

1.0 **GENERAL**

1.1 **Related Scope of Work and UBC Guidelines**

- .1 Relevant sections within Divisions 3 to 9 of the Technical Guidelines.
- .2 UBC LEED Implementation Guide.

1.2 **Related External Documents**

- .1 Latest edition of the British Columbia Building Code (BCBC).

1.3 **Description**

- .1 General requirements for concrete structures on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.

1.4 **Coordination**

- 1. In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 2. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 3. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 **Submittals**

- .1 Provide low-carbon concrete mix test results to the UBC Sustainability Dept. for review during construction.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 Design building structures and their structural components for a 100-year service life. Refer to the Technical Guidelines Performance Objectives located [here](#).
- .2 Structural design shall conform to Part 4 of the latest edition of the BC Building Code (BCBC). Live loads should be determined as per the BCBC for specific occupancies.
- .3 Slabs-on-grade are to be 150 mm minimum thickness, reinforced and provided with well - spaced control joints in an approximately square pattern, spacing less than 4000 mm on centre. This requirement is to account for small vehicle loading such as genie lifts that need to be brought into buildings for maintenance and repair work.

2.2 **Performance Requirements**

- .1 Ensure that the design and field review of non-structural components is covered in the contract documents (drawings and specifications).
- .2 Any drilling or coring into existing concrete slabs shall be reviewed by a professional structural engineer before proceeding with the work.
- .3 Existing post-tensioned floor systems are not to be used as an anchor for new equipment or installation of supports (such as unistrut systems) for new equipment without written approval from a structural consultant. Scanning alone of such systems is not acceptable. Any work associated with these systems are to be done by certified workers.

- .4 On new projects, the underside of slabs are to be spray-painted as 'DO NOT DRILL' so that contractors who are working on renovation projects can then reach out to the UBC PM for concrete scanning.
- .5 Structural information for new-post-tensioned slabs is to be included within the O&M manuals – such as floor plans noting the location of post-tensioned slabs and details.

3.0 **MATERIAL REQUIREMENTS**

3.1 **Product Selection**

- .1 Do not use calcium chloride in concrete mixes.
- .2 Low-carbon concrete mixes where specified must be suitable for the intended use. Provide confirmation from structural engineer and concrete mix supplier prior to construction.
- .3 Global warming potential recommendation for concrete on major projects and renewals at UBCV: GWP budget based on average of 15% below the BC 2022 industry average baseline.

4.0 **LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS**

Items in this section are lessons learned, and may be code or industry best practices which have been missed on past projects. If not applicable to a project, a variance is not required.

- .1 As unofficial drilling and coring into slabs continues to happen even after warning signs are installed to the contrary for post-tensioned slabs, therefore where post-tensioned slabs are designed, the project team to ensure the O&M manual clearly highlights locations of these slabs, including provision of relevant structural details within the Record drawings.

END OF SECTION

1.0 GENERAL

1.1 Related Scope of Work and UBC Guidelines

- .1 Section 03 00 00 Concrete – General Requirements
- .2 Section 07 00 10 Building Envelope – General Requirements
- .3 Section 07 40 00 Cladding
- .4 Section 07 62 00 Sheet Metal Flashing and Trim
- .5 UBC LEED Implementation Guide

1.2 Related External Documents

- .1 Latest edition of the British Columbia Building Code (BCBC).

1.3 Description

- 1. Section includes architectural concrete and accessories.

1.4 Coordination

- 1. In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 2. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 3. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 Provide low-carbon concrete mix test results to the UBC Sustainability Dept. for review during construction.
- .3 O&M Submittals
 - .1 Concrete mix specifications and type.
 - .2 Final reviewed shop drawings for control joint locations signed and sealed by a professional engineer registered in the Province of BC.

1.6 Quality Control & Assurance

- .1 Construction of mock-ups, mix designs and placement procedures to be as per project specifications.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Minimum concrete cover for reinforcing steel to be as per Part 4 of the BCBC for concrete cast against earth, walls or for fire-rating purposes.
- .2 Reinforcing and other steel requiring corrosion protection shall be embedded so that the minimum depth of concrete cover is in all cases greater than 40 mm and 50mm for exterior stairs.
- .3 Placement and curing procedures for low carbon concrete mixes are to be reviewed by the project team to ensure the desired concrete strength and finish are maintained.
- .4 Concrete strengths must be verified by independent concrete testing.

- .5 Exposed concrete walls to be provided with cap flashing with proper drip edges extending at least 10mm beyond the face of the wall to avoid drip lines.

2.2 Performance Requirements

- .1 Finishes should not require regular maintenance and should be durable.

3.0 MATERIALS

3.1 *Product Selection*

- .1 Components
 - .1 Concrete components to be certified compliant to CSA A23.1 for alkali - aggregate reactivity.
- .2 Finishes
 - .1 Provide an elastomeric paint finish for exposed concrete walls.
 - .2 Where a natural concrete look is desired for exterior walls, a clear water-based and penetrating silane/siloxane type coating can be used after final cleaning.
 - .3 Exterior concrete wall surfaces to be treated with a water-based sacrificial anti-graffiti coating to a height of 8' minimum.

END OF SECTION

1.0 GENERAL

1.1 Related Scope of Work and UBC Guidelines

- .1 Section 05 50 00 Metal Fabrications
- .2 Section 07 00 10 Building Envelope – General Requirements
- .3 Section 07 40 00 Cladding
- .4 Section 07 62 00 Sheet Metal Flashing and Trim
- .5 UBC LEED Implementation Guide
- .6 UBC Campus Plan Design Guidelines (Vancouver and Okanagan) - for metal screens and fences in the public realm.

1.2 Related External Documents

- .1 Latest edition of the British Columbia Building Code (BCBC).

1.3 Description

- .1 General requirements for steel structures on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.

1.4 Coordination

- 1. In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 2. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 3. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- 1. Design building structures and their structural components for a 100-year service life. Refer to the Technical Guidelines Performance Objectives located here.
- 2. Structural design shall conform to Part 4 of the latest edition of the BC Building Code (BCBC). Live loads should be determined as per the BCBC for specific occupancies.

2.2 Performance Requirements

- .1 Metal fabrications where noted to be galvanized are to be hot-dipped galvanized.

3.0 MATERIAL REQUIREMENTS

3.1 Product Selection

- .1 All structural steel to be shop primed except for the appropriate exclusions.
- .2 Exterior ledger angles and related components are to be galvanized for corrosion protection.
- .3 Where decking is specified, use only galvanized steel decking as suitable for the exposure of the decking (interior or exterior).

END OF SECTION

1.0 GENERAL

1.1 Related Scope of Work and UBC Guidelines

- .1 Section 05 00 00 Metals
- .2 Section 09 90 00 Painting & Coating (for exposed structural steel)
- .3 UBC LEED Implementation Guide
- .4 UBC Campus Design Guidelines (Vancouver and Okanagan) – for metal screens and finishes installed in the public realm.

1.2 Related External Documents

- .1 Latest edition of the British Columbia Building Code (BCBC).

1.3 Description

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. Work includes miscellaneous metal fabrications, including metal screens and fences.

1.4 Coordination

- 1. In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 2. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 3. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Product specifications, type and colour.
 - .2 Final reviewed shop drawings for metal fabrications and where required, signed and sealed by a professional engineer registered in the Province of BC.
 - .3 Provide Letter of Assurance for 1.5.2.2 above.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.5 Design Requirements

- .1 Finishes for miscellaneous metal fabrications including but not limited to the following:
 - .1 Guardrails, handrails and balustrades: stainless steel, powder-coated or galvanized as per project requirements.
 - .2 Exterior metal stairs and roof ladder, brackets and connections: galvanized.
 - .3 Bollards: shop prepped and primed, finish painted on site.
 - .4 Elevator hoisting beams at top of hoistways and elevator divider beams: shop painted.
 - .5 Elevator pit ladders: galvanized.
 - .6 Steel angle supports for brick veneer and concrete block: galvanized.
 - .7 Steel angles at junction of concrete block walls and concrete slabs over concrete block walls: galvanized.
 - .8 Steel channel frame to overhead rolling grilles and rolling doors: shop painted.
 - .9 Trench drains: cast iron grating set in galvanized angle frame.
 - .10 Louvre frames: powder-coated. Steel supports for aluminum louvres: galvanized.
 - .11 Corner guards in parking garages on concrete block walls: shop prepped and primed, finish painted on site.

- .12 Pipe and conduit guards in parking garages: shop painted
- .13 Sump covers and frames: galvanized.
- .14 Anchor bolts/nuts/washers: zinc-coated fasteners for exterior use or where built into exterior, and interior side of moisture barrier.
- .15 Concrete inserts: galvanized.
- .16 Nuts, bolts and washers are to be hot-dipped galvanized. Anchor bolts shall be in accordance with ASTM A36/A36M or A307. Coordinate with structural drawings for anchor bolts.
- .17 Metal screens to secure enclosed spaces such as mechanical ducts, pipes, and intake and exhaust vents from bird ingress.
- .18 Burglar bars: galvanized or shop painted as per project requirements.
- .19 Bike racks: galvanized, stainless steel or powder-coated as per project requirements.
- .20 Other miscellaneous metal fabrication as shown on drawings or details.

2.6 Performance Requirements

- .1 Determine applicable CSA, ASTM, and similar standards.
- .2 Metal fabrications where noted to be galvanized are to be hot-dipped galvanized.

3.0 MATERIALS

3.5 Materials

- .1 Materials that are sourced locally and have a high recycled content are preferred.
- .2 All exterior ledger angles, lintels and related components (connections, bolts, plates, etc.): hot dip galvanized.
- .3 Zinc rich galvanized primer for touch-up work.
- .4 High zinc dust content paint for re-galvanizing welds in galvanized steel, conform to ASTM A780/A780M-09.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Scope of Work and UBC Guidelines

- .1 Section 05 50 00 Metal Fabrications
- .2 Section 06 10 00 Rough Carpentry
- .3 Section 07 40 00 Cladding
- .4 Section 07 62 00 Sheet Metal Flashing and Trim
- .5 UBC LEED Implementation Guide

1.2 Related External Documents

- .1 Latest edition of the British Columbia Building Code (BCBC).

1.3 Description

- .1 General requirements for wood structures on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.

1.4 Coordination

- .1 In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .2 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .3 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Wood structures, including those falling under Part 9 of the BC Building Code, are to be engineered in accordance with Part 4 of the Building Code.
- .2 Design building structures and their structural components for a 100-year service life. Coordinate with the UBC Technical Guidelines Performance Objectives located [here](#).
- .3 Oriented strand board shall not be used for sheathing of wood frame shear walls.

2.2 Performance Requirements

- .1 Ensure that the maximum permitted moisture content of wood members do not exceed the limits specified in the Building Envelope section of these guidelines or 19%, whichever is more restrictive.
- .2 Protect susceptible wood products from moisture penetration

3.0 MATERIAL REQUIREMENTS

3.1 Product Selection

- .1 Where wall sill plates are located above concrete, use preservative treated wood plates installed on foam sill gaskets.
- .2 Do not use finger-jointed studs for members in tension.
- .3 Sub floors shall be constructed with exterior grade tongue and groove plywood, glued and screwed in place.

END OF SECTION

1.0 GENERAL

1.1 Related Scope of Work and UBC Guidelines

- .1 Section 06 00 10 Wood Structures - General Requirements
- .2 Section 06 40 00 Architectural Woodwork
- .3 Section 07 40 00 Cladding
- .4 Section 07 62 00 Sheet Metal Flashing and Trim
- .5 Section 08 11 00 Metal Doors and Frames
- .6 Section 08 14 00 Wood Doors
- .7 Section 08 41 13 Aluminum-Framed Entrances and Doors
- .8 Section 08 44 13 Glazed Aluminum Curtain Walls
- .9 Section 08 50 00 Windows

1.2 Related External Documents

- .1 Latest edition of the British Columbia Building Code (BCBC), Parts 3 & 4.
- .2 CSA O80 series, Wood Preservation.
- .3 Wood Preservation Canada.

1.3 Description

- .1 Miscellaneous rough carpentry, including shims, furring and backing for millwork and wall - mounted accessories.

1.4 Coordination

- 1. In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 2. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 3. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Quality Control and Assurance

- .1 Quality Assurance
 - .1 If the project is being carried out by the UBC Construction Office, cost of structural design to be included in the contract.
- .2 Quality Control
 - .1 Manufactured wood products to be protected from weather at all times, including during transportation and installation.
 - .2 Do not use finger-jointed studs.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS - NOT USED

3.0 MATERIALS

3.1 Product Selection

- .1 For all interior work, provide kiln-dried lumber with a maximum moisture content of 10% or less after kiln-drying and no greater than 12% moisture content at time of installation, unless otherwise indicated or approved.

3.2 Treated Wood

- .1 Examples of wood members to be treated:
 - .1 All wood exposed to the weather or in contact with the ground including wood grounds.
 - .2 All wood members in contact with concrete and masonry.
 - .3 Wood cants, plywood sheathing, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, air barrier, and waterproofing.
 - .4 Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - .5 Wood framing members less than 18 inches (460 mm) above grade.
 - .6 Wood floor plates installed on foundation walls.
 - .7 All wood members beyond the face of building paper at exterior walls (i.e. strapping within cavity walls).
 - .8 In applications where fire-retardant wood is required.
- .2 After treatment, kiln-dry lumber and plywood should have a maximum moisture content of 15%.
- .3 Fasteners:
 - .1 Fasteners for use in treated wood that will be exposed to the weather should be selected to withstand weathering as long as the treated wood itself.
 - .2 Fasteners used in combination with metal connectors must be the same type of metal to avoid galvanic corrosion caused by dissimilar metals.
 - .3 Hot-dipped galvanized or stainless steel fasteners are to be used with ACQ treated wood. Hot-dipped galvanized nails should not be fastened using a high pressure nail gun due to the risk of damage to the coating during firing.
 - .4 For borate treated wood used inside buildings, the same fasteners can be used as for untreated wood.
 - .5 Aluminum fasteners should not be used with treated wood, except if specifically tested, approved and labelled as suitable for use with new generation wood preservatives.
- .4 Flashing type for treated wood to be as per Section 07 62 00.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

1. Section 08 14 00 Wood Doors
2. Section 09 00 Finishes – General Requirements
3. Section 12 30 00 Fabricated Casework
4. Section 12 35 53 Laboratory Casework
5. UBC LEED Implementation Guidelines
6. UBC Protection of Contents Guideline – for seismic restraint of casework.

1.2 Related External Documents

- .1 Latest edition of the North American Architectural Woodwork Standards (NAAWS).

1.3 Description

- .1 *Section includes custom millwork.*

1.4 Coordination

- .1 In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .2 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .3 The Coordinating Registered Professional is required to coordinate these requirements with other disciplines.
- .4 Confirm with the UBCV Technical Review Team Architect on a project by project basis if hardware related to this section will be reviewed by the UBC Locksmith Shop.

1.5 Submittals

1. Design phase:
 - .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
 - .2 For Construction Office projects only, provide a list of all proposed materials for review and color samples for selection plus final approval.
2. Handover – O&M submittals:
 - .1 Final reviewed shop drawings.
 - .2 Confirmation of AWMAC warranty.
 - .3 Maintenance data complete with each finish type, colour and related hardware.

1.6 Quality Control and Assurance

1. Work to be in accordance with grades specified in the North American Architectural Woodwork Standards (NAAWS), current edition at time of tender.
2. Guarantee and Inspection Service:
 - .1 Architectural woodwork shall be manufactured [and/or] installed to NAAWS current edition at time of tender and shall be subject to an inspection at the factory and/or site by an appointed AWMAC Certified Inspector. Inspection costs shall be included in the tender price for the project.
 - .2 Shop drawings submitted to the AWMAC Chapter office for review before work commences. Work that does not meet the NAAWS as specified, shall be replaced,

- reworked and/or refinished by the architectural woodwork contractor, to the approval of AWMAC, at no additional cost to UBC.
- .3 If the woodwork contractor is an AWMAC manufacturer member in good standing, a two (2) year AWMAC Guarantee Certificate will be issued. *Issuance date should match the date of Substantial Performance of the project.* The AWMAC Guarantee shall cover replacing, reworking and/or refinishing deficient architectural woodwork due to faulty workmanship or defective materials supplied [and/or] installed by the woodwork contractor, which may appear during two (2) year period following the date of issuance.
 - .4 If the woodwork contractor is not an AWMAC Manufacturer member they shall provide the owner with a two (2) year maintenance bond, in lieu of the AWMAC Guarantee Certificate, to the full value of architectural woodwork contract.
3. Woodwork Manufacturer Qualifications:
- .1 Member in Good Standing of AWMAC.
 - .2 Minimum 5 years of production experience similar to this project, and qualifications that indicate ability to comply with requirements of this Section.
 - .3 Minimum one project in the past 5 years where the value of woodwork is within 20% of cost of woodwork for a project.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 Casework Grade – Custom. Economy Grade is not be used. Casework Style - Flush Overlay. This casework style prevents doors and drawers from being pried open.
- .2 Typical veneer when using wood veneer ply
 - .1 Rotary White Birch.
- .3 Endangered wood species in millwork, casework and furniture products must not be used.
- .4 Local manufacturers are preferred.
- .5 Adhesives, preservatives, hardeners, synthesizing agents and finish coatings shall be low-VOC compliant. Coordinate with the UBC LEED Implementation Guidelines.
- .6 MDF to be CARB2 compliant, no added formaldehyde and recycle certified.
- .7 Plywood shall be Exterior Grade (i.e. manufactured with no added formaldehyde).
- .8 Tables and custom millwork in Learning Spaces shall not have sharp edges and corners.

