All guidelines apply to both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.

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1.0 GENERAL

1.1 Related UBC Guidelines & Documents

.1 Section 23 00 00 HVAC (and all subsections)
.2 Section 20 00 00 Mechanical - General Requirements
.3 Section 01 91 00 Commissioning Requirements
.4 Section 25 05 00 Building Management Systems (BMS) Design Guidelines
.5 All other Tech Guidelines as may be applicable to a given project.

1.2 Related Documents External to UBC

.1 BC Plumbing Code and all references contained there within
.2 BC Building Code and all references contained there within
.3 Work Safe BC Occupational Health and Safety Regulation

1.3 Description

.1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
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.4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted.

2.1 Design Requirements

.1 This point and all sub-bullets for UBC Vancouver Only: Designs shall incorporate strategies for maximizing the delta-t of heating water across the building’s mechanical systems. The maximum acceptable supply water temperature to the building heating system shall be 55°C with a preference for lower temperatures whenever possible. Refer to section 33 61 00 for maximum supply and return water temperatures to the district energy system on the primary side of the HEX. Select heat exchangers and system designs that can meet these requirements. Design strategies that may be employed to achieve the low return water temperature requirement include:
  .1 Selecting heating coils for large delta-t or using switchover coils.
  .2 Cascading perimeter heat in series with heating coils.
  .3 Heating water temperature reset.
.2 Controls design and specification shall comply with TG Section 25 05 00 – Building Management Systems Design Guidelines

.3 Any system that utilizes large central air handlers to serve multiple zones shall include re-heat coils for all zones.
  .1 VAV box's shall have re-heat coils
  .2 Zones within displacement ventilation systems shall have re-heat coils

.4 All perimeter air terminal units shall have heating coils (or re-heat coils)

.5 Freezer farms, rooms that are specifically designated to hold multiple freezers have special design requirements.
  .1 Freezer farms shall have dedicated cooling equipment (such as fancoils or water to air heatpumps), it’s not acceptable to have freezer farms drive the supply air temperature of large air systems (which would then require excessive re-heat in other zones).
  .2 Due to the amount of equipment located in freezer farms, accessing equipment above the ceiling can be challenging. Special care needs to be employed to ensure reliable equipment access.
  .3 Ensure that freezer farms are designed for future capacity. At the engineer’s discretion, it may be reasonable to assume that all available floor space is filled with freezers comparable to the units being installed at the time of design.
  .4 Depending on the quantity and nature of the equipment, consider installing parallel cooling equipment.
  .5 If the room cannot be sufficiently cooled (to prevent equipment trip) by jamming the door open then make sure that the ac equipment (and all associated central infrastructure) is on emergency power.
  .6 Freezers associated with research should be on emergency power.
  .7 Floor mounted cooling units should be considered for these space for the ease of service access.

.6 Window mounted air conditioners and exhaust fans are not acceptable.

.7 Open ceilings generally make maintenance easier than drywall or t-bar. Work with the architect to install open ceilings in spaces such as communication closets, freezer farms, back of house prep areas, hallways, research labs.
  .1 Many of UBC’s clientele (especially in the Science departments) prefer utility and flexibility over aesthetics. Consider the wide use of open ceilings when it has service or future flexibility benefits.

.8 All mechanical equipment that is related to temperature control, equipment that that requires scheduling, or any item that requires remote monitoring shall be connected to BMS.

.9 This point and all sub-bullets for UBC Vancouver Only: Refer to Section 20 00 30 Indoor Thermal Environment (UBC Vancouver) and I-B-53 Energy Policy for Classrooms for thermal design criteria. Some key points are:
  .1 2.5% summer design condition for cooling systems at UBC shall be 31°C DB/ 23°C WB based on projected 2050s climate. See 20 00 30 for more info on how this was determined.
.2 Many spaces including learning spaces shall be designed for indoor temperatures of 25°C.
.3 Where possible use natural ventilation and passive principles to cool offices and transient spaces.
.4 Refer to the following for detailed design guidance:
   .1 Climate Ready Requirements for UBC Buildings
   .2 TG Section 20 00 30 – Indoor Thermal Environment
   .3 I-B-53 Energy Policy for Classrooms.

