base tender.
- Assist with integrated system tests

General

1. Control systems shall tie into existing digital control system on Campus. Existing system is Delta Controls.
2. Any existing system being upgraded in any main building system must be upgraded to a digital control system. Use of pneumatics is not permitted.
3. Provide a separate thermostat/sensor and zone for each instructional space, meeting room, or other space where occupant loads can vary significantly throughout the day.
4. In general, control logic shall be designed to maximize energy savings for the system without impeding thermal comfort. ASHRAE Guideline 36 shall be used as a reference for all HVAC systems. Control logic shall be coordinated and worked on in conjunction with USask Building Automation Group during design period.
5. Use demand control ventilation strategies. For small meeting rooms, or spaces with four or less users expected, occupancy sensors are acceptable.
6. Maximum of three spaces of similar load patterns may be grouped into a single zone. Corner offices, or spaces with multiple exterior wall direction exposure, shall be zoned individually.
7. Thermostats shall not be located in circulation/corridor spaces. Wall mounted temperature sensors c/w stainless steel face plates shall be used. Thermal settings shall be controlled from OWS.
8. Thermal zones shall be limited to 300m2 for interior spaces, and 175m2 for spaces with exterior thermal loads. Exterior zones shall extend no more than 3m into the building from the exterior wall.

More information on the controls scope can be determined through conversation and consultation with USask's controls group.