2.2 **Performance Requirements**

- .1 Laboratories
 - .1 [Wood casework is not allowed in wet laboratories. This includes wood trims and doors and door frames. If some wood finishes are desired in a low-risk lab environment, a variance request will need to be provided for approval.](#)
- .2 Seismic restraint is required on all cabinets and shelving over 1200 mm high or where units are likely to be a hazard from overturning. Coordinate with the requirements of the UBC Protection of Contents Guideline.

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 Components
 - .1 MDF shall be typical core material for door and drawer fronts.
 - .2 Veneer core plywood to be used at the following locations:
 - .1 Core for countertops with plumbing cut-outs.
 - .2 High humidity areas.

- .3 All food service areas.
- .3 When plastic laminate or melamine surfacing is used, provide same finish (backer sheet when concealed) on *both* surfaces of the core.
- .4 Drawer sides, backs and bottoms to be constructed of minimum 12 mm (1/2") Baltic Birch plywood or Apple plywood.
- .5 Typical edge banding for wood cabinets shall be a minimum solid 3 mm (1/8") birch or same species as veneer when hardwood veneer is used. Other options for edge banding are minimum 3mm PVC or ABS edge banding. Each of the options listed here should be carefully reviewed for use depending on the work environment in which it will be installed.
- .6 On all shelving designed for use as chemical storage, a 50 mm clear acrylic plastic lip must be installed on the shelf edge.
- .7 Cabinets
 - .1 Preferred product is No- added-Formaldehyde (NAF) Medite.
 - .2 Maximize recycled content use.
 - .3 Standard cabinet construction to be 3/4" thick
- .8 Cabinet Hardware Requirements
 - .1 Ensure local suppliers are used for availability of products for maintenance and replacement.
 - .2 Locks to be per UBC Grand Master System - hardware to be reviewed by UBC Access Services Locksmith Shop during the design phase.
- .9 Cabinet Hardware Preferences
 - .1 Hinges shall be European Style concealed type Blum, GRASS, Salice, Hettich or approved equal, 110 degree opening, 170 degree opening when noted.
 - .2 Pulls shall be Gallery Style 302B stainless steel or equal.
 - .3 Drawer slides shall be Accuride 3832 (or equal) min. 100 lbs (45.5 kg.) duty; full extension.
 - .4 File drawer slides to be Accuride 4034 or equal, min. 150 lbs (68kg); full extension.
 - .5 Cabinet locks -supplied by Owner for installation by this Section.
 - .6 Stainless steel hardware is required in laboratories.
- .2 Finishes
 - .1 Factory finishing is to be AWMAC custom grade unless directed otherwise.
 - .1 Clear finish is to be AWMAC conversion varnish System 5.
 - .2 Opaque finish is to be AWMAC conversion varnish System 5.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Division 03 and relevant TG sections therein
- .2 Division 04 and relevant TG sections therein
- .3 Division 05 and relevant TG sections therein
- .4 Division 06 and relevant TG sections therein
- .5 Division 07 and relevant TG sections therein
- .6 Division 08 and relevant TG sections therein
- .7 Section 09 00 00 Painting and Coating
- .8 Divisions 20, 22, 23, 25, 26, 27 and 28
- .9 UBC LEED Implementation Guide
- .10 UBC Energy Modelling Guidelines
- .11 Owner's Project Requirements
- .12 UBC Bird-Friendly Design Guidelines
- .13 UBC Vancouver Campus Plan Design Guidelines for cladding types
- .14 UBC Resilience-Based Design Guide for Nonstructural Systems

1.2 Related External Documents

1. Latest edition of the British Columbia Building Code (BCBC).
2. RCABC Roofing Practices Manual.
3. Latest edition of the MPI Architectural Painting Specification Manual.

1.3 Description

1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.

1.4 Coordination

- .1 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .2 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .3 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- .4 Input from a Building Envelope consultant is required in the design development process. The Building Envelope consultant is to review all building envelope details including envelope penetration details, and review comments are to be incorporated prior to tender and Building Permit issuances.
- .5 [Grade should slope away from the building. Consultant coordination needed between architectural, civil and landscape drawings to mitigate the differing information found on drawings from these disciplines. Provide a typical section through each building elevation to the extent that it meets existing grades.](#)

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements – Claddings

- .1 Refer to Section 07 40 00 Cladding for acceptable exterior cladding types.
- .2 Exterior wood cladding is not acceptable due to increased maintenance requirements, for example at the CIRS building. In the absence of a proper O&M manual, it has been very difficult to replicate the exact finish and fire-retardant treatment, even by the supplier.
- .3 If the provision of exterior wood cladding is an absolute design requirement, locations are to be reviewed with the UBC Technical Review Team Architect. Such locations are also to be

protected with the use of canopies or sufficient building overhangs, in addition to the protective finish used.

- .4 Make provision for maintenance access on the exterior. Provision for a genie lift or boom lift access on the exterior is to be provided. Coordinate lift and vehicular loading requirements on sidewalks with the civil engineer.

2.2 Design Requirements – Weather Barriers

- .1 All heated occupied buildings on campus shall have a competent air barrier system, which requires integration into the plane of air tightness early in the design development process.
- .2 Vapour barriers are required in all UBC buildings and they shall be located on the warm side of insulation.
- .3 Refer to Section 07 25 00 Weather Barriers for detailed requirements.

2.3 Design Requirements – Exterior Openings

- .1 Provide appropriate screening of mechanical openings, seal cracks and maintain overall integrity of building envelope surfaces to provide effective control against rodent/pest/bird entry into buildings.
- .2 At the design phase, coordination is required with the UBC Bird-Friendly Design Guidelines.
- .3 Birds can be prevented from roosting on buildings or entering them by a range of physical measures. These include nets, spikes, reflective deterrents, wires and any other effort to seal potential entry points.

2.4 Design Requirements – Exterior Metal Fabrications and Coatings

- .1 Canopies, guardrails and handrails, safety anchors, signage and art work to be designed to resist damage from exterior exposure and made of corrosion resistant materials, adequately coated, or sheltered from wetting.
- .2 All structural penetrations to support exterior metal fabrications to be designed to integrate with air and vapour barrier systems, cladding systems, and be protected from corrosion where exposed in the wall cavity.
- .3 All steel exposed outdoors (aside from exposed structural steel members in a building and canopies) is to be hot dip galvanized. Paint, if applied should consist of a marine/industrial grade coating system (a typical system would consist of an epoxy barrier coat and aliphatic urethane topcoat).
- .4 Coordinate with Section 09 90 00 for painting of exposed structural steel members in buildings and canopies
- .5 All inserts set into masonry or concrete, used to affix exterior metal fabrication, to be stainless steel.
- .6 Coordinate with Sections 05 50 00 Metal Fabrications and Section 08 80 00 Glazing.

2.5 Design Requirements – Exterior Glazing

- .1 Refer to Section 08 80 00 Glazing, 3.1 for exterior glazing requirements for guardrails and canopies.

2.6 Design Requirements – Roofs

- .1 Roof design for all new buildings should include parapets or guardrails for safe and efficient roof and rooftop equipment maintenance working conditions, particularly when UBC maintenance crews need to work close to the parapet edge. Working areas are to be secured with minimum 1,067 mm (3'-6") high insulated or thermally broken parapets or guardrails. A variance will need to be granted if guardrails or guardrail-height parapets cannot be accommodated at roof level. Section 11 81 29 would apply if a variance is granted.
- .2 Guardrails shall be side-mounted to the parapet. Parapets to be of sufficient height to accommodate side-mounting of guardrail posts.
- .3 All roof equipment must be mounted on curbs at least 100mm above scupper level.
- .4 A roof leak detection system is required for inverted roof locations; see Section 07 50 00 Membrane Roofing.

2.7 Design Requirements - Roof Access

- .1 3'-6" high guard rails or high parapets should be provided at the roof perimeter to prevent falls from the roof, and which conform to the latest edition of the BC Building Code.
- .2 Mechanical or electrical roof-top equipment that is vital to the function of the building or equipment that is vital to research should be located not less than 10'-0" from the roof edge.
- .3 Where roofs are accessible by faculty and students, extending one passenger elevator to roof level to provide an accessible mode of travel for UBC visitors, faculty and students.
- .4 Provision of a dedicated freight elevator may be required for servicing mechanical/electrical equipment especially when a mechanical or electrical penthouse is provided. Review freight elevator requirement with the UBCV Technical Review Team or UBCO Facilities Management.

2.8 Design Requirements – Canopies and Overhangs

- .1 Refer to the UBC Campus Plan Design Guidelines for design of canopies or overhangs where needed for weather protection of the public.
- .2 Refer to Section 08 00 10 Openings- General Requirements for technical requirements for the design of canopies or overhangs over exterior doors.

2.9 Performance Requirements – NOT USED

3.0 MATERIALS

1. Refer to individual sections in Division 7.

4.0 LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS

Items in this section are lessons learned, and may be code or industry best practices which have been missed on past projects. If not applicable to a project, a variance is not required.

- .1 Guardrail posts, whether at roof level or on upper floors, are to be side-mounted to a high enough parapet or curb, and not top-mounted through the roof assembly. Structural design should take into account side-mounting of the guardrail posts. A variance for top-mounted installations ([into roof assemblies](#)) will not be granted.
- .2 All green roof details, whether at roof level or at grade are to be coordinated with the landscape and civil design. Complete details showing the landscape build-up plus drainage are to be included within the architectural detail sheets or booklet. The site plan should coordinate drainage slopes and methods with the landscape and civil designs.
- .3 Penetration details (wall and roof) are to be included as part of the architectural detail sheets or booklet. Refer to Section 20 00 05 Mechanical General Requirements which notes issues with mechanical penetrations on recently built UBC buildings. It is not acceptable to have such penetration details shown only on the mechanical or electrical drawings.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 03 00 00 Concrete
- .3 Section 07 00 10 Building Envelope – General Requirements

1.2 Related External Documents

- .1 Latest edition of the British Columbia Building Code (BCBC).
- .2 RCABC Roofing Practices Manual for horizontal waterproofing systems such as at grade green roof systems.

1.3 Description

- 1. Work includes damproofing and waterproofing systems.
- 2. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 3. In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 4. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 5. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.4 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
 - .2 Environmental Product Declaration (EPD)
- .3 Product data sheets for all products used in a damproofing or waterproofing system.

1.5 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Membrane integrity testing of installed material properties including adhesion, material thickness and water tightness testing (where applicable) to be carried out by the Contractor at their expense.
 - .2 RCABC warranty standards are required for all waterproofed roofs, podiums, plazas / promenades and terraces. RCABC inspections are to be conducted by an approved RCABC inspection company. Vehicle parking structures (split slabs), below grade walls, foundations, and repairs or renovations to existing waterproofing systems do not require a RoofStar Guarantee.
 - .3 Contractor to provide material submittal and drawings showing any deviation from RCABC Waterproofing Standards to the UBC PM for approval and to notify UBC PM and Technical Review Team Architect of any deviations. Deviations shall be approved in writing by RCABC prior to installation in order to retain warranty coverage.
- .2 Quality Control
 - .1 Contractor to test moisture content of concrete substrate to verify that substrate moisture content does not exceed manufacturer's specifications. Submit testing results to UBC PM and Technical Review Team Architect prior to application of membrane.

- .2 Watertightness testing of applied waterproofing on horizontal surfaces by Electronic Field Vector Mapping (EFVM) scans are to be performed prior to installation of overburden, at no cost to the Owner.
- .3 Warranties
The following are required:
 - .1 First two years - Guarantee, secured by Performance Bond, commencing on the Final Holdback release due date.
 - .2 Third year to fifth year - Extended Guarantee, unsecured by Bond, commencing on the expiration of the Performance Bond. Joint and Sealant guarantee by Coating applicator and Manufacturer.
 - .3 Horizontal waterproofing: 5 year RCABC waterproofing warranty and detailing; 10 years Manufacturer's material warranty and Performance Bond are required. RoofStar Guarantee Standards for waterproofing are applicable for podiums, plazas / promenades and terraces only. Vehicle parking structures (split slabs), below grade walls, foundations, and repairs or renovations to existing waterproofing systems do not require RoofStar Guarantee coverage. When a 5 year RCABC waterproofing warranty is provided, the Extended Guarantee (1.5.3.2) is not required.
 - .4 Submit the RCABC RoofStar "Roofing Assignment and Guarantee Request" sheet with all roof guarantee certificates at closeout of project.
 - .5 Submit signed certificates to Consultant at closeout of project.
- .4 Commissioning
 - .1 Contractor to repair any defects found in membrane as a result of testing or Electric Field Vector Mapping (EFVM) scan at no cost to the Owner.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 RCABC warranty standards are required for all waterproofed roofs (inverted), green roofs (inverted), podiums, plazas / promenades and terraces. Vehicle parking structures (split slabs), below grade walls, foundations, and repairs or renovations to existing waterproofing systems do not require a RoofStar Guarantee.
- .2 Membranes under landscaping require access for maintenance and replacement. Pavers or other material that can be removed and re-used for hard landscaping is preferable.
- .3 Membranes are not to be buried under cast-in-place concrete except as absolutely necessary at sidewalks and driveways. A variance request will need to be granted for such instances.
- .4 Per RCABC requirements, electronic leak detection and monitoring is required at all green roofs and waterproofed podiums and plazas and where concrete (split slabs, tile or stone set in a mortar bed etc.) is installed above as noted above.
- .5 For soft landscaping (plants etc.) over membranes use materials that can be removed with light excavation equipment and be disposed of. More valuable plants can be placed in movable planters.
- .6 Membranes, primers or surface-patching materials shall be fully bonded to the surface of the concrete structure to help isolate leak locations.
- .7 Concrete structures under the membrane should be sloped to drains at a minimum of 2%. Account for deflection or other subsidence of the structure when specifying and designing slopes.
- .8 Cold joints at below grade foundation concrete walls should be detailed with vertical reveals to control crack propagation. All below grade foundation walls to be designed with waterstopped crack control joints, located at a minimum of 15'-0" on centre. Spacing to be confirmed with project structural engineer. Architectural details of below-grade construction

- cold joints and control joints should be prepared and to be reviewed by the building envelope consultant.
- .9 Apply membranes only after sustained intervals of dry weather. If construction schedule dictates application during poor weather season, select alternate waterproofing type suitable for poor weather installation. Installation shall strictly follow manufacturer's guidelines for substrate moisture content.
 - .10 Membranes to terminate at least 100 mm higher than the finished grade surfaces of any landscaping. Use termination bars or reglets to finish the top edge of the membrane and install counter flashing to cover and protect membrane above grade. Reglets can be used where aesthetic concerns need to be addressed. All details to meet RCABC requirements.
 - .11 Sills at service doors to be raised 100 mm above finished grade surfaces and be provided by ramps to grade if required to be accessible.
 - .12 Sills at main public access doors and at exit doors must be located flush with exterior walkway pavers. Provide a 3/4" deep recessed pocket immediately beneath the door threshold. Extend the waterproofing membrane into the recessed pocket and upturn at the back and sides of the pocket. Threshold to be set on shims to provide a flush installation with interior finishes and to reduce the risk of any tripping hazard.
 - .13 Exterior pavers shall be installed on pedestals to promote drainage. Pavers are to be provided with adequate spacing or provide trench drains to prevent ponding at or near doorways. Floor finishes on the interior side of these doors should not be moisture-sensitive type products.
 - .14 Door sills to be integrated with terminations of roofing membranes using a liquid waterproofing flashing membrane (PMMA).
 - .15 Subgrade membranes to be drained to perimeter drains via a permeable fill or geotextile system placed on top of the membrane.
 - .16 Starter curb details to be used for all curbs and planter walls on a green roof at roof level.
 - .17 All penetrations for irrigation, electrical or gas services to extend into a roofing jack that terminates into a drained, accessible garden box.
 - .18 All horizontal waterproofing membranes to be covered with protection board.
 - .19 Drain bodies to have clamping ring to receive membrane.