.10 UBC’s Climate Action Plan (CAP) has set a target of 100% reduction in GHG emissions below 2007 levels by 2050. In support of this plan, natural gas shall not be used as the primary heating source in new and replacement air handling and space heating equipment, including but not limited to rooftop units, unit heaters, space heaters, etc. Natural gas may be used as a backup heating source at the unit where required to ensure heating requirements can be met.

2.2 Testing and Commissioning Requirements

.1 Any project which is modifying the central building system or installing new central infrastructure that will affect multiple spaces shall hire a Commissioning Authority (CxP). Refer to section 01 91 00 for more information. Some examples where this would apply are:
   .1 Chiller replacement
   .2 Boiler replacement where the piping has significant modifications
   .3 Installation of manifolded fumehood exhaust system
   .4 Full floor renovations
   .5 Any project with a moderate mechanical scope or controls scope. If unsure, ask UBC Building Operations Mechanical Engineer

3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they’re not applicable then a variance is not required.

.1 Displacement ventilation systems are not suitable in many office environments where they may blow under desks or be affected by moving furniture. Displacement ventilation systems also provide limited options for modifications (i.e. increasing/decreasing supply air temp) if comfort requirements aren’t being met.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines & Documents

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2.0 MATERIAL AND DESIGN REQUIREMENTS

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2.1 Design Requirements

.1 All air handlers that are used for 100% outdoor air shall have glycol coils.
   .1 Glycol loops shall be separated from the main building hydronic loop by heat exchangers.
   .2 This point and all sub-bullets for UBC Vancouver Only: If the air handler has heat recovery (heat wheel, plate to plate or tempeff), is fully controlled by BMS and has a freeze stat directly wired to disable the fan VFD and has a pumped coil then glycol may be omitted at the designer’s discretion.

.2 Provide shutoff valves on the supply and return of all equipment. Use of balancing valves for isolation is not acceptable.

.3 Triple duty valves are not acceptable. Install, instead a balancing valve (or other flow measuring device), isolation valve and a check valve.
.4 Use of venturi check valves with flow measuring capability are encouraged on pumps which have VFD’s in lieu of a balancing valve and a check valve. They provide the advantage of forcing contractors to balance by using the VFD’s and preventing them from cutting in balancing valves un-necessarily.

2.2 Equipment Requirements

.1 Pumps
   .1 All critical pumps shall be installed in duty/standby configuration. Lead/lag is not acceptable unless installing a triplex pump set lead/lag/standby.
   .1 Critical pumps include most heating/cooling pumps and any pump with a possible freeze protection application as well as all other pumps of notable size or as identified by the consultant.
   .2 All pumps shall be displayed on BMS graphics showing the command and the feedback status. If a pump fails to run, an alarm shall be displayed on the front page of the graphics.

.2 Fluid Coolers and Cooling Towers
   .1 Closed loop fluid coolers are preferred to cooling towers. Where sizing pushes a project towards an open loop cooling tower, submit a variance application.
   .2 Open loop systems (cooling tower condenser water and sump lines for fluid coolers) shall utilize a cyclonic dirt separator.
   .3 Preference is for the sump pump to be located indoors and for this to be the location that the chemical treatment occurs.
   .4 Cooling towers/fluid coolers over 8 ft high shall have service platforms with permanent ladders.
   .5 Multi-cell cooling towers/fluid coolers with separate sumps shall have equalizing line of sufficient size to maintain water level in all sumps. Provide sump isolation valves in equalizing line.
   .6 Provide a multifunction controller for chemical treatment complete with:
      .1 Conductivity based bleed
      .2 Makeup scale and corrosion inhibitor
      .3 Dual biocide feed based on calendar clock
   .7 Cooling towers/fluid coolers over 100T shall have BACnet connected BTU meters installed on the inlet/outlet which log instantaneous power (kW) and cumulative energy (kWh)

.3 Chillers
   .1 Specify minimum five year warranty.
   .2 Where chillers with brazed plate heat exchangers are used, provide parallel strainers selected for full flow c/w isolation valves so that each strainer can be cleaned independently. Strainers shall meet chiller manufacturer requirements (typically 60 mesh). Provide pressure gauges piped across the strainers for measuring pressure drop (one set of gauges for both strainers is okay).
   .3 Barreled chillers where the shell and tube hex can be opened at both ends are preferred to modular chillers
   .4 Brazed plate heat exchangers are not to be installed on piping systems connected to an open loop cooling tower.
.5 Modular chillers or heat pumps must be installed with isolation valves on condenser and chilled water heat exchangers.