2.2 Performance Requirements

- .1 Materials installed to provide required damproofing and waterproofing shall be:
 - .1 Compatible with adjoining materials.
 - .2 Resistant to deterioration that may reasonably be expected, given the function and exposure of the materials.
- .2 The installation is not to leak at terminations, drains, upturns, or splices.
- .3 The installation is to be impermeable to chloride ions such as from exposure to deicing slats

3.0 MATERIALS

3.1 Product Selection

- .1 UBC-required sub-grade waterproofing system for horizontal surfaces (inverted roofs, podiums, plazas / promenades and terraces):
 - .1 Low-slope applications under soft landscaping: 2-ply torch-applied SBS roofing or hot-applied rubberized asphaltic waterproofing
 - .2 Low-slope application under hard landscaping: 3-ply torch-applied SBS roofing or hot-applied rubberized asphaltic waterproofing
- .2 UBC-required sub-grade waterproofing system for vertical surfaces:
 - .1 Based on results of geotechnical report and occupancy type, the following membrane should be considered as a minimum:
 - .1 Drained and cast in place wall at parkade with no occupied or finished areas only: damproofing with drainage composite protection.

- .2 Drained and cast in place wall: 1-ply torch-applied SBS waterproofing with drainage composite protection.
- .3 Drained and blind side formed wall (cast in place or shotcrete): sheet applied blind side waterproofing with drainage composite.
- .4 Drained and high-risk occupancy: 2-ply torch applied waterproofing or blindside waterproofing with drainage composite for shotcrete foundations.
- .5 Hydrostatic pressure and cast in place wall: 2-ply torch applied waterproofing with protection.
- .6 Elevator Pits – Waterproofing system applicable for green concrete with 10 mil poly protection and drainage composite. Concrete to have crystalline waterproofing additive and waterstops used at cold joints.
- .7 Hydrostatic pressure blind side: Sheet applied blindside waterproofing with protection.
- .8 Hydrostatic pressure shotcrete: 2-ply SBS blindside waterproofing with protection with shotcrete foundations.
- .9 Hydrostatic occupied or high risk: not allowed.

3.2 Acceptable Products

- .1 Dampproofing:
 - .1 Dampproofing materials, installed to 60mils DFT:
 - .1 Tremco Tremproof 260
 - .2 Epro – E Spray
 - .3 Soprema – Colphene LM Barr
- .2 Elevator Pit Waterproofing only:
 - .1 Waterproofing materials acceptable for green concrete and installed to 90mils DFT:
 - .1 Tremco Tremproof 250GC
 - .2 Epro – E Spray
 - .3 Soprema – Colphene LM Barr
- .3 Vertical Waterproofing Materials:
 - .1 Sheet applied blind side waterproofing system:
 - .1 Soprema BSW
 - .2 Epro Pre Tak
 - .3 Grace PrePrufe
 - .2 Torch-applied SBS waterproofing system:
 - .1 Soprema Colphene Torch and Stick
 - .2 Siplast Paradiene 20
 - .3 IKO Torchflex TP 180
 - .3 Blindside waterproofing with shotcrete foundation walls:
 - .1 Soprema BSW
 - .2 Grace PrePrufe
 - .3 Epro PreTak
- .4 Horizontal (Podium) Waterproofing:
 - .1 Torch-applied SBS roofing membrane:
 - .1 Soprema Flam 180
 - .2 Siplast Paradiene 20 TG
 - .3 IKO Torchflex TP 180
 - .2 Hot-applied rubberized asphaltic waterproofing:

- .1 Hot rubber products to conform to CGSB-37.50-M98, Standard for "Asphalt, Rubberized, Hot Applied, for Roofing and Waterproofing"
- .2 Product to be an approved RCABC waterproofing system.
 - .1 Henry – 790-11 Hot Rubber
 - .2 Hydrotech 6125
 - .3 Soprema Colphene H
- .5 Accessories:
 - .1 Waterstops at joints and penetrations:
 - .1 Swelling waterstops approved with manufacturers waterproofing system.
 - .2 Crystalline slurry at all horizontal concrete shotcrete joints with water stop approved by waterproofing membrane manufacturer.
 - .3 Drainage Composite
 - .1 10mm 2 layer with dimpled core and geotextile
 - .4 Root Barrier:
 - .1 10mils HDPE or 30mils LDPE complete with taped seams
 - .5 Pond Liner:
 - .1 80 mils fully welded HDPE
 - .6 Protection Board:
 - .1 3mm asphalt impregnated cover board
 - .2 10mm drainage composite
- .6 Where specific products are listed and the consultant team would like to propose an equivalent, please provide a variance request clearly noting how the proposed product meets the performance requirements of the approved products/systems.

4.0 **EXECUTION**

- .1 All substrate cracks in concrete substrates to be pre-treated by sawing out crack, installing bridging sealant, and reinforcing waterproofing system over the crack or as per the manufacturer's written instructions.
- .2 Concrete bonding surfaces to be cleaned and prepared by shot-blasting, sand blasting, or water blasting. Remove all laitance, oils, dust, concrete paste and sack all bugholes prior to product installation.
- .3 Review of below-grade application to be completed by the Architect and Building Envelope Consultant prior to backfill. Contractor shall document with photographs prior to backfill or overburden placement.
- .4 Manufacturer's representative to review application on site at the request of the Consultant or UBCV Technical Review Team Architect or UBCO Facilities Management. Site review to be accompanied with written report.

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

1. Section 07 00 10 Building Envelope – General Requirements
2. Section 07 10 00 Dampproofing and Waterproofing
3. Section 07 25 00 Weather Barriers
4. Section 07 50 00 Membrane Roofing
5. Section 07 55 63 Vegetated Protected Membrane Roofing
6. Section 07 40 00 Cladding
7. UBC Energy and Emissions Targets
8. UBC Energy Modelling Guidelines
9. Owner's Project Requirements

1.2 **Related External Documents**

- .1 Latest edition of the British Columbia Building Code (BCBC).

1.3 **Description**

- .1 Work includes thermal insulation used in wall, roof and below-grade assemblies.

1.4 **Coordination**

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Registered Coordinating Professional is required to coordinate these requirements with other disciplines.

1.5 **Product Data Submittals**

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
 - .2 Environmental Product Declaration (EPD)
 - .3 Where required, include verification product does not contain materials identified on the Living Building Challenge 4.0 Red List – April 2022
- .3 Shop drawings (including all enclosure interface details) sealed and signed by a professional Engineer.
- .4 Manufacturer test data to confirm performance criteria.

1.6 **Quality Control and Assurance**

- .1 Quality Control
 - .1 During construction, contractor to arrange for a third party review of spray polyurethane insulation installation. Cost of third party review to be paid by contractor.
 - .2 Manufacturer's representative to undertake field reviews upon request by the Consultant or UBCV Technical Review Team Architect or UBCO Facilities Management. Reviews shall be accompanied with a written field report.
- .2 Commissioning
 - .1 Consultant and contractor to confirm installation of insulation being installed to meet project's assembly effective thermal performance requirement.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Buildings shall meet or exceed performance requirements of latest applicable version of the BCBC.
- .2 Energy modelling shall conform to:
 - .1 The UBC Energy Modelling Guidelines, Version 3.1
 - .2 Energy and Emissions Requirements based on the Project Specific Requirements.
- .3 Spray Polyurethane Insulation shall meet the requirements of CAN/ULC-S705.2-98, Spray Polyurethane Insulation.
- .4 Wall assembly thermal insulation is typically located outside the air barrier and inside cladding materials, neither of which are intended to be disturbed for 75 years or more. The performance of the insulation must be sustained during this service life.
- .5 Insulation and other thermal separations are to be located to prevent condensation on the interior surface of all building envelope assemblies.
- .6 Thermal insulation shall be placed exterior of the moisture barrier. When specific conditions limit exterior insulation amounts, split insulated walls could be considered provided at a minimum 2/3rds of the insulation clear field performance is exterior of the vapour barrier.
- .7 Expanded polystyrene insulation may not be used where in contact with ground, below-ground or wet locations.
- .8 Provide sufficient thermal resistance to minimize condensation at intersecting building assemblies. Consider the use of interior Spray Polyurethane Insulation.
- .9 For plastic foam insulations, CAN/ULC-S770 Standard shall apply for establishing the required "R" value (known as LTTR "Long Term Thermal Resistance" value in this standard).

2.2 Performance Requirements

- .1 Energy targets for new projects and major renovations are developed to reduce UBC's energy use over time and support UBC's Climate Action Plan (CAP 2030). To meet these targets, energy modeling utilizes TEDI targets.
- .2 Overall effective R-values for building assemblies shall at a minimum meet the prescriptive requirements of the latest BC Building Code version, except as described in 2.
- .3 For UBCV projects only, projects meeting a TEDI target, projects will be asked to confirm by consultant memo that thermal bridging calculations have been completed and how the worst impacts have been mitigated.
- .4 Thermal bridging effects shall be accounted for, evaluated and provided identifying how thermal bridging will be mitigated to meet overall effective thermal performance requirements. When calculating the clear field value of assemblies (or equivalent minimum effective R-value) and the overall effective thermal performance of the opaque assemblies using the thermal transmittances between assemblies, use one of the following techniques:

- .1 If the assembly matches one of those available in the online, "Building Envelope Thermal Bridging Guide: Analysis, Applications & Insights" document, then use calculated values in the document. This document is available at: <https://thermalenvelope.ca/>.
- .2 Use two-dimensional heat transfer modeling performed by a qualified professional for thermal bridges that are continuous along one axis such as studs, exposed slab edges, balconies, z-girts, etc. or
- .3 Use three-dimensional heat transfer modeling performed by a qualified professional for intermittent or point thermal bridges including repetitive penetrations such as cladding attachment screws or clips, beam penetrations, multiple canopy penetrations etc.
- .4 One-off penetrations such as roof drains, louvers, scuppers or single canopy penetrations etc. need not be modeled.

3.0 MATERIALS

3.1 Product Selection

- .1 Materials
 - .1 For plastic foam insulations, AN/ULC-S770 Standard shall apply for establishing the required "R" value (known as LTTR "Long Term Thermal Resistance" value in this standard).
 - .2 Expanded polystyrene insulation shall not be used where in contact with ground, below-ground or wet locations.
 - .3 The use of spray-in-place polyurethane (spray foam) insulation at intersecting building assemblies is accepted where deemed necessary (refer to the latest edition of BCBC, Part 5). It should be noted that spray foam insulation has very high global warming potential (GWP) and therefore only used where other insulation types cannot be used.
 - .4 Materials considered to have sufficient service life include:
 - .1 For rainscreen walls: semi rigid rock wool and fibreglass.
 - .2 For roofs: refer to RCABC's list of approved products.
 - .3 Spray foam insulation should only be used when protected by concrete, masonry or gypsum wall board such as in a precast or cast in place sandwich application.
 - .5 Fasteners (attachment of cladding, sub-girts, flashings, etc.) located in the exterior wall cavities shall be of stainless steel.

3.2 Acceptable Products

- .1 Mineral Wool Insulation:
 - .1 Non-combustible, inorganic glass fiber with thermosetting resin binder formed into insulating boards. Semi-rigid or rigid, as required by the Project.
 - .2 Surface burning characteristics to CAN/ULC S102. Flame spread 0, smoke developed 0.
 - .3 Non-combustibility to CAN/ULC S114.
- .2 Extruded Polystyrene (XPS):
 - .1 Closed- cell, rigid extruded polystyrene, no HFC 134a with low global warming potential of less than 10 kgCO₂/m² @RSI =1,R5.68.
 - .2 Meet CAN/ULC-S701.1, Type 4.
- .3 Fibreglass Batt:
 - .1 Fibreglass batt preformed, unfaced, and flexible blanket insulation for friction-fit installation in wood or steel framed cavity.
 - .2 Non-combustible to CAN/ULC-S702
 - .3 Surface burning characteristics to CAN/ULC-S102. Flame spread 0, smoke developed 0.
- .4 Rigid Cellular Polyisocyanurate:

- .1 Closed cell, polyisocyanurate foam core insulation bonded on each side to fiberglass facers during the manufacture process.
- .2 Meet CAN/ULC-S704, Type 3 and ASTM C1289 Type II, Class 2, Grade 2.
- .5 Concrete Faced Insulation Panels:
 - .1 Concrete topped thermal insulation boards made of closed-cell rigid extruded polystyrene (XPS) topped with latex modified concrete mix. XPS to meet 3.2.2.1.
 - .2 Meet CAN/ULC S701.1, Type 4.
- .6 Spray foam polyurethane:
 - .1 Insulation: spray applied closed cell, rigid polyurethane foam to CAN/ULC-S705.1 and ASTM C1029 Type 2, two component, Medium density. Zero ozone depletion blowing agent.
 - .2 Meet ULC 101, Standard Methods of Fire Endurance Tests of Building Construction and Materials. (CAN/ULC S101-140) and ULC 102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies. (CAN/ULC S102).
- .7 Expanded Polystyrene
 - .1 Type I and II EPS (expanded polystyrene) insulations are permitted however are intended to be used to provide slope to drain in combination with polyisocyanurate insulation. EPS insulation to be protected by at least 2" of mineral wool or XPS insulation.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 07 00 10 Building Envelope – General Requirements
- .2 Section 07 40 00 Cladding
- .3 Section 07 21 00 Thermal Insulation
- .4 UBC Energy Modelling Guidelines
- .5 Owner's Project Requirements

1.2 Related External Documents

- .1 Latest edition of the British Columbia Building Code (BCBC).

1.3 Description

- 1. Weather-resistive barriers that are a part of exterior wall systems to protect building materials from exterior water penetration.

1.4 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional is required to coordinate these requirements with other disciplines.

1.5 Submittals

- 1. Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- 2. O&M Submittals
 - .1 Product data sheets.
 - .2 Environmental Product Declaration (EPD).
 - .3 Certification for air barrier assembly (CCMC or equivalent).
- 3. Product data sheets.
- 4. Manufacturer performance test data to confirm performance criteria.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Construct mock-up of assemblies to check contractor's procedures.
 - .2 Test mock-ups at strategic locations for water and air tightness.
- .2 Quality Control
 - .1 Test strategic areas of the assembly early in the construction to evaluate performance and improve overall airtightness.
- .3 Commissioning
 - .1 Tier 1, 2 and 3A projects should conduct whole building airtightness testing meeting ASTM E799 or USACE Version 3 standard in accordance with BCBC Energy Step Code.
 - .2 Buildings that comply with BCBC 10.2.2.1 using ANSI/ASHRAE 90.1 or NECB are required to comply to 1.5.3.1(buildings that do not comply using step code).

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 All heated and occupied buildings on campus must have an air barrier. Any materials located between separate air and vapour barriers must be immune to moisture damage (100% inorganic).
- .2 The air and vapour barriers are to be located close together in the assembly, or be of one material if possible.
- .3 The moisture barrier should be continuously adhered to the substrate and flashed/drained to the exterior at every two floors maximum.
- .4 The moisture barrier must be continuous and flashed to the exterior to prevent entry of water.
- .5 The vapour barrier is to be located on the warm side of insulation. For split wall assemblies, incorporating the air and vapour barriers together is preferred.
- .6 The air barrier must be located at a thermally protected location in the assembly and must be continuous across all parts of the building above grade.
- .7 Architect to provide details showing the location and continuity of the air / vapour / moisture barrier systems at all joints and junctions between enclosure assemblies (windows, doors, walls, roofs, penetrations, foundations, etc.) in the building.
- .8 Architect to coordinate all wall and roof penetration details with structural, mechanical and electrical disciplines. All such details are to be provided in the architectural drawing set. Penetrations through the building envelope, and interfaces at windows and doors are the most common sources of service life and performance-related problems with air, vapour and moisture barrier systems.
- .9 Architect to ensure all details have been reviewed by a Building Envelope Consultant.

2.2 **Performance Requirements**

- .1 Air barrier materials must be located at a thermally protected location in the assembly and must be continuous across all parts of the building above grade.
- .2 The air barrier is to be integrated with all components of the building enclosure such as walls, windows and door frames, roof, foundation, and service penetrations.
- .3 The air barrier shall have a service life equal to cladding or be maintainable from inside the building.
- .4 Air and moisture barrier must be the same material and have the following properties:
 - .1 Material air tightness: 0.02 l/sm² @75pa – ASTM 2178
 - .2 System air tightness: 0.2 l/sm² @75pa – ASTM E2357
 - .3 Building air tightness: 2.0 l/sm² @75pa – ASTM E779
- .5 The air barrier system shall be continuous and provide a comprehensive Whole Building Air Tightness (WBAT) of minimum 1.27 l/s.m² at 75Pa unless otherwise specified below or unless Energy Performance Requirement or mechanical system specifications override this requirement.
 - .1 Air tightness for other specific assemblies:
 - .1 Walls behind masonry cladding 0.3 l/sm².
 - .2 Walls enclosing heated spaces with sustained high air borne moisture loads:
Air tightness to be increased as required to protect the wall assemblies.
- .6 The air barrier shall be structurally supported and resist cyclic deformations caused by structural or other movement at all joints.
- .7 Air barrier system shall be tested and rated in advance of construction and/or by testing in the field during construction and commissioning to check compliance with air tightness requirements.

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 Air and Vapour barriers:
 - .1 Exterior insulated rainscreen walls: self-adhesive non-permeable membrane sheet acting as both air and vapour barriers.
 - .2 Interior insulated rainscreen walls: smart vapor retarder such as Membrane by CertainTeed.
 - .3 Hybrid insulated (insulation inside and outside of stud wall) rainscreen walls: Self-adhesive waterproof membrane which are vapour permeable.
 - .4 All other walls: properties and location of the vapour barrier in the assembly must comply with ASHRAE 160. Provide model results showing where the dew point will be located.

3.2 **Acceptable Products**

- .1 Exterior Air & Vapour Barriers (Preferred):
 - .1 SBS Modified Asphalt Sheet, fully adhered, 40 mils minimum, conforming to ASTM 2178, less than 1 perm vapour permeance per ASTM E 96/E 96M.
 - .2 Butyl based adhesive with cross laminated facer, 20 mils minimum, conforming to ASTM 2178, less than 1 perm vapour permeance per ASTM E 96/E 96M.
- .2 Exterior Air Barriers (Vapour Permeable):
 - .1 Fully adhered, 20 mils minimum, conforming to ASTM E 2178, more than 10 perms vapour permeance per ASTM E96/E 96M.
- .3 Interior Air & Vapour Barriers:
 - .1 Polyethylene sheet, 3 mils minimum, conforming to ASTM 2178, less than 1 perm vapour permeance per ASTM E96/E 96M.
 - .2 Smart vapour retarder, 1 perm maximum under dry cup conditions (ASTM E96) and 10 perms minimum under wet cup conditions.
- .4 Alternative Systems:
 - .1 Spray polyurethane insulation (sprayfoam) will be considered on a project specific basis due to it's very high global warming potential. Consult with the Green Building Manager, Sustainability Department if considering use.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 UBC Campus Plan: Design Guidelines
- .2 Section 03 33 00 Architectural Concrete – for exterior sealer type
- .3 Section 04 05 23 Masonry Accessories – for exterior sealer type
- .4 Section 07 00 10 Building Envelope – General Requirements
- .5 Section 07 21 00 Thermal Insulation
- .6 Section 07 40 00 Cladding
- .7 Section 08 00 10 Openings - General Requirements
- .8 UBC LEED Implementation Guide
- .9 UBC Energy Modelling Guidelines
- .10 Owner's Project Requirements
- .11 UBC Vancouver Campus Plan Design Guidelines
- .12 UBC Resilience-Based Design Guide for Nonstructural Systems

1.2 Related External Documents

- .1 Latest edition of the British Columbia Building Code (BCBC).

1.3 Description

- 1. Section includes exterior cladding and all structural support systems.

1.4 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Product specifications, type and colour.
 - .2 Environmental Product Declaration (EPD).
 - .3 Final reviewed shop drawings (including anchoring system for cladding and all enclosure interface details) sealed and signed by a professional engineer registered in the Province of BC.
 - .4 Maintenance data and instructions.
 - .5 Warranty information.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Construct mock-ups of assemblies where necessary to review constructability and architectural finish. Mockups can be undertaken on the building and remain in place if design and performance meet project performance and design requirements.
 - .2 Submit cladding assembly test results for AAMA 508 Pressure Equalized Rainscreen test.
 - .3 Undertake Performance Mock-up Testing, AAMA 501, on custom built cladding assemblies where performance evaluation has not been previously undertaken.
 - .4 For renovation projects, a stand-alone mock-up may be desirable to confirm compatibility with existing cladding or exterior finishes.

- .2 Quality Control
 - .1 Construct mock-ups of all assemblies to check contractor's procedures.
 - .2 Manufacturer's representative to undertake field reviews upon request by the Consultant or UBCV Facilities or UBCO Facilities Management. Reviews shall be accompanied by a field report.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 The cladding is to be integrated with all components of the building enclosure such as window and door frames, roof, foundation, and service penetrations to provide a weather tight system. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines such as the building envelope, structural, mechanical consultants and energy modeler.
- .2 CRP to coordinate with the building envelope, structural, mechanical and electrical consultants and energy modeler on the following:
 - .1 Coordinate details of air tightness, drainage, venting, insulation, and cladding of enclosure assemblies.
 - .2 Integrate design with design of windows, doors, flashing and other penetrations.
- .3 Choice of cladding materials to be reviewed in accordance with the UBC Campus Plan Design Guidelines.
- .4 Masonry veneer is one of the recommended cladding types on campus as per the UBC Campus Plan Design Guidelines. Stone or thin brick (20 mm or thinner tile) adhesively bonded to stucco or sheet materials are not to be substituted for masonry
- .5 Window and door installations should be designed to allow replacement of the units without dismantling masonry wall assemblies
- .6 Provide vented rainscreen systems with minimum 1/2", and preferably 3/4" capillary break and cross-cavity flashings at every second floor minimum.
- .7 Provide compartmentalized cavities at least every second floor level, beneath the parapet, and at the outside corners of the building.
- .8 Exterior insulated rainscreen cavities should be drained and ventilated to the exterior. Provide insect screen/bug mesh in ventilated cavities.
- .9 Exposed wood structures such as glulam elements are to be sufficiently protected with adequate overhead protection and other mitigation measures.
- .10 Cladding shall be designed to conform to structural and seismic design requirements

2.2 Performance Requirements

- .1 Design service life of claddings to be minimum 75-years as per CSA S478 Section 6.3.5. Design service life of cladding attachment and accessories to match cladding service life.
- .2 Cladding shall be designed to resist lateral and vertical deformations of the primary structure without loss of attachment to the building.
- .3 Energy targets for new projects and major renovations are developed to reduce UBC's energy use over time and support UBC's Climate Action Plan (CAP 2030). For maximum overall effective thermal transmittance of building assemblies – refer to section 07 21 00, 2.2.
- .4 Thermal bridging effects shall be accounted for, evaluated and provided identifying how thermal bridging will be mitigated to meet overall effective thermal performance requirements. Refer to Section 07 21 00, 2.2.4 for techniques to be used.
- .5 Cladding shall be designed to be weather tight under sustained conditions of combined wetting and 500 Pa wind pressure.

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 Identify all materials that form the cladding assembly and closures to adjacent systems.
- .2 Cladding material choices should be coordinated with the UBC Campus Plan Design Guidelines that apply to each campus. The following exterior cladding types are considered to have a sufficient design service life and acceptable for use:
 - .1 Masonry coated with clear penetrating sealer as per Section 04 05 23.
 - .2 Concrete, precast - the recommended approach is to use exterior insulated precast concrete or precast sandwich panels
 - .3 Architectural concrete, coated with clear, penetrating sealer as per as per Section 03 00 00 or elastomeric paint with interior insulation under 1:4 overhang ratio.
 - .4 Anodized aluminum composite panels, class I or thicker anodizing
 - .5 Stainless steel, terne-coated stainless steel or zinc
 - .6 Exterior porcelain /ceramic-faced panels
 - .7 Terracotta panels
 - .8 High density fiber cement boards Grade II, Type A conforming to ASTM C1186.
 - .9 Wood siding/cladding but with the following limitations:
 1. Exterior vertical applications of cedar or Accoya wood. All exterior wood cladding applications are to be protected with an adequate-sized canopy or building overhang.
 2. Wood in exterior soffit applications are acceptable.
 3. Specify institutional grade coatings for all wood cladding types.
- .3 Wall systems allowed:
 - .1 Vented rain screen systems with min 3/4" capillary break and cross cavity flashings at every second floor minimum.
 - .2 Unvented mass wall systems with insulation separating exterior wythe and interior moisture barrier or mass wall and vented rain screen joints.
 - .3 Coated architectural concrete with interior spray foam insulation, complete with crack control reveals.
 - .4 Uncoated architectural concrete with interior cementitious waterproofing (such as a Xypex) and interior spray foam insulation, complete with crack control reveals. Precast concrete panels are preferred instead.
- .4 Cladding types not permitted:
 - .1 Exposed architectural concrete with interior insulation.
 - .2 [Exterior Insulation and Finish System \(EIFS\)](#)
 - .3 Stucco

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 07 00 10 Building Envelope – General Requirements
- .2 Section 07 21 00 Thermal Insulation
- .3 Section 07 55 63 Vegetated Protected Roofing
- .4 UBC LEED Implementation Guide
- .5 UBC Energy Modelling Guidelines
- .6 Owner's Project Requirements

1.2 Related External Documents

- 1. Latest edition of the British Columbia Building Code (BCBC).
- 2. RCABC Roofing Practices Manual.

1.3 Description

- .1 Work includes 2- ply SBS membrane roofing system complete with all related assembly components, fasteners, adhesives, cover boards, underlays, insulation, membranes and all roof related hardware and flashings as appropriate to the building and as specified.
 - .1 In addition to the above, and in the case of re-roofing, the assembly shall include wood blocking additions and/or modifications as required to meet the requirements of the new roofing assembly.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Registered Coordinating Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Manufacturer's product data sheet for each product provided, type and colour, including MSDS data.
 - .2 Manufacturer performance test data to confirm performance criteria.
 - .3 Sloped insulation, cricket and/or back slope plan.
 - .4 Manufacturer's leakproof warranty.
 - .5 Manufacturer's confirmation of training – if needed.
 - .6 Fastening patterns and sheet layout for mechanically attached membrane assemblies.
 - .7 Environmental Product Declaration (EPD)

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Meet or exceed the RoofStar Guarantee 5-Year guarantee standards All roofing system products to conform to the RoofStar Guarantee Standards and to the appropriate CSA, CGSB, ULC, CULC, and ASTM Standards for the materials used in the roofing system; products to be listed in the RGC Accepted Materials List of the RoofStar Guarantee

Roofing Practices Manual, and to be in conformance with the manufacturers' published product and performance data.

- .2 Quality Control
 - .1 An Independent Inspection Agency acceptable to RoofStar Guarantee, and assigned by RoofStar Guarantee on acceptance by the Consultant and the UBC Project Manager, to conduct field review inspections as per the minimum protocols as set forth by the RoofStar Guarantee for their 5 Guarantee Program. It is understood that in addition to these responsibilities the independent inspection agency will provide re-inspection services at the 2year anniversary – in the case of the 5 year warranty.
 - .1 Cost for the warranty and inspections are to be included in the contract sum.
 - .2 UBC reserves the right to increase the field review inspection frequency to FULL TIME site inspections while the work is in progress. Extra costs for this to be borne by UBC.
 - .3 Added inspections just prior to the expiration of the warranty, if required, will be arranged and the costs borne by UBC.
 - .4 A manufacturer's representative to also inspect the work as required for the purposes of providing the manufacturer's labour, material and workmanship warranty upon completion.

1.7 Warranties

- .1 Provide the RoofStar Guarantee Roofing System Record, to include the RoofStar Guarantee standard 5-Year Guarantee, copies of Inspection Reports, listing and literature of all products used, and Roof Maintenance Guide.
- .2 Provide a manufacturer's warranty certificate, including any extended warranties.
- .3 Where adhesive is used in the assembly, include and provide the adhesive manufacturer's warranty.
- .4 Active or passive roof leak detection system warranty.
- .5 All warranties to commence at date of Substantial Performance.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Roofing is to be designed to meet Guarantee Standards of the Roofing Contractors Association of British Columbia Guarantee Corp. (RoofStar Guarantee) as published in the "RGC Roofing Practices Manual" ("RPM") and requires a minimum 5 (five) year RoofStar Guarantee.
- .2 Roofing is to be designed to CSA 123.21 Wind Uplift Standards.
- .3 New and re-roof assemblies shall have a minimum of 2% slope to drain. This can be achieved by structural slope, sloped insulation, cricket and back slopes or any combination of these.
 - .1 A variance request will need to be granted for any deviations. Consideration will only be given where existing building conditions will not allow for excessive tapered insulation elevations, for example, low window sills, low door thresholds or poor drain locations.
- .4 The design service life of low-sloped roofs is to be a minimum of 25years
- .5 As per RCABC requirements, for green roofs at grade or roof level (inverted roofs) with soil or landscape buildup or cast concrete or asphalt (non-removable topping), a RoofStar Guarantee approved passive roof leak detection system must be included in the assembly. Inverted roofs with gravel ballast or pavers do not need to have a roof leak detection system as these are easy to open up and leaks can be traced when required. Refer to 3.1..4 in this section for further details.
- .6 An active (monitored) roof leak detection system is required for high value buildings such as museums, libraries and research facilities. Libraries with conventional roof systems can be provided with a passive leak detection system.
- .7 Initial EFVM scan and leak locate system is required for all inverted roof assemblies.
- .8 Monitored leak detection is NOT Required in the following situations:
 - .1 Conventional roofing over steel deck or vented wood space.

- .2 Conventional roofing over concrete deck.
- .9 Performance standards for roof insulation are set out in Section 07 21 00 Thermal Insulation
- .10 The installation of concrete or asphalt topping over 2 ply SBS membrane roofing is not permitted. A variance will need to be granted for such installations.
- .11 Hot rubberized asphaltic type membrane is acceptable where hard to access surfaces are present.
- .12 Vapour retarders are to be included in all assemblies and shall be fully adhered to the substrate. Products shall be appropriate to the building envelope configuration and be installed so as to wrap and envelope the insulation, compatible for connection to the building envelope air barrier, and be sealed at all penetrations. Laminate Kraft paper and adhesive is not an acceptable vapour retarder.
- .13 In conventional roof assembly, insulation is to be adhered with two-part urethane adhesive. In the case of conventional roof assembly over wood frame decking, screw fasten the first layer and adhere the upper layers (this reduces thermal bridging and eliminates washer heads at fasteners from showing through the roofing membrane).
- .14 Insulation overlay board is to be installed over the insulation and under the roof membrane in all cases even if manufacturers' minimum standards do not require it. This requirement would also apply with mineral fiber insulation board which have an integral facer to receive the membrane.
- .15 Roofing membranes are to be fully adhered, or torched applied 2 ply SBS modified bitumen membrane. A variance will need to be granted for alternative roofing membranes. A variance request noting the performance comparisons with a 2 ply SBS membrane roof will need to be provided for review.
 - .1 For re-roofing projects, systems and assemblies that do not require the use of hot asphalt, kettles or tankers are to be used.
- .16 Drains
 - .1 For new construction all drains shall be cast iron and include all appropriate hardware.
 - .2 Cast iron drains shall be re-used when re-roofing, and complete with drilled and tapped stud holes and new hardware as required to function as originally designed and installed.
 - .3 At all cast drains, tie-in is to be done with the application of reinforced PMMA stripped into the drain.
 - .4 All drain baskets, strainers or screens shall be cast iron or aluminum, plastic will not be permitted.
 - .5 The use of drain inserts will only be considered when dictated by building configurations or circumstance. A variance will need to be granted for such instances.
 - .6 If drain inserts must be used a "U-Flow" or Menzies "Blue Seal" connection seal shall be utilized when a hard plumbing connection is not possible. O-rings are not acceptable.
 - .7 All drains are to be sumped minimum 2' with sumps turned 45° degree to direction of roofing plies.
- .17 Membrane plies are to extend over the top of all parapets and 50 mm down past blocking and lapped over the outside surface of the wall finish. Where nailable substrates exist, the membrane shall be mechanically secured (nailed) on the outside face.
- .18 Where the top edges of the stripping plies terminate on higher walls the stripping plies are to terminate in such a way as to obtain two seals on the vertical wall face (cap stripping to extend up past base sheet and obtain a separate seal to the substrate).
 - .1 All stripping plies shall be mechanically terminated to the substrate at least 200 mm above the roof surface.
 - .2 Top edges of membranes are to be protected by counter flashings.
 - .3 In new construction, reglets will be installed to allow for the installation of membrane plies and or flashings. Gum lip flashings are not permitted.
 - .4 In re-roofing projects where reglets cannot be re-used or are not present and gum lip flashings must be used, installation shall be "double gum lip" as per RCABC Guarantee standards RPM detail.
- .19 Install walkway paths at all access door and hatches, around all rooftop mechanical and other equipment requiring maintenance, and from there leading to the main roof access stairs, ladders, or roof hatch.

- .20 Provide overflow scuppers in accordance with the latest applicable edition of the British Columbia Plumbing Code. Install overflow scuppers at height below the height of door sills wherever possible and at a location visible and able to be maintained.
- .21 For green roof installations at grade, see requirements for below-grade waterproofing system in Section 07 10 00.