.6 Chillers over 40T shall be provided with a BACnet connected power meter (electricity) which logs instantaneous power (kW) and cumulative energy (kWh).

.7 Installed chillers must have a Prime Mover Nameplate kW Rating, as defined by the BC Safety Authority Directive D-BP-2013-02, of less than 200 kW. Units over 200 kW nameplate rating fall under continuous supervision status plant operation and require a variance from the Technical Guidelines to be specified and installed.

.4 Boilers or chillers with aluminum heat exchangers are not acceptable because they do not align with UBC’s water treatment procedures.

2.3 Construction and Material Requirements

.1 Acceptable piping systems (this section is a work in progress, please email andrew.porritt@ubc.ca to request updates – most industry standard, non-proprietary systems will be accepted)

.1 Heating Water

.1 Black iron (all manufacturers with local support and proven track record)

.1 Grooved for 3” and above

.2 Threaded for 2” and below (with regular use of unions)

.3 Welded with flanges

.2 Type K Copper (solder, grooved or flanged)

.3 Uponor (up to 3”)

.1 Not acceptable within 20’ of district energy heat exchangers

.2 A fail safe control valve must be in place to shutoff flow if the water temp approaches Uponr temp limits. This valve should alarm to BMS but must require a manual reset on site. There must be a clear sign at the location of the push button explaining what the valve exists for.

.3 There must be substantial labelling (on BMS graphics and on site) stating the max temperature and implications of higher temps

.2 Cooling Water

.1 Black iron (all manufacturers with local support and proven track record)

.1 Grooved for 3” and above

.2 Threaded for 2” and below (with regular use of unions)

.3 Welded with flanges

.2 Type K Copper (solder, grooved or flanged)

.3 Uponor (up to 3”)

.3 Condenser Water

.1 Black iron (all manufacturers with local support and proven track record)

.1 Grooved for 3” and above

.2 Threaded for 2” and below (with regular use of unions)

.3 Welded with flanges

.2 Type K Copper (solder, grooved or flanged)

.3 Uponor (up to 3”)

.2 Insulation Requirements

.1 Chilled water and condenser water piping shall have continuous vapour barrier.
.2 All piping 3” and over shall have h-block supports at the hangers.
.3 Indoor piping
   .1 Insulation shall have paper wrap (even in existing mech rooms which have canvas)
   .2 Pre-formed PVC elbows
.4 Outdoor piping
   .1 Insulation shall have continuous pvc wrap which is UV stable and sealed to prevent water ingress into the insulation.
   .2 Pre-formed, PVC elbows
.5 Chilled and condenser water pump bodies shall be insulated with pre-formed foam (preferred) or closed cell adhesive foam.
.6 Thickness and additional specifications by consulting engineer.
.7 Heat exchangers, valves 3” and over and other special fittings shall have removable insulation blankets.
.8 Plastic pipe shall have the same insulation requirements as metal pipe except that additional supports shall be used when required by code.
   .1 Trays shall always be used when the pipe is flexible.

.3 Provide valve handle extensions on all chilled and condenser water valves where they penetrate piping insulation.

.4 Wafer style valves are not acceptable. All valves shall be capable of end of line isolation.

.5 Provide pressure test plugs (Petes Plugs or Winters Test Plugs) at all locations that a pressure gauge is installed and on both sides of all differential pressure sensors. The reason for this is that pressure gauges are notoriously inaccurate and this can be used to validate them and also to commissioned differential pressure sensors.

2.4 Testing and Commissioning Requirements

.1 This point and all sub-bullets for UBC Vancouver Only: UBC Building Official shall be invited to witness all tests that are required by code or the tech guidelines.

.2 Hydraulically test steam and hydronic piping systems at 1-1/2 times system operating pressure.
   .1 Maintain test pressure without loss for 48hr.

.3 For renovation projects, all new lines shall be flushed and pressure tested prior to connecting to the base building system.