2.2 Performance Requirements

- .1 Life Cycle Expectation
 - .1 Minimum 25 year service life expectancy

3.0 MATERIALS

3.1 Product Selection

- .1 System at Low-Slope Roofs
 - .1 2-ply SBS Bituminous Modified Flexible Membrane Roofing System, exposed, insulated, adhered, generally torch-applied. Refer to RoofStar Guarantee Manual Outline Specification for this system, from which the following are preferred options for UBC.
 - .1 Thermal barrier/underlay at steel deck to be provided where required by code: shall be minimum ½" gypsum board.
 - .2 Vapour retarder is required on all roofing assemblies and shall be adhered SBS modified bitumen sheet.
 - .2 Steel or wood decks shall receive primer as prescribed by the membrane manufacturer. Membrane shall be peel and stick, self-adhered or adhered appropriate to the membrane manufacturer and the specified roofing assembly. Kraft vapor retarders are not acceptable.
 - .3 Concrete decks shall receive primer as prescribed by the membrane manufacturer. Preferred membrane application shall be fully adhered and torch applied.
 - .4 Insulation overlay shall be ¼" inch or ½" inch "Dens Deck" and be adhered or mechanically attached through to the substrate as determined by the substrate and the requirements of the assembly.
 - .1 Note that 2 (two) layers of insulation overlay are required when installed over heat sensitive insulations.
- .2 Coordinate with Section 07 21 00 Thermal Insulation for effective R value of insulation for both new and re-roofing assemblies. The effective R value of insulation is to be measured at 0°C. For new roofs, it is recommended to exceed the minimum requirements of the latest version of the BC Building Code.
 - .1 Insulation for use in conventional assemblies, the preferred roofing configuration, is polyisocyanurate or mineral fibre.
 - .2 Type I and II EPS (expanded polystyrene) insulations are permitted however are intended to be used to provide slope to drain in combination with polyisocyanurate insulation.
 - .3 Type IV XPS (extruded polystyrene) is intended for use only in inverted roofing assemblies and is to be considered only when inverted roofing is unavoidable. Use products with the lowest possible global warming potential; HFC blowing agents are not permitted.
 - .4 Insulation installed in conventional assemblies shall be installed in two layers with a minimum 12 inch offset and stagger between layers (for example 2 layers of 2 inch as opposed to 1 layer of 4 inch).
 - .5 Insulations installed in adhered assemblies are to be maximum 4' X 4' in size. Insulation installed in mechanically attached assemblies to be a maximum of 4' X 8' in size
- .2 Attachment
 - .1 For installation on wood or steel decks to meet CSA 123.21 Wind Uplift Standards and/or as required to FM (Factory Mutual) 1-90 whichever is greater.

- .2 Fasteners: minimum number of fasteners and stress plates for installation on wood or steel decks to be as specified by the RoofStar Guarantee Manual for 5/10 Year Guarantee standards and/or as required to FM (Factory Mutual) 1-90 whichever is greater.
- .3 Adhesives: adhesive application rates when used in adhering insulations and coverboards on concrete decks shall meet or exceed the requirements of the RGC, the manufacturer and FM requirements for 1-90.
 - .1 The preferred adhesive for all assemblies is a two-component polyurethane such as Insta-Stik by Dow Chemical or similar.
- .3 Roof Penetrations
 - .1 All penetration hardware to have only one line or cable per flashing installation and shall incorporate a gooseneck hood, heat shrink or uncured EPDM membrane wrap c/w stainless hose clamps. Tape, putty or caulking are not acceptable.
- .4 Multiple lines or cables installed in only one penetration flashing is only acceptable when a purpose made hood or gooseneck is installed and that said lines or cables are slack enough to allow for a significant downward belly in the lines/cables.
- .3 Roof Level Accessories
 - .1 Install roof walkway paths from all access door and hatches, around all rooftop mechanical and other equipment requiring regular maintenance, and from there leading to the main roof access stairs, ladders, or roof hatch.
 - .1 Walkways to be either a reinforced walkway, cap sheet manufactured by the same manufacturer as the roof membrane, or 2' x 2' x 2" precast plain finish concrete paver slabs on pedestals (no substitutes such as duckboards or poured-in-place concrete).
 - .2 Install paver slabs approx. 2" inch apart and away from cants and flashings, in a regular and uniform pattern.
- .4 Roof Leak Detection Systems
 - .1 The roof leak detection system must meet RoofStar Guarantee requirements as laid out in the RCABC Roofing Practices Manual.
 - .2 Active (or monitored) roof leak detection systems must have the capability of issuing email alerts complete with a graphic of the roof indicating the location of the leak and must also be capable of issuing alarms to the BMS system.
 - .3 The roof leak detection system can be hard wired or connected via BACnet to the UBC BMS system. Project team to coordinate with the UBC BMS group.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

1. Section 07 00 10 Building Envelope – General Requirements
2. Section 07 21 00 Thermal Insulation
3. Section 07 55 00 Membrane Roofing
4. Section 07 62 00 Sheet Metal Flashing & Trim
5. Division 32 - for landscape maintenance
6. UBC LEED Implementation Guide – for water use for irrigation
7. Safety and Risk Services policies for health and safety

1.2 **Related External Documents**

1. Latest edition of the British Columbia Building Code (BCBC). The BC Building Code requires that all roofs, except when permitted (tents, inflatable structures, certain small “assembly occupancy” buildings), must be Class A, B, or C, as determined in accordance with CAN/ULC-S107-10 “Standard Methods of Fire Tests of Roof Coverings.”
2. RCABC Roofing Practices Manual.
3. Refer to Canadian Landscape Standard, current edition, Section 13 - Landscape over Structure and BC Standard for Extensive Green Roofs, and CMHC Roof Deck Design Guidelines.

1.3 **Description**

1. A vegetated (green) roof system has a variety of typologies primarily based on growing media depth and vegetative selection. Common types include extensive, rooftop agriculture, modular, and intensive.
2. All typologies include, at minimum, the following basic components: vegetation, growing media, filter fabric, edging, vegetative free zone ballast, drain mat, and root barrier.
3. A loose laid vegetated roofing system includes all base components installed with individual layers laid over each other.
4. A modular (tray) vegetated roofing system includes all base components with some components being loose laid and others enclosed in a multifunctional modular product.

1.4 **Coordination**

- .1 The guidelines apply to all work completed within buildings on the UBC Vancouver campus. Green roofs are NOT supported at the UBC Okanagan campus.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Registered Coordinating Professional (CRP) is required to coordinate these requirements with other disciplines. Projects with vegetated roof system require close and early design coordination among the landscape architect, architect, structural engineer, building envelope consultant, mechanical engineer and manufacturer to ensure that the landscape design objectives are integrated into the structural design. Special consideration around waterproof membrane compatibility, irrigation, water drainage and or retention/detention systems, maintenance access, glazing reflectivity, and weightbearing capacity are of critical importance.
- .5 CRP to coordinate architectural AND landscape green roof detailing.
 - .1 For at grade green roof assemblies, CRP to coordinate green roof drainage requirements with both landscape architect and civil engineer.
- .6 Submittal of a maintenance plan for the vegetated or vegetated-hybrid system is mandatory at the design stage and requires coordination between the landscape architect, manufacturer, landscape contractor and Landscape Architect in UBC Municipal Services. Special consideration to the establishment phase, warranty conditions, safety, and rooftop access of maintenance equipment should be addressed.

- .7 Coordination between the project Landscape Architect, supplier, and Landscape Architect in UBC Municipal Services is required for vegetative and growing media selection. Should the vegetated roof be desired to provide stormwater detention, project specific rainwater detention evaluation should be provided for the green roof assembly.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Submit two (2) copies of the most current technical data sheets. These documents must describe the physical properties of materials [and explanations about product installation, including restrictions, limitations and other manufacturer recommendations].
 - .2 Green roof components shop drawings.
 - .3 Sheet metal flashing shop drawings.
 - .4 Planting material information and maintenance data as per Division 32 requirements.
 - .5 Manufacturer's confirmation of training – if needed.
 - .6 Environmental Product Declaration (EPD).
 - .7 Manufacturer performance test data to confirm performance criteria.
 - .8 Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Meet or exceed the RoofStar Guarantee 5-Year guarantee standards. All roofing system products to conform to the RoofStar Guarantee Standards and to the appropriate CSA, CGSB, ULC, CULC, and ASTM Standards for the materials used in the roofing system; products to be listed in the RGC Accepted Materials List of the RoofStar Guarantee Roofing Practices Manual, and to be in conformance with the manufacturers' published product and performance data.
 - .2 Certificates of qualification may be part of the documents required for submission. Where applicable, these requirements shall be part of the call for tender(s).
 - .3 The contracted installer and his subcontractors must be officially recognized as authorized contractors by the vegetated roofing system supplier at the time of tendering and throughout installation.
 - .4 Required work may be carried out only by applicators who have been trained in the application of the green roofing systems and who are employed by an enterprise which has the adequate and necessary equipment.
 - .5 A representative of the waterproofing materials manufacturer can be present on the worksite at commencement of work or at any other time during the work, as required.
 - .6 The contractor must at all times enable and facilitate access to the worksite and the roofs for the said manufacturer's representative.
- .2 Quality Control
 - .1 An Independent Inspection Agency acceptable to RoofStar Guarantee, and assigned by RoofStar Guarantee on acceptance by the Consultant and the UBC Development Manager, to conduct field review inspections as per the minimum protocols as set forth by the RoofStar Guarantee for their 5 Guarantee Program. It is understood that in addition to these responsibilities the independent inspection agency will provide re-inspection services at the 2 year anniversary – in the case of the 5 year warranty.
 - .1 Cost for the warranty and inspections are to be included in the contract sum.
 - .2 UBC reserves the right to increase the field review inspection frequency to FULL TIME site inspections while the work is in progress. Extra costs for this to be borne by UBC.
 - .3 Added inspections just prior to the expiration of the warranty, if required, will be arranged and the costs borne by UBC.

- .4 A manufacturer's representative to also inspect the work as required for the purposes of providing the manufacturer's labour, material and workmanship warranty upon completion.

1.7 Warranties

- .1 Provide the RoofStar Guarantee Roofing System Record, to include the RoofStar Guarantee standard 5-Year Guarantee, copies of Inspection Reports, listing and literature of all products used, and Roof Maintenance Guide. All roofing system products to conform to the RoofStar Guarantee Standards and to the appropriate CSA, CGSB, ULC, CULC, and ASTM Standards for the materials used in the roofing system; products to be listed in the RGC Accepted Materials List of the RoofStar Guarantee Roofing Practices Manual, and to be in conformance with the manufacturers' published product and performance data.
- .2 Provide a membrane manufacturer's warranty certificate.
- .3 Where adhesive is used in the assembly, include and provide the adhesive manufacturer's warranty.
- .4 Active or passive roof leak detection system warranty.
- .5 All warranties to commence at Date of Substantial Performance.
- .6 Retain relevant articles when an extended vegetative roofing material warranty is requested in addition to a waterproofing system warranty (warranty of the membrane manufacturer). Refer to extended warranty providers requirements to ensure continuity between manufacturers recommendations and warranty requirements.
- .7 The membrane manufacturer will issue a written document in the owner's name, valid for a 5-year period, stating that it will remove and reinstall the vegetative system components to repair any leaks in the roofing membrane to restore the roofing system to a dry and watertight condition, to the extent that manufacturing or installation defects of one or several components caused such water infiltration. The warranty must cover the total cost of repair(s) during the entire warranty period. The warranty certificate must reflect these requirements.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Green roof systems are to be designed to meet the Guarantee Standards of the Roofing Contractors Association of British Columbia.
- .2 Structural Deck System Requirements
 - .1 Conventional Vegetated Green Roof Assemblies
 - .1 Concrete roof deck structures
 - .2 Wood framed roof deck structures
 - .3 Steel deck structures
 - .4 Inverted vegetated green roof and podium assemblies
 - .5 Concrete deck structures only
- .3 Inverted roof assembly requirements to be as per Section 07 10 00 Damproofing and Waterproofing.
- .4 Conventional roof system requirements to be as per Section 07 55 00 Membrane Roofing.
- .5 Performance standards for roof insulation to be those set out in Section 07 21 00 Thermal Insulation.
- .6 Roof penetrations are to be designed to RCABC standards. Additional information can be found in 2.1.13.
- .7 Vapour retarders
 - .1 Vapour retarders are to be included in all assemblies and shall be fully adhered to the substrate. Products shall be appropriate to the building envelope configuration and be installed so as to wrap and envelope the insulation, compatible for connection to the building envelope air barrier, and be sealed at all penetrations. Laminate Kraft paper and adhesive is not an acceptable vapour retarder.

- .8 Minimum slope for drainage and roof drains
 - .1 New and re-roof assemblies shall have a minimum of 2% slope to drain. This can be achieved by structural slope, sloped insulation, cricket and back slopes or any combination of these.
 - .2 Roof drain requirements to be as per Section 07 50 00, 2.1.16.
- .9 Confirm inclusion of root barrier across project documents. It should be specified/referenced in both architectural AND landscape architecture documents.
- .10 For systems with a greater than 15% slope modular systems, consult with the manufacturer for product requirements, placement, and compatibility
- .11 Root Barrier
 - .1 The root barrier should be detailed overtop the waterproofing membrane, across the entirety of the roof field. It should run up all projections, drains, and/or vertical interfaces to meet the highest point of growing media and ballast.
 - .2 Root barrier layer breaks should be detailed with, at minimum, a 1 foot overlap- fastened with a manufacturer approved fastener. Alternatively, 3 foot overlaps without tape are acceptable.
- .12 Drainage mat
 - .1 Drainage mat must run continuous across the roofing field in order to facilitate water movement to drain. Therefore, it must encompass both the delimited vegetative free zones and vegetated zones.
 - .2 The drainage mat should be detailed between root barrier and filter cloth, across the entirety of both the vegetated and vegetative free zone roofing field. Therefore, it should be detailed under the filter cloth, metal edging, and vegetative free zone ballast. It should be detailed flush to all drains, projections, and interfaces.
 - .3 In a protected roofing assembly (PMA) roofing assembly the drainage mat must be an open diffusion product, and it's placement will change. It should be detailed between the XPS insulation layer and the filter cloth, across the entirety of the vegetated and non-vegetated roofing field.
- .13 Edging
 - .1 The edging should be detailed on top of the drain mat and between the filter cloth and the drainage mat, adjacent to the vegetation free zone ballast.
- .14 Vegetation free zone
 - .1 Vegetation free zones are essential to reduce potential clogging of essential systems like drains and help maintain plant health by providing maintenance paths. Minimum recommended widths are to improve ease of access for maintenance staff and reduce likelihood of vegetative infiltration of roofing components.
 - .2 Vegetation free zones should be detailed around all roof penetrations such drains, roof anchors, parapets, and other rooftop projections like mechanical and electrical services and equipment, and/or high traffic areas.
 - .3 The vegetation free zone (river rock) should be detailed between the edging and the perimeter parapets and all roof projections. It should be detailed to go over the root barrier and drain mat to ensure adequate drainage.
 - .4 Vegetative free zone ballast should be lower than the adjacent growing media found in the vegetative zone in order to reduce maintenance issues and for maintenance ease of use.
 - .5 The vegetation free zone should be detailed at 300mm (12") wide for linear edges and with a 300mm radius around roof drains and other roof projections.
- .15 Filter fabric
 - .1 To prevent growing media seepage, it's essential that the filter fabric runs up the vertical interface of the edging, to the top of the edging.
 - .2 The filter fabric should be detailed overtop of the drain mat, across the vegetated roofing field, overtop and up the vertical interface to the top of the edging.
 - .3 Filter fabric breaks should be detailed with, at minimum, a 1' overlap.

- .16 Growing media
 - .1 Growing media should be detailed between the vegetation and the filter fabric, within the vegetated roofing field.
- .17 Vegetation
 - .1 Vegetation should be detailed at the top of the system, above the growing media, within the vegetated roofing field.
- .18 Roof leak detection system
 - .1 For green roofs at grade over suspended slab or at roof level (inverted roofs) with soil or landscape buildup, a RoofStar Guarantee approved passive roof leak detection system must be included in the assembly.
 - .2 An active (monitored) roof leak detection system is required for high value buildings such as museums, libraries and research facilities.
 - .3 Initial EFVM scan and leak locate system is required for all inverted roof assemblies.
 - .4 Active (or monitored) roof leak detection systems must have the capability of issuing email alerts complete with a graphic of the roof indicating the location of the leak and must also be capable of issuing alarms to the BMS system.
 - .5 The roof leak detection system can be hard wired or connected via BACnet to the UBC BMS system. Project team to coordinate with the UBC BMS group.
- .19 Roof level access path
 - .1 Install walkway paths at areas requiring regular maintenance, and from there leading to the main roof access door.
- .20 Water retention/detention
 - .1 Roofing components, provide both retention AND temporary water detention capacity, targeted at peak outflow reduction but to a limited capacity. If additional water retention/detention is being reviewed for a project for green roofs, selection should be determined by a combination of water retention and/or detention targets, weightbearing capacity, irrigation needs and use of specialized components targeted for water retention/detention within the green roof assembly.
 - .2 Above evaluation to be done by the project team and shared with the Sustainability Department (C&CP) and UBCV Technical Review Team Architect.
- .21 Basis of design details
 - .1 Refer to the basis of design details provided as a starting point for green roof assembly design.
 - .2 CRP to use these details for coordination of green roof details with the landscape architect.