.4 This bullet and all sub bullets shall apply to UBC Vancouver Only: Projects that do work on building hydronic systems shall be responsible for chemical treatment. The mechanical engineer is responsible for specifying the water treatment protocol and which chemicals are required. The contractor is responsible to hire a specialized water treatment company to supervise and direct, at a minimum the below:
   .1 New Buildings
      .1 Flush and clean each loop including circulating a cleaning/dispersant chemical for 24 hours or as recommended by the chemical cleaning company. Provide a
.2 Supply and install appropriate chemicals as determined by the engineer and the water treatment company - chemical scale and corrosion inhibitor (closed loops) or algaecides (open loops).

.3 Provide final test report after all treatment and flushing indicating that the system is clean and at normal levels.

.2 Existing buildings

.1 At project outset, take a sample water quality reading. Use this sample to identify any existing deficiencies in water quality. If water quality is sub-par, provide the Project Manager with a proposed plan to remediate. UBC may, at their discretion choose to proceed with this work.

.2 If required (as determined by the engineer and water treatment company), flush and clean each loop including circulating a cleaning/dispersant chemical for 24 hours or as recommended by the chemical cleaning company. Provide a report of completed flushing by the chemical treatment company indicating that the water has been tested to confirm that the cleaning chemicals have been removed from the system.

.3 At project completion, supply and install appropriate chemicals as determined by the engineer and the water treatment company - chemical scale and corrosion inhibitor (closed loops) or algaecides (open loops).

.4 Provide final test report after all treatment and flushing indicating that the system is clean and has achieved, at a minimum levels equal to the project outset testing.

.3 Each analysis shall include at a minimum:

.1 Total suspended solids
.2 Total suspended iron
.3 Total hardness
.4 Total dissolved solids
.5 Magnetite
.6 pH
.7 Conductivity

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines & Documents

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.2 Section 20 00 00 Mechanical - General Requirements
.3 All other Tech Guidelines as may be applicable to a given project.

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2.0 MATERIAL AND DESIGN REQUIREMENTS

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2.1 Design Requirements

.1 All condensate receivers shall have an overflow, piped to drain through a condensate cooler/quench tank.

.2 All condensate receivers and quench tanks shall be vented outside the building.

.3 Autoclaves
   .1 Preference is for autoclaves that have unitary electric steam generators with automatic blow down to quench tanks.
   .2 Central steam boilers shall only be considered in buildings with a very high density of equipment that requires process steam.

.4 This point and all sub-bullets for UBC Vancouver Only: Humidification shall only be provided where it has research impacts; for example some labs such as animal care have specific humidity requirements or areas that house art or rare books.
   .1 In general, humidification shall not be provided for occupant comfort because Vancouver’s mild climate does not justify the added cost, complexity and energy.
2.2 Construction and Material Requirements

.1 Acceptable piping systems
   .1 Steam (treated with amines)
      .1 Schedule 80 Carbon Steel
      .2 Schedule 40 Carbon Steel
   .2 Condensate Return (treated with amines)
      .1 Schedule 80 Carbon Steel
   .3 Steam (clean, untreated)
      .1 304 Stainless steel
   .4 Condensate Return (treated with amines)
      .1 304 Stainless steel

.2 Insulation
   .1 Indoor piping
      .1 Insulation shall have paper wrap (even in existing mech rooms which have canvas)
      .2 Pre-formed PVC elbows

.3 No brass or bronze valves shall be used on steam systems.

.4 All steam systems shall include provisions for “double block and bleed” isolation. UBC Staff are unable to work on steam systems unless a double block and bleed isolation is in place.

.5 Unions shall be provided at regular spacing throughout steam systems so that any piece of equipment or valve can be replaced without having to substantially dismantle the system.

2.3 Testing and Commissioning Requirements

.1 This point and all sub-bullets for UBC Vancouver Only: This UBC Building Official shall be invited to witness all tests that are required by code or the tech guidelines.

.2 Hydraulically test steam and hydronic piping systems at 1-1/2 times system operating pressure.
   .1 Maintain test pressure without loss for 48hr.

3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they’re not applicable then a variance is not required.

.1 Where central steam boilers are installed for process loads, the steam is typically treated with neutralizing amine chemicals to prevent damage to the condensate return lines. However, the use of amines may be un-acceptable in live steam humidification systems. As a result, consider separate systems for humidification and for process loads. Steam system designs need to indicate which boilers should be treated with amines.
1.0 GENERAL

1.1 Related UBC Guidelines

1.2 Coordination Requirements

   .1 Coordinate with UBCO Operations.
   .2 Coordinate with other design disciplines.