2.2 Performance Requirements

- .1 Life Cycle Expectation
 - .1 Minimum 25-year service life expectancy

3.0 MATERIALS

3.1 Product Selection

- .1 Inverted Roof Assembly – Membrane - refer to Section 07 10 00, 3.0 for requirements of this system. Basis of design details have been provided for reference at the end of this section.
- .2 Conventional Roof Assembly – refer to Section 07 50 00, 2.2 for requirements of this system.
- .3 Vegetation
 - .1 Due to the permanent nature of green roofs, it's suggested that vegetative selection includes a majority of perennial coverage, unless design intent stipulates otherwise, like in the case of rooftop agriculture. Vegetation can be installed as seeds, cuttings, plugs, shrubs, trees, or pre-vegetated mats.
 - .2 Vegetative selection should be determined by a combination of factors including but not limited to climate, growing media depth, growing media composition, design intent, irrigation, and maintenance requirements.

- .4 Growing Media
 - .1 Contact the manufacturer's representative to help determine the right growing medium composition for the green roof vegetation. Its recommended that an irrigation system be installed and maintained in good condition to sustain water needs throughout wet and dry seasons.
 - .2 Growing media selection should be determined by a combination of factors including, but not limited to, depth of the assembly and vegetative choice. Growing media depth influences both water retention capacity, irrigation requirements, and overall weight. Vegetated roofing assembly growing media, in general, should have higher porosity, lower organic content, and higher mineral aggregate content than typical soil blends.
 - .1 Non-Irrigated Extensive and Semi-Intensive Systems

Growing medium consisting of an unconsolidated mixture of organic matter and mineral aggregates. The composition is specially formulated by the vegetated roofing system manufacturer for extensive or semi-intensive systems, to provide optimal water retention, permeability, structural stability and density for plants with low water needs.
 - .2 Irrigated Semi-Intensive and Intensive Systems

Growing medium consisting of an unconsolidated mixture of organic matter and mineral aggregates. The composition is specially formulated by the vegetated roofing system manufacturer for semi-intensive and intensive systems, to provide optimal water retention, permeability, structural stability and density for plants with medium and high water needs.
- .5 Retention and/or Retention + Detention
 - .1 Water retention capacity can be enhanced through specialized components targeted at water retention. Alternatively, roofing components, provide both retention AND temporary water detention capacity, targeted at peak outflow reduction.
 - .2 Additional water retention/detention selection should be determined by a combination of weightbearing capacity, irrigation needs, and any water retention and/or detention targets.
- .6 Filter Fabric
 - .1 Filter fabric selection should aim to limit breaks and stabilize the growing media to prevent it from infiltrating other system components.
- .7 Edging
 - .1 Edging selection should be determined by growing media depth, durability, design aesthetics, and water flow needs. Metal edging should be, at minimum, as high as growing media depth, and in areas with high water flow rates, should be perforated.
- .8 Vegetative free zone ballast
 - .1 Ballast selection should be determined by a combination of design aesthetics, weightbearing capacity, maintenance, and any wind uplift requirements. In general, either concrete pavers, or rounded river stones between sizes of 19mm and 38mm are recommended.
- .9 Drain Mat
 - .1 Consult warranty provider requirements for need and use of a second drain mat layer.
 - .2 Drain mat selection should be determined by a combination of compressive strength, water flow rate, and roof assembly needs. For protected membrane assemblies, an open diffusion drain mat is required, laid overtop of the insulation layer. For conventional roofing assemblies, either an open diffusion or dimple drain mat is acceptable, laid over top of the root barrier.
- .10 Root Barrier
 - .1 :20 Mil polypropylene sheets are required in extensive systems due to shallow vegetative root systems and, in the case of pre-vegetated mats, reduce the likelihood of volunteer species becoming established. 30 Mil polypropylene sheets are required in non-extensive systems with more aggressive vegetative root penetration, and/or that have a higher likelihood of volunteer species establishment.

- .2 Root barrier selection should be determined by a combination of vegetative choice, site conditions, and maintenance planning.

4.0 **MAINTENANCE REQUIREMENTS**

- .1 Maintenance is required before, during, and after install of the vegetated roof system. Special consideration should be paid to irrigation, weeding, pest control, and fertilization needs of the vegetated roofing sections. Furthermore, regular cleaning of debris from drains and vegetation free zones is required.
- .2 Intensive systems will generally require a higher degree of maintenance than extensive systems. Likewise, a sedum mat component will have a shorter establishment period than most perennials and shrubs. Consult with the Landscape Architect, Municipal Services when developing a maintenance program best suited to roof typology and vegetative selection.
- .3 A maintenance program should be developed to include, at minimum, limited conditions for vegetation care, before, during, and after handoff to Facilities. Furthermore, it should include special conditions for the establishment period of the vegetation. Lastly, it should include long term conditions for both vegetative care, drain cleaning, and regular roof maintenance.
- .4 The first two-year establishment period for the vegetated system generally requires higher frequency maintenance visits than subsequent years.
- .5 Maintenance is a requirement of many warranty conditions, thus should be designed, at minimum, to meet warranty conditions.

5.0 **LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS**

Items in this section are lessons learned, and may be code or industry best practices which have been missed on past projects. If not applicable to a project, a variance is not required.

- .1 All green roof details, whether at roof level or at grade are to be coordinated with the landscape and civil design. Complete details showing the landscape build-up plus drainage are to be included within the architectural detail sheets or booklet. The architectural site plan should coordinate drainage slopes and methods with the landscape and civil designs.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

1. Section 07 00 10 Building Envelope - General Requirements
2. Section 07 21 00 Thermal Insulation
3. Section 013300 Submittal Procedures
4. UBC LEED Implementation Guidelines
5. UBC Energy Modelling Guidelines
6. Owner's Project Requirements

1.2 Related External Documents

1. Latest edition of the British Columbia Building Code (BCBC).
2. RCABC Roofing Practices Manual.
3. Roof covering to conform to CAN/ULC-S107-M "Standard Methods of Fire Tests of Roof Coverings" for a Class A, B or C classification.
4. CSSBI-S8 "Quality and Performance Specification for Pre-Finished Sheet Steel Used for Building Products".
5. ASTM-A924/A924M "Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process".
6. CSSBI-20M "Standard for Sheet Steel Cladding for Architectural Industrial and Commercial Building Application
7. CAN/CGSB-1.171 "inorganic Zinc Coating".
8. ASTM-A653/A653M "Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process."
9. AAMA 621

1.3 Description

1. Work includes sheet metal roofing, anchoring methods and fasteners.
2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.4 Coordination

1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals

- .1 Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
- .2 Environmental Product Declaration (EPD).
- .3 Shop drawings (including all structural and enclosure interface details) sealed and signed by a professional Engineer.
- .4 Manufacturer performance test data to confirm performance criteria.
- .5 Maintenance Data
 - .1 As-installed hardware.
 - .2 Source for replacement parts.
 - .3 Maintenance instructions.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Meet or exceed the RoofStar Guarantee 5-Year guarantee standards All roofing system products to conform to the RoofStar Guarantee Standards and to the appropriate CSA, CGSB, ULC, CULC, and ASTM Standards for the materials used in the roofing system; products to be listed in the RGC Accepted Materials List of the RoofStar Guarantee Roofing Practices Manual, and to be in conformance with the manufacturers' published product and performance data.
- .2 Quality Control
 - .1 An Independent Inspection Agency acceptable to RoofStar Guarantee, and assigned by RoofStar Guarantee on acceptance by the Consultant and the UBC Development Manager, to conduct field review inspections as per the minimum protocols as set forth by the RoofStar Guarantee for their 5 Guarantee Program. It is understood that in addition to these responsibilities the independent inspection agency will provide re-inspection services at the 2 year anniversary – in the case of the 5 year warranty.
 - .1 Cost for the warranty and inspections are to be included in the contract sum.
 - .2 UBC reserves the right to increase the field review inspection frequency to FULL TIME site inspections while the work is in progress. Extra costs for this to be borne by UBC.
 - .3 Added inspections just prior to the expiration of the warranty, if required, will be arranged and the costs borne by UBC
 - .4 A manufacturer's representative to also inspect the work as required for the purposes of providing the manufacturer's labour, material and workmanship warranty upon completion.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Roofing is to be designed to meet Guarantee Standards of the Roofing Contractors Association of British Columbia Guarantee Corp. (RGC) as published in the "RGC Roofing Practices Manual" for a 5-Year guarantee.
- .2 Design roof system to accommodate thermal movement of the roof sheet caused by ambient temperature.
- .3 Use exterior insulated assemblies whenever insulated roof assemblies are utilized.
- .4 Use thermal clips or bearing plates to provide a thermally efficient assembly and structurally support the roofing system.
- .5 Design roof system to withstand as a minimum dead loads, seismic, movement, wind load, snow loads, snow build-up and rain load as required by the BCBC. Signed shop drawings by an professional engineer registered in BC is required.
- .6 Sheet metal roofing systems are to be concealed fastener type.

2.2 Performance Requirements

- .1 The design service life of sheet metal roofs is 30 years to first major maintenance/replacement.
- .2 The air barrier system in sheet metal roofing systems is to function as a secondary drainage plane. All fastener penetrations are to be sealed and clamped, and the air barrier plane is to be water tight over the design service life of the roofing.
- .3 Sheet metal roofs must be designed to consider potential snow slumping hazards. Snow retention stops or clips must be incorporated into roof slopes where there is the potential for injury to the public from sliding snow.
- .4 Energy targets for new projects and major renovations are developed to reduce UBC's energy use over time and support UBC's Climate Action Plan (CAP 2030). Coordinate with Section 07 21 00 Thermal Insulation for effective R value of insulation for both new and re-roofing assemblies. The effective R value of insulation is to be measured at 0°C. For new roofs, it is recommended to exceed the minimum requirements of the latest version of the BC Building Code.
- .5 Thermal bridging effects shall be accounted for, evaluated and provided identifying how thermal bridging will be mitigated to meet overall effective thermal performance requirements. Refer to Section 07 21 00, 2.2.4 for techniques to be used.

3.0 MATERIALS

3.1 Product Selection

- .1 Sheet metal roofing is to be a minimum 0.71 mm thick (24 ga), Z275 (G90) galvanized. Prefinished metal work to have AAMA 621 two-coat fluoropolymer coating not less than 70% PVDF..
- .1 Series 10000 paint finish by ArcelorMittal or equivalent applied over galvanizing.
- .2 Kynar 500
- .2 Selection of other sheet metal roofing systems should include service life and maintenance considerations in addition to design considerations. A variance will need to be granted for alternate options. The variance request should include design and performance comparisons.
- .3 Sheet metal accessories for low slope roofs are to be a minimum 0.71 mm thick (24 ga), Z275 (G90) galvanized. Prefinished metal work to have Series 10000 paint finish over galvanizing or equivalent.
- .4 Insulation to be rockwool or polyisocyanurate types.
- .5 Metal work concealed in the roof assembly is to be at a minimum 18 ga Z275 (G90) galvanized sheet metal, protected with a bituminous coating where in contact with damp materials.
- .6 Air barrier/roof underlay membrane systems considered to have adequate design service lives for use under sheet steel roofing systems are:
 - .1 Single ply polyester-reinforced torch applied SBS modified bitumen roofing membrane; fully reinforced 180g felt weight.
 - .2 Some high melting point, adhesively applied bitumen membranes, fully reinforced 180g weight.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 06 10 00 Rough Carpentry
- .2 Section 07 00 10 Building Envelope – General Requirements
- .3 Section 07 10 00 Dampproofing and Waterproofing
- .4 Section 07 40 00 Cladding
- .5 Section 07 50 00 Membrane Roofing
- .6 section 07 61 00 Sheet Metal Roofing

1.2 Related External Documents

- 1. RCABC Roofing Practices Manual.
- 2. Fabricate to SMACNA (Sheet Metal and Air Conditioning Contractor's National Association) – Architectural Sheet Metal Manual Standards.
- 3. CSSBI-S8 "Quality and Performance Specification for Pre-Finished Sheet Steel Used for Building Products".
- 4. ASTM-A924/A924M "Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process".
- 5. CAN/CGSB-1.171 "inorganic Zinc Coating".
- 6. ASTM-A653/A653M "Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process."

1.3 Description

- 1. Section includes sheet metal flashing and trim for wall and roof assemblies.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures.
- .2 Provide samples for colour selection only if it is a Construction Office project.
- .3 O&M Submittals
 - .1 Product specifications, type and colour.
 - .2 Environmental Product Declaration (EPD).
 - .3 Final reviewed shop drawings (including all enclosure interface details).
 - .4 Manufacturer performance test data to confirm performance criteria.
 - .5 Maintenance Data
 - .1 Source for replacement.
 - .2 Maintenance instructions.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Refer Sections 07 40 00 Cladding, 07 50 00 Membrane Roofing and 07 61 00 Sheet Metal Roofing.
 - .2 Follow all recommendations of the "RGC Roofing Practices Manual", as a minimum.
 - .3 Include flashings in mockups as specified for work of other sections.
- .2 Quality Control
 - .1 Refer Sections 07 40 00 Cladding, 07 50 00 Membrane Roofing and 07 61 00 Sheet Metal Roofing.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Meet the guarantee standards of the Roofing Contractors Association of British Columbia Guarantee Corp. (Roofstar Guarantee) as published in the "RGC Roofing Practices Manual" for a 5-year guarantee.
- .2 Provide sheet metal in base metal thickness specified. Where no thickness is specified, provide base sheet metal in thickness recommended in SMACNA Architectural Sheet Metal Manual for type of item being fabricated, but not less than 24 gauge thickness for all installations.
- .3 Zinc coated steel sheet: 24 gauge thickness minimum, commercial quality to ASTM A653/A653M, with Z275 (G90) designation zinc coating.
- .4 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality, grade 33 with AZ150 coating, regular spangle surface, 24 Gauge base metal thickness.
- .5 Provide continuous clip-type fasteners at all parapet flashings, of same material as flashing.
- .6 Provide 19mm (¾") high standing seam or 1" pocket S-Lock joints between flashing section
- .7 Provide overflow scuppers whenever perimeter walls exceed 100 mm (4") in height, to BC Building Code requirements. Refer to SMACNA Appendix A-7, Scupper Sizing.
- .8 Fabrication shall be standing seams only at inside and outside corners, provide S-lock at all other locations
- .9 Apply isolating coating to all metal surfaces in contact with cementitious materials.
- .10 Avoid the use of reglets as roof membrane terminations.
- .11 Avoid surface fasteners.
- .12 Provide a minimum of 10% slope at all flashings.
- .13 Cap flashings to extend a minimum of 10mm beyond the face of the walls to avoid drip lines.

3.0 MATERIALS

3.1 Product Selection

- .1 Base metal for sheet metal accessories and for sheet metal flashing and trim to be:
 - .1 Zinc coated sheet steel conforming to the requirements of ASTM A653 (or A653M as applicable) with a minimum zinc coating of G90 (Z275), or
 - .2 Prefinished steel sheet with coating system consisting of base metal with factory applied pre-treatment, primer, and fluoropolymer (PVDF) topcoat meeting requirements of CSSBI S8.
 - .1 Finished colour finished on both sides.
 - .2 Exposed coating thickness: dry film coating system thickness not less than 22 micrometres.
 - .3 Flashing should be humidity, salt spray and chalk resistant.
 - .3 Aluminium-zinc coated (Galvalume) steel sheet conforming to the requirements of ASTM A792 (or A792M) with a minimum coating of AZ50 (AZM150) or
 - .4 Aluminum sheet conforming to CSA HA Series 1975, plain:
 - .1 Generally minimum 0.81 mm (20 gauge), 1.02 mm (18 gauge) at parapets and flashings 200mm (8") width or wider.
 - .5 Minimum 24 gauge thickness.

- .2 Provide sheet metal in base metal thickness specified. Where no thickness is specified, provide base sheet metal in thickness recommended in SMACNA Architectural Sheet Metal Manual for type of item being fabricated, but not less than 24 gauge thickness for all installations.
- .3 Zinc coated steel sheet: 24 gauge thickness minimum, commercial quality to ASTM A653/A653M, with Z275 (G90) designation zinc coating.
- .4 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality, grade 33 with AZ150 coating, regular spangle surface, 24 Gauge base metal thickness.
- .5 Flashing used in contact with treated wood must be compatible with the treated wood and last long enough to be suitable for the intended application. Flashing must also be of the same type of metal as any fasteners that penetrate through them to avoid galvanic corrosion.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 07 00 10 Building Envelope – General Requirements (for roof safety requirements)
- .2 Section 07 50 00 Membrane Roofing
- .3 Section 07 62 00 Sheet Metal Flashing and Trim

1.2 Related External Documents

- 1. RCABC Roofing Practices Manual.
- 2. WorkSafe BC OHS Regulations.

1.3 Description

- 1. Roof hatches and service ladders.