1.3 Description

   .1 HVAC water treatment system procedures and design requirements.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General Requirements

   .1 The specification shall clearly state which systems are to be cleaned and subsequently treated with control agents.

   .2 Requirements

      .1 In new buildings the scope of work will cover all new systems.
      .2 Heating, cooling and condenser water systems shall be chemically cleaned and treated as appropriate.
      .3 In existing buildings where existing systems are to be modified or extended, the mechanical consultant shall contact UBCO Operations to determine what sections should be cleaned and treated.
      .4 In renovation projects, where existing systems are extended or modified, the consultant shall review their original analysis of the pertinent water systems with UBCO Operations for a decision on the extent of the cleaning and whether or not it should be carried out by the contractor.
      .5 In energy conservation retrofit projects, the consultant shall review their original analysis of all the water systems with UBCO Operations for agreement on cleaning the systems.

   .3 Technical Support

      .1 The mechanical sub-contractor or, in the case of energy conservation retrofit projects, the controls-contractor, shall employ a Chemical Water Treatment Company approved by UBCO Operations to instruct and supervise the sub-contractor/contractor in the cleaning and treatment of the listed systems. The company shall employ technicians fully trained in the cleaning and treatment of building piping systems.

   .4 Characteristics of Control Chemicals

      .1 Chemicals must be non-toxic when released to atmosphere, noncorrosive and non-staining if a leak occurs. Chemicals shall be compatible with all system components so that operation or life expectancy of the components is not affected by the application of the chemical treatment.
.5 Existing Metering Pumps and Pot Feeders

.1 The consultant shall ensure that existing metering pumps and pot feeders are in good operative condition or shall install new devices where none exist. Refer to this Guideline.

.2 All water treatment heating and cooling shall have chemical pot feeders, flow indicators, bypass filters and water meters.

.6 Cross Connection Control

.1 The consultant shall ensure that backflow prevention devices are incorporated to prevent control chemicals from migrating to potable water systems within the building or to the Campus Water Distribution System. Refer to Guideline Section 22 11 18 Backflow/Cross Connection Control for control devices and to AWWA requirements.

2.2 Pipe Cleaning Chemicals

.1 Dispersant/Purging compounds must be approved by UBCO Operations. Compounds shall not cause odors.

.2 Corrosion Inhibitors

.1 Chemical Water Treatment Companies and products used must be approved by UBCO Operations and Risk Management.

.2 Control Agent for Algae, Bacteria and Fungi (Biocide) for cooling tower water use: Sodium Hypochlorite.

2.3 Cleaning

.1 Under the supervision of the UBCO Operations’ approved Chemical Water Treatment Company and in the presence of the UBCO Operations’ representative, the Mechanical Sub-Contractor/ Controls Contractor shall:

.1 Position all control valves and other in-line devices and remove all strainer gaskets so that all system components can be flushed.

.2 Drain system at all low points and flush with clean water to remove loose and suspended matter. Maintain flushing pressure and system venting to ensure that all circuits are flushed. System shall be drained and flushed a minimum of two times; continue until flushed water appears clean. Clean and replace baskets when flush complete.

.3 Supply and add a cleaning dispersant/purging compound to the system as recommended by the UBCO Operations’ approved Chemical Water Treatment Company.

.4 Drain, flush, refill and repeat until water quality meets the acceptable level of 0.5 mm of suspended solids, including magnetite, as determined by the UBCO Operations’ approved Chemical Water Treatment Company. For draining please follow Risk Management Environmental release procedure and contact UBCO Operations and Risk Management.

.5 Ensure that the system is filled and that all operational components are returned to their proper operational settings.
.6 Ensure that the system is tight. Correct any leakage in piping installed under this contract. If leakage occurs in an existing system, report to the Mechanical Inspector of Campus Planning & Development.

2.4 Water Treatment

.1 Supply and add the chemical scale and corrosion inhibitor to the closed circuit heating or chilled water piping system under the direction of, and according to, the concentration recommended by the UBCO Operations’ approved Chemical Water Treatment Company.

.2 All glycol systems shall be 30% by volume uninhibited propylene glycol and the glycol supplier shall require approval from UBCO Operations.