1.4 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Product specifications, type and anchoring methods.
 - .2 Shop drawings (*including all interface details*) sealed and signed by a Professional Engineer registered in the Province of British Columbia.
 - .3 Manufacturer performance test data to confirm performance criteria.
 - .4 Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
 - .5 Maintenance Data
 - .1 As-installed hardware.
 - .2 Source for replacement parts.
 - .3 Maintenance instructions

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Roof Hatches
 - .1 Roof hatches are acceptable only in the following circumstances:
 - .1 Roofs with **no rooftop equipment** requiring maintenance may be accessed using an internal *ship's* ladder and roof hatch, size 3'-0" x 2'-6", insulated integral curb and flashing, c/w externally mounted safety grab handle and non-removable pin (NRP) hinges.
 - .2 Roofs having **rooftop equipment requiring occasional maintenance** may be accessed using an internal ship's ladder) and roof hatch, size 2'-6" x 4'-6" *or a service stair* and roof hatch size 2'-6" x 8'-0". Hatch to have insulated integral curb,

and flashing, externally mounted safety grab handle *and* non-removable pin (NRP) hinges.

- .3 **UBCO only** – Roof hatches are to be supplied with guards around roof hatches. These are to be a permanent (side-mounted and bolted) OSHA and Worksafe compliant roof hatch guardrail system with a self-closing safety gate.

.2 Roof Ladders

- .1 Roofs having rooftop equipment requiring regular maintenance or to a penthouse at roof level are to be accessed via a stairway extending to the roof or through provision of a ladder. Roof ladder design to be as follows:
 - .1 Only ship ladders are acceptable. A variance will need to be granted for the use of vertical ladders.
 - .2 Ladder dimensions to be as per WorkSafe BC standards. *Treads are not to overlap over one another. The beginning of each tread should align with the end of the tread below.*
 - .3 *Ships ladder slope should not exceed 60 degrees.*

2.2 Performance Requirements

- .1 Roof hatches and ladders to conform to WorkSafe BC OHS requirements and standards.

3.0 **MATERIALS**

3.1 Product Selection – NOT USED

3.2 Finishes

- .1 Roof hatch guardrail to be of anodized aluminum or galvanized steel.
- .2 Standard exposed ladder finish: Galvanized *steel*.

4.0 **LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS**

Items in this section are lessons learned or misses from past projects. These may also include code or industry best practices. If not applicable to a project, a variance is not required.

- .1 *Recent ships ladders installed on new builds have been unusable from a safety perspective. Based on design modifications done after installation to increase tread overlap, design requirements have been updated as noted above.*

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 07 00 10 Building Envelope – General Requirements
- .2 Coordinate with firestopping requirements in Divisions 21, 26 and 27.

1.2 **Related External Documents**

- 1. Latest edition of the British Columbia Building Code (BCBC).
- 2. CAN/ULC S115-11, "Standard Method of Fire Tests of Firestop Systems".
- 3. ULC List of Equipment and Materials:
 - .1 ULC or cUL listed firestop assemblies for intended application.

1.3 **Description**

- 1. Firestopping systems as required by architectural, mechanical and electrical disciplines.

1.4 **Coordination**

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 **Submittals**

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures.
- .2 O&M Submittals
 - .1 Shop drawings/ product sheets indicating location of firestopping, and ULC/cUL listings.
 - .2 Tag service penetrations and every 3.0 meters of joint seal with printed tags indicating name and phone number of subcontractor and the following statement: "CAUTION! FIRESTOP: DO NOT RE-ENTER, PUNCTURE OR DESTROY UNLESS PREPARED TO RE-SEAL IMMEDIATELY WITH PROPER, ULC-APPROVED METHOD. ALL NEW WORKS SHALL BE REVIEWED BY UBC PERMITS & INSPECTIONS."
 - .3 Manufacturer performance test data to confirm performance criteria.
 - .4 Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
 - .5 Environmental Product Declaration (EPD).
 - .6 Maintenance Data
 - .7 Method for replacement of the firestopping system.
 - .8 Maintenance instructions

1.6 **Quality Control and Assurance**

- .1 Quality Assurance
 - .1 Ensure that other sections are aware of the maximum and minimum clearance requirements to the penetration stipulated by the Underwriter's design listing.
- .2 Quality Control
 - .1 Installer to be certified by product manufacturers for installation of products, including for safety and so as to ensure warranties are not affected.
 - .2 Do not mix products in the system from differing manufacturers.
 - .3 Use the same product for all like applications.

- .3 Commissioning
 - .1 Prior to occupancy and during demonstration and training for UBC maintenance crews, provide a comprehensive seminar to UBC's mechanical and electrical staff on the purpose and nature of the firestop systems used. Include a demonstration with "hands-on" session on re-entry, re-sealing and all safety aspects of the firestops.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Firestopping to be designed to act as a firestop and smoke seal within fire-resistive wall and floor assemblies for any penetrating items such as cables, cable trays, conduits, ducts, pipes or any poke-through termination devices, such as electrical boxes along with their means of support through the wall or floor opening.
- .2 Provision of firestopping materials at fire-resistive wall and floor assemblies such as joints at intersections of dissimilar construction.
- .3 Systems that have Environmental Product Declarations (EPD) are preferable.

2.2 Performance Requirements

- .1 Firestopping performance requirements to be as per the approved ULC or cUL system for the intended application.

3.0 MATERIALS

3.1 Product Selection

- .1 General firestopping products manufactured by Hilti (Canada) Limited. Other major firestopping manufacturers are acceptable as long as the ULC listed firestopping system is properly installed and will suffice to satisfy the latest edition of the BC Building Code.
- .2 Zone pathways for Division 27 – specifically use Hilti CFS-SL GP system. Due to the nature of IT cables and how they are installed and re-installed, UBC IT has expressed a preference for this particular system as it allows the most future flexibility and cost effectiveness while maintaining the most effective fire barrier over time and penetration re-entry, in particular the speed sleeve product preference at this time.
- .3 UBC Project Manager/ Construction Office to coordinate review of the installed firestopping systems with UBC Permits & Inspections for compliance with the approved ULC listing.
- .4 Use low VOC products.
- .5 Use primers whenever recommended by manufacturer.

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 03 33 00 Architectural Concrete
- .2 Division 7 – related sections therein
- .3 Division 8 – related sections therein
- .4 UBC Resilience-Based Design Guide for Nonstructural Systems

1.2 **Related External Documents**

- 1. Latest edition of the British Columbia Building Code (BCBC) – where applicable.

1.3 **Description**

- 1. Section includes joint sealants used in wall assemblies, around windows and doors (interior and exterior), including within curtainwall and storefront systems.

1.4 **Coordination**

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. The CRP is to develop envelope details and select sealants so as to obtain high performance, durability, and low-maintenance details. Details are to be reviewed by a building envelope consultant.

1.5 **Submittals**

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Shop drawings (including all enclosure interface details) sealed and signed by a professional engineer registered in the Province of BC.
 - .2 Product data and specifications, type and colour, manufacturer and distributor name.
 - .3 Environmental Product Declaration (EPD).
 - .4 Manufacturers Safety Data sheet (MSDS) for all toxic or potentially toxic materials.
 - .5 Manufacturer performance test data to confirm performance criteria.
 - .6 Maintenance data and instructions.
 - .7 Warranties - applicable extended warranties for each product as offered by sealant manufacturers.

1.6 **Quality Control and Assurance**

- .1 Quality Assurance
 - .1 Installation by trade contractor who specializes in the application of sealant systems.
 - .2 Incorporate quality assurance programs in the contract documents particular to the project and developed in concert with manufacturers and suppliers of this trade, and the envelope consultant.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Proper joint design to be reviewed, especially with regard to sealant movement.
- .2 All joints to receive sealant shall be designed to be 4 times as wide as the anticipated movement. This should include movement due to thermal expansion and contraction as well as structural movement. This is of particular importance at window and door frames.
- .3 Sealants selected on a project should be compatible with adjacent surfaces that they come into contact with.

2.2 Performance Standards

- .1 Only high-performance elastomeric sealants are to be used. Sealants must be capable of withstanding dynamic movement in exterior applications for long periods of time (typically 20+ years).
- .2 Durability of sealants is important, especially when considering the service life of the building.

3.0 MATERIALS

3.1 Product Selection

- .1 Exterior weather seal sealants shall be high performance neutral cure silicone with excellent adhesion to both porous and non-porous surfaces, high movement capability and excellent weatherability. Acceptable products are : Dow Corning 991, 790 and 795 or GE SILPRUF and GE SILPRUF NB.
- .2 Use non-staining sealants for sensitive substrates such as stone unless testing has been done to ensure compatibility and use of regular sealants.

4.0 LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS

Items in this section are lessons learned, and may be code or industry best practices which have been missed on past projects. If not applicable to a project, a variance is not required.

- .1 UBC experiences continual failures in exterior caulking around door and window frames, louver frames, in cladding joints and other areas of non-movement. Consequently, joint sealants are not to be used as a primary method of waterproofing or shedding water. Appropriate penetration details complete with flashing and counter flashing to be provided.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Division 03 and relevant TG sections therein
- .2 Division 04 and relevant TG sections therein
- .3 Division 06 and relevant TG sections therein
- .4 Division 07 and relevant TG sections therein
- .5 Section 08 and relevant TG sections therein
- .6 Division 09 and relevant sections therein
- .7 Divisions 20, 22, 23, 25, 26, 27 and 28
- .8 UBC LEED Implementation Guide
- .9 UBC Energy Modelling Guidelines
- .10 Owner's Project Requirements
- .11 UBC Bird-Friendly Design Guidelines
- .12 UBC Resilience-Based Design Guide for Nonstructural Systems

1.2 Related External Documents

1. Latest edition of the British Columbia Building Code (BCBC).
2. CAN/CSA-A440.2-09/A440.3-09 - Fenestration energy performance/User guide to CSA A440.2-09, Fenestration energy performance.
3. CAN/CSA-A440.4 "Window and Door Installation"

1.3 Description

1. General design and performance requirements for doors, windows and curtainwall systems.

1.4 Coordination

1. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
2. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
3. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
4. Input from a Building Envelope (BE) consultant is required in the design development process. The BE consultant is to review all BE details, and review comments are to be incorporated prior to tender and Building Permit issuances.
5. Input from the structural consultant is required during the design process. The structural consultant is to review and provide all base building structural requirements.
6. Provide window, curtain wall and door hardware schedules for review by UBC Access and Security and Locksmith Shop prior to tender and Building Permit.

1.5 Submittals

- .1 Refer to specific submittal requirements in sections 08 11 00 Metal Doors and Frames, 08 41 13 aluminum-Framed Entrances and Storefronts, 08 44 13 Glazed aluminum Curtain Walls and 08 50 00 Windows.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements – Windows and Curtain Wall Systems

- .1 All seals between frame and glazing to be made with compressed gaskets.
- .2 Frames to be glazed with internal or external removable stops or using tamper proof fasteners where security is required. Glazing to be designed to enable glass replacement without deconstruction of adjoining assemblies.

- .3 Window and curtain wall installations need to accommodate building movements including inter-storey drift during seismic loading.
- .4 Sound transmission ratings for windows to be selected based upon Acoustical Report where available for a project. For learning spaces acoustical requirements, refer to Section 10 00 10 Special Room Requirements.
- .5 While operable windows are encouraged, operable windows are not to be provided in laboratories or spaces where pressure differentials need to be maintained. This will allow negative pressures to be maintained relative to adjacent spaces and to prevent draft conditions.
- .6 Windows in laboratory spaces to be openable only with a controlled tool, for use only in the event of a mechanical system shut-down/failure.
- .7 Hardware and seals of operable units should be designed so that hardware can be adjusted and seals maintained or replaced over the life of the window to maintain air and weather tightness. Proprietary hardware should not be provided.
- .8 Frames need to be supplied with receiving surfaces for sealing to air and vapour barrier materials, insulation, and cladding of exterior wall assemblies.
- .9 Coordinate fritting requirements with the UBC Brid-friendly Design Guidelines. Frit placement within insulated glazed units should not conflict with the low-e coating location as per Section 08 80 00 Glazing.
- .10 Make provision for window washing on the exterior with the use of a genie lift or boom lift. Coordinate sidewalk width, manlift and other smaller vehicular loading requirements on sidewalks with the civil engineer, after consultation with the UBCV Technical Review Team Architect or UBCO Facilities Management.

2.2 Design Requirements – Doors

This Section applies to doors in Sections 08 11 00 Metal Doors and Frames, 08 41 13 Aluminum-Framed Entrances and Storefronts and 08 44 13 Glazed Aluminum Curtain Walls.

- .1 Water tightness rating for exterior exposed doors to be selected based upon exposure to elements related to location on the facade and site conditions per AAMA/WDMS/CSA 101/I.S.2/ A440-17.
- .2 Maximum exterior and interior door height to be 2,134 mm (7'-0"). Door above this height will require a variance.
- .3 Exterior doors:
 - .1 Install all exterior doors not able to meet required water tightness performance in protected locations under the cover of an overhang with an overhang ratio (horizontal projection of overhang to overhang to height above door sill) appropriate for the door type. All measurements are taken from the exterior edge of the door threshold.
 - .2 Overhang projection outward from plane of door:
 - .1 Out-swing door:..... 1:4 min
 - .2 Sliding door: 1:4 min
 - .3 In-swing:..... 1:2 min
 - .4 Double swing:..... 1:2 min
 - .5 Double slider: 1:2 min
 - .6 Wood door:..... 1:2 min
 - .7 Outswing Press steel door: 1:2 min
 - .3 Overhang projection to jamb in plane of door 1:4 minimum.
 - .4 Any door with less than a 1:2 overhang ratio (Out-swing door and sliding doors in table above) must also meet the minimum water penetration test resistance requirements for windows located in the wall at that location, and be verified through field testing.
 - .5 Exceptions to the above rules may also be made for outward opening or sliding doors that can resist water penetration in the lab and in the field at pressures in excess of 500 Pa with multi point locking system.

- .4 Frames to be glazed with internal removable stops or using tamper proof fasteners where security is required.
- .5 Where fire-rated doors are required, use hollow metal, thermally broken doors. At other locations, it is acceptable to use wide stile thermally broken aluminum doors or fiberglass doors with pressed metal frames.
- .6 All doors with glazed assemblies (floor to door height or floor to ceiling height) to be tempered glass.
- .7 Where panels of vision or opaque glass is located in a required fire separation, use fire-rated safety glass such as Firelite, not wired glass.
- .8 Use of floor checks, pivots, concealed closers and/or concealed panic devices is not permitted. Coordinate with Section 08 71 00 Door Hardware.
- .9 Glazed doors must have stiles and rails. Refer to Section 08 11 00 Metal Doors and Frames.
- .10 Frameless glass doors are not recommended for use. Maintenance considerations are to be evaluated when proposing the use of frameless glass doors.
- .11 Service room door swings should be as noted in Sections 10 00 10 Special Room Requirements, 20 00 05 Mechanical – General Requirements and 27 05 05 Communications Rooms Design Guidelines. Acoustic seal to be provided for doors to these rooms.
- .12 Any exterior or interior vestibule doors that swing over walk-off mats must have sufficient clearance underneath to clear the mats without having to make special provisions in the mats such as cutaways.
- .13 Door sub sill pans need to be integrated with terminations of roofing membranes.
- .14 Check roof overflow scuppers for height relative to door sills at roof level. Overflow scuppers should be below door threshold waterproofing height.
- .15 Sill accessories and flashing material shall be connected with waterproof joints or shall be under laid with continuous secondary waterproofing. Joints shall remain waterproof while accommodating thermal movement for the life of the installation.

2.3 Performance Requirements

- 1. Refer to individual sections in Division 8.

3.0 MATERIALS

- 1. Refer to individual sections in Division 8.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 03 33 00 Architectural Concrete
- .2 Section 07 00 10 Building Envelope – General Requirements
- .3 Section 07 25 00 Weather Barriers
- .4 Section 07 40 00 Cladding
- .5 Section 08 00 10 Openings – General Requirements
- .6 Section 09 90 00 Painting and Coating
- .7 Divisions 26 and 28
- .8 Section 27 05 05 Communication Rooms Design Guidelines

1.2 Related External Documents

- 1. Latest edition of the British Columbia Building Code (BCBC), including accessibility requirements.
- 2. Canadian Steel Door Manufacturers Association (CSDMA), Recommended Specifications for Commercial Steel Doors and Frames.
- 3. Fire-Rated Door Assemblies: CAN/ULC-S104-10 - Standard Method for Fire Tests of Door Assemblies; CAN/ULC-S105-09 - Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104; labeled and listed by ULC, cUL, Warnock Hersey, or other testing agency.
- 4. NFPA 80 for installation of fire rated doors and frames.

1.3 Description

- 1. Section includes hollow metal doors (HMD), insulated metal doors (IMD) and pressed steel frames (PSF).

1.4 Coordination

- 1. The Guidelines apply to all work completed within buildings on both the UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. Provide door and door hardware schedules for review by UBC Access and Security and Locksmith Shop prior to tender and Building Permit.
- 6. Genie or manlift access requirements will need to be coordinated if only providing single exterior doors due to security reasons. Review with UBC Access and Security.