.3 Supply and add the chemical scale and corrosion inhibitor to the open circuit condenser water system under the direction of, and according to, the concentration recommended by the chemical water treatment company.

.4 Supply and add the algae, bacteria and fungi control agent to the cooling tower water under the direction of, and according to, the concentration recommended by the chemical water treatment company.

.5 Obtain a receipt and give one copy to the consultant. The receipt shall be sent to UBCO Operations.

2.5 Testing

.1 Chemical water treatment company shall provide a laboratory test report as required.

.1.1 Provide laboratory test reports confirming the correct chemical concentrations have been achieved.

2.6 Monitoring

.1 Provide laboratory test reports and treatment recommendations for treated water samples taken by the owner’s operating personnel.

.2 Test reports will be sent to the chemical water treatment company monthly for the first three months, and once every three months thereafter for one year following the initial test.

.3 Each analysis shall provide concentrations of significant components of each water sample as outlined by the water treatment company.
.4 The cost of the testing is to be borne by the Contractor.

.5 The UBCO Operations’ approved Chemical Water Treatment Company shall send to the Owner on a scheduled basis, properly identified sample bottles for each of the systems to be tested as required.

.6 Test reports shall be sent as they occur to UBCO Operations.

2.7 Reports

.1 Test reports shall be sent as they occur to UBCO Operations.

.2 A copy of reports shall be sent to the Consulting Engineer.

.3 Provide four (4) copies of written instructions for the chemical testing and treatment specific to this project for insertion into the operating and maintenance manuals.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines & Documents

.1 Section 23 00 00 HVAC (and all subsections)
.2 Section 23 38 00 Fume hood and Lab Exhaust
.3 Section 20 00 00 Mechanical - General Requirements
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2.0 MATERIAL AND DESIGN REQUIREMENTS

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2.1 Design Requirements

.1 Underground HVAC Ducts are not acceptable.

.2 For all heating/cooling coils, ensure that access is provided to replace the coils without necessity to dismantle adjacent equipment or building components.

.3 Variable pitch fans are not acceptable.

.4 Fan Array Requirements:
   .1 All fan arrays shall have back draft dampers associated with each fan. Such that if any one fan fails, the others can continue to run without short circuiting through the failed fan.
   .2 BMS shall receive status on each individual fan within a fan array and this shall be displayed on the graphics.
.3 Preference is that BMS has direct control over each fan in the array (enable, status, speed, alarm, BACnet). If this is not possible, the controller must connect to BMS with enable, status, speed, alarm and BACnet.

2.2 Construction and Material Requirements

.1 Filters
   .1 Air filters provided for use in primary air handling equipment must adhere to the following nominal trade sizes:
      .1 24" x 24" x 2"
      .2 12" x 24" x 2"
   .2 Filters in primary air handling equipment for standard academic buildings shall filter to MERV 13.
      .1 Filters in special applications such as lab buildings shall have MERV ratings as determined by the consulting engineer.

.2 Flex connectors shall be supplied on the inlet and outlet of all ducted fan equipment (fancoils, fans, air handlers, etc.)

.3 Flex connectors shall not be used to connect ducts of different size/shape

.4 Direct drive fans are preferred.

.5 When belt drives are required, the following applies:
   .1 Multiple belts must be matched sets
   .2 Cast iron or steel sheaves secured to shafts with removable keys shall be used
   .3 Adjustable pitch sheaves are commonly supplied on fans and while useful for balancing, they shall not be left in place at project completion as they lead to increased belt ware. It is suggested that consultants include in their spec that the balancer should be responsible for changing the sheaves.
   .4 For motors 7.5 kW and over sheave with split tapered bushing and keyway having fixed pitch.

2.3 Testing and Commissioning Requirements

.1 Mechanical Designer is responsible for specifying cleaning requirements and ensuring that the HVAC system is turned over clean of construction dust/debris and ready for use.
   .1 Projects modifying existing ducts systems shall clean all existing ductwork within their project boundaries.

.2 Filter access demonstration.
   .1 During the project demonstration UBC Facilities reserves the right to ask the contractor to demonstrate the removal and replacement of 5% or Q=5 (which ever is greater) filters at the UBC Facilities representatives choosing.
   .2 If the filters are not reasonably accessible, the contractor shall make modifications and demonstrate to UBC Facilities at which time UBC Facilities may ask for a further 5% or Q=5 to be demonstrated.
3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS

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.1 Avoid putting air moving equipment such as fancoils above classrooms as they lead to acoustic issues.

.2 It is common that acoustic return air boots are not installed or are incorrectly installed (line of sight to the fan section is not completely obscured). Please see that this item is addressed during design and construction.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines & Documents

.1 Section 23 00 00 HVAC (and all subsections)
.2 Section 20 00 00 Mechanical - General Requirements
.3 All other Tech Guidelines as may be applicable to a given project.

1.2 Related Documents External to UBC

.1 BC Plumbing Code and all references contained there within
.2 BC Building Code and all references contained there within
.3 Work Safe BC Occupational Health and Safety Regulation

1.3 Description

.1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
.2 These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
.3 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

2.0 MATERIAL AND DESIGN REQUIREMENTS

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted.

2.1 Design Requirements

.1 All exhaust ductwork for Class 3 exhaust or greater (as defined by Ashrae 62.1) shall be negative while within the building. Class 3 exhaust may be positive in mech rooms. Class 4 exhaust may be positive in mech rooms provided that exhaust fans are in their own separate mech room. Please review The Fumehood Mechanical Room and Rooftop Access Policy I-B-06 and ensure that all designs comply with this policy – some pitfalls are:
   .1 UBC uses leak detector on the flex connections and ductwork on the positive side of the fan to check for air leaks.
   .2 Special attention must be paid to drains on fumehood exhaust fans. Many fans have these drains on the positive side of the fans. Where this is the case, these drains are a source of contaminated air leakage that must be addressed to comply with UBC’s roof access policy. Caution that there are many pitfalls with using p-traps as maintaining a positive seal is challenging – trap primers typically have air gaps built in which can themselves become a source of leakage. Please reach out to UBC Facilities if you would like to discuss this item.
.2 Where the fume hood exhaust duct static pressure may exceed 4” of WC, provide passive make up air openings in building structure or design all elements of building envelope (including roofs and skylights) for an additional structural load that may be imposed on the building due to high negative pressure in the event of a supply air handler or general control failure.

.3 See Section 11 53 13 Fume Hoods, for design and face velocity requirements for fume hoods.

.4 Radio isotope cabinets to be on separate fans, not connected to other systems or other RI cabinets.

.5 Fumehood numbering/labelling requirements:
   .1 Attached to the fumehood
      .1 Fumehood equipment tag (FH-FLOOR-INDEX#) (see TG 20 00 08)
      .2 Associated exhaust fan
         .1 If installing a new system then the exhaust fan tag should indicate the location of it. However, if connecting to a fan where the tag does not indicate the location then add this information (ex FEF-05 (Roof)).
   .2 Attached to the exhaust fan
      .1 Exhaust fan tag (FEF-FLOOR-INDEX#) (see TG 20 00 08)
      .2 List of associated fumehoods
         .1 These lamacoids made end up being quite large for manifolded systems, be sure to allow for this. Use multiple lamacoids if required.
      .3 Associated disconnect (VFD, starter, or breaker)
   .3 Attached to the VFD
      .1 VFD tag (VFD-FLOOR-INDEX#) (see TG 20 00 08)
      .2 Associated exhaust fan
      .3 Associated disconnect

.6 Decision to install scrubbers for perchloric acid or similar uses shall be reviewed with UBC Risk Management Services during the design phase.

.7 Where fume hood exhaust stacks are used their design shall comply to WSBC and ANSI Z9.5.
   .1 Manifolded exhaust systems are often preferred and are acceptable as described by WSBC.

.8 In new buildings, stacks shall be grouped together to provide an aesthetic appearance when viewed from street level.

.9 When installing manifolded fumehood exhaust systems with heat recovery coils:
   .1 Filters shall be provided upstream of the coils.
   .2 Means shall be provided to service the filters or coils without shutting down the fumehood exhaust system. Options for this include:
      .1 Large by-pass sections complete with dampers (which may be motorized or have manual handles)
.2 Installing a coil for each fan, downstream of the isolation damper.

.10 For lab exhaust systems all devices directly related to the lab need to be on the same BMS controller so that there isn’t a lag in response times. For example if a fumehood sash height sensor isn’t on the same controller as the exhaust fan (or pressure independent exhaust valve) then there can be a lag in response time and the hood can go into alarm before the fan speed ramps up.

.11 Provide minimum of 8 air changes per hour (ACH) for all wet laboratories during occupied hours and, where possible, an unoccupied nighttime setback to 4 ACH. Laboratories designed with 4 ACH unoccupied nighttime setback must have adequate motion detection to override nighttime setback conditions when occupied, as well as adequate VAV supply and exhaust control. Alternate proposals to be reviewed with UBC Facilities and approved by UBC Safety and Risk Services.

2.2 Construction and Material Requirements

.1 Fumehood exhaust material requirements - All fumehood exhaust shall be constructed of welded stainless steel as a minimum. Mechanical Engineer to determine if a more resistant material is required such as CPVC. Lesser materials such as galvanized steel aren’t acceptable even if the exhaust is non-corrosive because it's impossible to forecast future uses of fumehoods.

.1 Whatever resistant material is deemed necessary, this standard must be carried through all connected equipment including fans and pressure independent air control valves.

.2 Flex connections on inlet and outlet of fumehood exhaust fans shall be installed:

.1 Between two round ducts of the same diameter which are completely in line with each other and which are ~1” apart.

.2 Out of a single piece of flexible material (rubber or other material suitable for the contaminated exhaust stream) which overlaps the ducts on each side by 1” minimum and overlaps onto itself by 3” minimum.

.3 The flexible material shall be glued to itself to create continuous loop around the duct.

.4 The flexible connector shall be connected to the ductwork with two stainless steel worm-drive duct clamps on each side of the flex connector.

.3 Sound attenuators and internally line ductwork are not acceptable on fumehood exhaust ductwork.

.4 Provide hasps on all fumehoods so that the fumehoods can be locked shut for servicing the exhaust air system.

2.3 Testing and Commissioning Requirements

.1 Refer to section 11 53 13 - Fumehoods
3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS

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.1 When manifolding multiple fumehoods into a single exhaust system, ensure that the requirements of ANSI Z9.5 are met for system reliability (typically multiple fans) and flow regulating devices (pressure independent air valves).

.2 WSBC regulations do not currently allow low flow fumehoods. Face velocities must be between 80-120fpm

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines & Documents

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2.0 MATERIAL AND DESIGN REQUIREMENTS

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2.1 Design Requirements

.1 TSBC / CSA B52 Requirements for Chillers. UBC TSBC Inspector has provided the below interpretations of CSA B52. Please reach out to TSBC for clarification during design if additional information is needed.

.1 When calculating the refrigerant volume in a room, table 1 of CSA B52 only applies to occupied spaces. Mechanical Rooms are not considered occupied spaces and therefore any room with a chiller, even if it is a modular chiller will need to meet the requirements of a machine room including the requisite ventilation and leak detection.

.2 In addition to the signage requirements described in CSA B52, signs posted on the egress doors and the entrance to the machinery room shall include the following "For assistance contact UBC Building Operations Service Centre : 604-822-2173".

.2 Refrigerant leak detector requirements are:

.1 Visual and audible alarm inside the mechanical room and outside each door.
.2 Refrigerant PPM display outside the mechanical room.
.3 Signage on the door(s) indicating the equipment type, refrigerant type and quantity per TSBC Reqs.
.4 Manual override button for the exhaust fan.
.5 BMS to monitor the refrigerant detector alarm as well as the fan status.

2.2 Equipment Requirements

.1 See section 23 21 00 – Hydronic Systems for building level chiller requirements

.2 Use of domestic water cooled condensing units (i.e. once through cooling) is not permitted. This includes HVAC equipment as well as specialty lab equipment, cold rooms, ice makers and other similar devices.

.3 When VRF or split systems (neither of which are preferred) are used, they must be integrated into BMS (as with all heating/cooling equipment). This varies from manufacturer to manufacturer but may require ordering additional components.

2.3 Construction and Material Requirements

.1 Brazed joints are required for all field installed refrigeration joints. Compression couplings aren’t acceptable.

3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS

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.1 Unitary refrigerant equipment such as terminal heatpumps, split systems and especially VRF systems often have higher maintenance cost and lower reliability compared to chilled water systems. Applications where these systems are being considered should be carefully reviewed to determine if they provide the lowest lifecycle cost.

***END OF SECTION***