1.5 Submittals

- 1. Design phase:
 - .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
 - .2 For Construction Office projects only, provide paint colour samples for review.
- 2. Handover – O&M submittals:
 - .1 Provide final reviewed door shop drawings and colour specifications for painted doors.
 - .2 Provide door hardware list and location.
 - .3 Provide manufacturer installation instructions and test data, for fire rated doors.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Standard and minimum door size shall be 915 mm wide x 2,134 mm high x 44 mm thick (3'-0" x 7'-0" x 1 3/4").
- .2 Maximum door height: 2,134 mm (7'-0"). A variance will need to be granted for over-height doors.
- .3 All materials should be shop fabricated and finished, with no field cutting of materials allowed.
- .4 Glazed doors must have stiles and rails. No glazed doors with only top and bottom rails or patch hardware. Stile width of glazed doors shall be 127 mm (5") x 45mm (1 3/4") minimum to accept surface-mounted panic hardware and mortise locksets.
- .5 Doors must have mid-rails if equipped with panic hardware and exit devices.
- .6 Avoid exterior double doors where security is a requirement. Exterior exit doors with panic hardware or 'pass out' locksets must be singles with in their own frames.
- .7 Provide lockable removable mullions at double doors where extra width is required such as for genie or manlift access into the interior, moving equipment and supplies, etc.
- .8 [Where](#) single entrance doors [are ganged together](#), in such instances, ensure width of doors can accommodate the passage of a genie or manlift access into the interior, moving equipment and supplies, etc.
- .9 Frames to be fully-welded. A variance will need to be granted for knock-down frames.
- .10 For security reasons from within a building, provide for EXIT alarms on certain Exit-Only doors.
- .11 Provide electrical pathways to mid hinge, strike and header of frames for future electrification of openings. Must include pull string to each pathway
- .12 Provide back boxes for electrical wire or conduits.
- .13 [Standard procedures to be followed for concealed door frames within the drywall assembly such as EzyJamb door frames are as follows:](#)
 - .1 [Concealed door frames shall not be used for exterior doors.](#)
 - .2 [As cracks develop quite often on drywall assembly over the door frames, use concealed door frames for rooms that do not require frequent usage. Since wear and tear on the drywall installation is minimized, this in turn reduces cracking.](#)
 - .3 [Door type and height should be considered when considering the use of concealed door frames. Follow manufacturer's installation requirements for jamb installation, fastening and hinge type.](#)

2.2 Performance Requirements

- .1 Doors shall be designed to have a 25-year service life.

3.0 MATERIALS

3.1 Product Selection

- .1 Interior Doors: [shall be](#) 18 gauge (1.2 mm), galv. to ZF075 wiped zinc coating, honeycomb structural core.
- .2 Exterior Doors: shall be 18 gauge ([1.2](#) mm), galv. to Z275 (G90) zinc coating, insulated polyurethane insulation core.
- .3 Interior Frames: shall be 16 gauge ([1.6](#) mm), galv. to ZF075 wiped zinc coating; galvanizing on anchors to match frames.
- .4 Exterior Frames: shall be 16 gauge (1.6 mm), galv. to Z275 (G90) zinc coating, galvanizing on anchors to match frames.
- .5 Finishes: All new doors scheduled to be painted are to be hollow metal. Finish paint coat must be applied before final hardware install.

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 08 11 00 Metal Doors and Frames
- .2 Section 08 71 00 Door Hardware
- .3 Section 09 21 16 Gypsum Board Assemblies
- .4 Divisions 26 and 28
- .5 Section 27 05 05 Communication Rooms Design Guidelines

1.2 **Related External Documents**

- 1. Latest edition of the British Columbia Building Code (BCBC), including accessibility requirements.
- 2. CAN/CSA-0132.2 Wood Doors.
- 3. CAN 3-0188.1 Particle Cores.
- 4. WDMA I.S.6A-13 - Industry Standard for Interior Architectural Stile and Rail Doors.
- 5. NFPA 80 for installation of fire-rated doors and frames.

1.3 **Description**

- 1. Work includes interior wood doors.

1.4 **Coordination**

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. This section applies to interior wood doors only. Exterior wood doors are not allowed on UBC's campuses.
- 6. Provide door and door hardware schedules for review by UBC Access and Security and Locksmith Shop at the Construction Documents phase, prior to tender and Building Permit.
- 7. If only providing single doors into learning spaces, CRP to coordinate manlift/genie lift access requirements with the Facilities Technical Review team.

1.5 **Submittals**

- 1. Design phase:
 - .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
 - .2 For Construction Office projects only, provide a list of all proposed materials for review and color samples for selection plus final approval. Submit 8"x12" top corner sample of each type of door proposed for acceptance of construction and veneer.
- 2. Handover – O&M submittals:
 - .1 Provide a list of installed door types and color samples.
 - .2 Provide final reviewed shop drawings.
 - .3 Provide manufacturer installation instructions and test data, for fire rated doors.

1.2 **Quality Control and Assurance**

- .1 Quality Assurance
 - .1 Comply with WDMA I.S.6A-13 - Industry Standard for Interior Architectural Stile and Rail Doors.
- .2 Quality Control
 - .1 CRP to ensure function and performance are clearly defined based on use.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Standard and minimum door size: 915 mm wide x 2,134 mm high x 44 mm thick (3'-0" x 7'-0" x 1 ¾").
- .2 Maximum door height: 2,134 mm (7'-0"). A variance will need to be granted for over-height doors.
- .3 All doors to be solid core.
- .4 Wood door with a mineral core are only acceptable for use where an interior fire-rated door is required.
- .5 Provide solid wood backing for all hardware installation.
- .6 Seal hinge gains, top and bottom of doors before installation.
- .7 Glazed doors shall have stile width of 127 mm (5") minimum for hardware installation.
- .8 Avoid adhesives, preservatives, hardeners, and synthesizing agents and finish coatings that contain formaldehyde and high V.O.C. content.
- .9 Where lightweight interior doors are required, fiberglass doors may be used. Doors are to have a minimum exterior wall thickness of 2 mm, and to have a structurally solid and integrated frame.

2.2 Performance Requirements

- .1 Performance duty level to be as per current edition of the North American architectural Woodwork Standards (NAAWS). Architect to ensure the appropriate duty level is specified for the intended usage.

3.0 MATERIALS

3.1 Product Selection

- .1 Endangered wood species must not be used in the manufacturing of wood doors.
Acceptable species:
 - .1 Veneer shall be Birch, Oak, or Maple.
 - .2 Trim shall be Birch, Oak or maple.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 07 00 10 Building Envelope – General Requirements
- .2 Section 07 25 00 Weather Barriers
- .3 Section 07 40 00 Cladding
- .4 Section 08 00 10 Openings – General Requirements
- .5 Section 08 44 13 Glazed Aluminum Curtain Wall
- .6 Section 08 80 00 Glazing
- .7 Divisions 26, 27 and 28
- .8 UBC LEED Implementation Guide
- .9 UBC Energy Modelling Guidelines
- .10 Owner's Project Requirements
- .11 UBC Resilience-Based Design Guide for Nonstructural Systems

1.2 Related External Documents

1. Latest edition of the British Columbia Building Code (BCBC) including accessibility requirements.
2. CAN/CSA-A440.2 "Fenestration Energy Performance"
3. CAN/CSA-A440.4 "Window and Door Installation".
4. NFRC 100 "Procedure for Determining Fenestration Product U-Factors"
5. AAMA 501 "Methods for Tests for Exterior Walls"
6. ASTM E283, "Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors."
7. ASTM E330, "Structural Performance of Exterior Windows, Curtain walls and Doors by Uniform Static Air Pressure Difference."
8. ASTM E331, "Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Differential."
9. ASTM-E1105 "Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls and Doors by Uniform or Cyclic Static Air Pressure Difference."

1.3 Description

1. Section includes exterior aluminum storefront framing systems and entrance doors.
2. Only use storefront in protected areas under overhangs or canopies or in the interior. In all other exterior locations, a curtain wall system is required.

1.4 Coordination

1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines, including:
 - .1 Building Envelope Consultant.
 - .2 Code Consultant.
 - .3 Structural Consultant
 - .4 Energy Modeler

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
 - .2 Environmental Product Declaration (EPD)
 - .3 .
- .3 Shop drawings (including all enclosure interface details) sealed and signed by a professional engineer registered in the Province of BC.
- .4 Manufacturer performance test data to confirm performance criteria.
- .5 Maintenance Data
 - .1 As-installed hardware.
 - .2 Source for replacement parts.
 - .3 Maintenance instructions
- .6 Warranties as per 1.6.3.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 All structural performance requirements of this section including anchorage and fasteners to be designed and certified by a professional engineer registered in the Province of British Columbia and Letters of Assurance.
 - .2 Costs to be included in the contract price.
- .2 Quality Control
 - .1 UBC will appoint and pay for an independent inspection agency to conduct field testing for water penetration, air leakage and pressure equalization where required.
 - .2 Initial field test at any given location shall be paid by UBC. Cost of re-testing to verify corrected work shall be paid by Contractor
 - .3 Contractor is responsible to provide test chambers and ensure adequate power and water supply.
 - .4 Water testing to ASTM E.1105 and air leakage testing at NAFS test pressure.
 - .5 When entrance system is in well protected locations, water testing is not necessary.
- .3 Warranties
 - .1 Manufacturer shall review, verify and provide written acceptance to verify compliance for installation and provide warranty as follows:
 - .2 2-year parts and labour warranty.
 - .3 5-year water penetration.
 - .4 10-year insulated glazing unit (IGU or sealed unit) warranty

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Due to extensive failures of face-sealed storefront glazing on exposed walls of many of UBC's recent projects, storefront glazing will be used for interior applications only. Self-draining curtain wall systems shall be selected for installation within exterior walls.
- .2 Environmental Separation:
 - .1 Water Tightness rating for windows to be selected based upon exposure to elements related to location on the façade and site conditions. Use the NAFS Canadian supplement. Pass test at minimum 500 Pa.
 - .2 Glazing as part of curtain-wall system to conform to NAFS, including the following ratings:
 - .1 Water Tightness: Pass minimum 500 Pa test pressure

- .2 Air Infiltration: Air infiltration/exfiltration levels to be A3 for operable products 0.5 L/sm² and fixed 0.2 L/sm² at 75Pa.
 - .2 The overall thermal transmittance of fenestration and doors shall be determined for the reference sizes listed in accordance with:
 - .1 CSAA440.2/A440.3, "Fenestration energy performance/User guide to CSA A440.2:19, Fenestration energy performance
 - .2 NFRC100, "Procedure for Determining Fenestration Product U-factors.
 - .3 The minimum overall thermal transmittance U-Factor shall be 1.9 W/m²K
 - .4 Wind Load Resistance shall meet ASTM E330
 - .5 Resistance to Forced Entry shall be F20 (windows reachable from grade).
 - .6 Hardware to include multi-point locking with centre locking handle.
- .3 System to utilize exterior rain screen deterrents, interior air seal barriers, and pressure-equalized cavities to minimize water infiltration into the internal areas of the system, while providing moisture control and drainage to the exterior.
 - .4 Structural Design:
 - .1 Curtain wall assemblies to support design loads and accommodate structural deflection, long term creep movements and drift as shown on the structural drawings without stress on glass or reduction in performance, or other detrimental effects caused by structural movement.
 - .5 Operable windows which are within 3.6 m (12') from grade to meet ASTM F 588 Grade 20 minimum for forced entry resistance.
 - .6 At exterior locations, ensure that a waterproofed sill pan membrane (or equivalent) is installed to drain to exterior, over the entire perimeter of the opening over which the framing system is to be installed.
 - .7 Fasteners
 - .1 Exposed fasteners and anchors: aluminum, 300 series stainless steel,
 - .2 Concealed fasteners and anchors: aluminum, or 300 series stainless steel.
 - .3 Concealed anchors: aluminum, or carbon steel painted after fabrication with zinc chromate or other primers not containing lead.
 - .8 Use of floor checks, pivots, concealed closers, in-floor power operators and/or concealed exit devices is not permitted.
 - .9 Install overhead stops, wall stops, or floor stops where required to prevent damage from door contacting wall, another door, and provide controlled swing/stop.

2.2 Performance Requirements

- .1 Life Expectancy: 25-Year for exterior installations, 25-Year for interior installations.
- .2 For security reasons from within a building, EXIT alarms may be required on certain Exit-Only doors.

3.0 MATERIALS

3.1 Product Selection

- .1 Preferred Systems:
 - .1 Framing shall be Kawneer 1600UT curtain wall or Kawneer AA 6400 -refer to sections 08 44 13 and 08 50 00
 - .2 Kawneer 451 storefront section approved equivalent is acceptable when not used for environmental separation of the building envelope.
 - .3 Doors: Kawneer 350T/ 500T Insulpour medium/ wide stile (or equivalent), maximum height 2,134 mm (7'-0"), maximum width 1,220 mm (4'-0").

3.2 Finishes

- .1 Finishing products:
 - .1 Light and Neutral Colours: Thermosetting fluropolymer two coat meeting the requirements of AAMA 2604.
 - .2 Dark Exterior colours: Thermosetting enamel coating or thermosetting fluoropolymer two coat meeting the requirements of AAMA 2605.
 - .3 Clear anodized coating to conform to AAMA Class II.
 - .4 Champagne, bronze or black coloured anodized coating to conform to AAMA Class I.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 07 00 10 Building Envelope – General Requirements
- .2 Section 07 25 00 Weather Barriers
- .3 Section 07 40 00 Cladding
- .4 Section 08 00 10 Openings – General Requirements
- .5 Section 084433 Sloped Curtain Wall Glazing
- .6 Section 08 80 00 Glazing
- .7 Division 28 for Access and Security requirements
- .8 UBC LEED Implementation Guide
- .9 UBC Energy Modelling Guidelines
- .10 Owner's Project Requirements
- .11 UBC Resilience-Based Design Guide for Nonstructural Systems

1.2 Related External Documents

1. Latest edition of the British Columbia Building Code (BCBC) including accessibility requirements.
2. CAN/CSA-A440.2 "Fenestration Energy Performance"
3. CAN/CSA-A440.4 "Window and Door Installation".
4. AAMA/ WDMA/ CSA 101/ I.S.2/ A440-17.
5. NFRC 100 "Procedure for Determining Fenestration Product U-Factors"
6. AAMA 501 "Methods for Tests for Exterior Walls"
7. ASTM E283, "Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors."
8. ASTM E330, "Structural Performance of Exterior Windows, Curtain walls and Doors by Uniform Static Air Pressure Difference."
9. ASTM E331, "Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Differential."
10. ASTM-E1105 "Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls and Doors by Uniform or Cyclic Static Air Pressure Difference."

1.3 Description

1. Work includes exterior aluminum curtain wall framing system complete with doors and windows within the system.

1.4 Coordination

1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines, including:
 1. Building Envelope Consultant.
 2. Code Consultant.
 3. Structural Consultant
 4. Energy Modeler

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures

- .2 O&M Submittals
 - 1. Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
 - 2. Environmental Product Declaration (EPD)
- .3 Shop drawings (*including all enclosure interface details*) sealed and signed by a professional Engineer registered in the Province of British Columbia.
- .4 Manufacturer performance test data to confirm performance criteria.
- .5 Maintenance Data
 - 1. As-installed hardware.
 - 2. Source for replacement parts.
 - 3. Maintenance instructions
- .6 Warranty information as per 1.6.5.

1.6 Quality Control and Assurance

- .1 Installer Qualifications: Installer must have successfully installed the same or similar systems required for the project and other projects of similar size and scope.
- .2 Quality Assurance
 - .1 All structural performance requirements of this section including anchorage and fasteners to be designed and certified by a professional engineer registered in the Province of British Columbia and to provide a Letter of Assurance. Costs to be included in the contract price.
 - .2 Laboratory testing: Curtain wall manufacturer to provide as a minimum a certified copy of test report verifying compliance with the project specifications.
- .3 Quality Control
 - .1 UBC will appoint and pay for an independent inspection agency to conduct field testing for water penetration.
 - .2 Initial field test at any given location shall be paid by UBC. Number of test locations to be confirmed by the project design team and UBC. Cost of re-testing to verify corrected work shall be paid by Contractor.
 - .3 Contractor is responsible to provide test chambers and ensure adequate power and water supply.
 - .4 Water testing to ASTM E.1105.
- .4 Mock-up test procedures
 - .1 On major new projects and renewals utilizing a customized curtain wall system curtain wall subcontractor is required to arrange for a representative performance mock-up (PMU) to be tested in an accredited lab. Test procedures to include the following:
 - .1 Preload, static pressure air infiltration, static pressure water infiltration, dynamic pressure water infiltration, structural service loads, inter-story drift test, inter-story vertical movement, condensation Resistance / thermal cycling, structural ultimate loads.
- .5 Warranties
 - .1 Manufacturer shall review, verify and provide written acceptance to verify compliance for installation and provide warranty as follows:
 - .2 2-year parts and labour warranty.
 - .3 5-year water penetration.
 - .4 10-year sealed unit warranty

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements – Vertical Curtain Wall System

- .1 Requirements are applicable to exterior aluminum curtain wall type framing system including doors and windows within the system.
- .2 Self-draining curtain wall systems be selected for installation on exposed walls with no overhangs. Particular attention should be given to the storm-facing east and south-facing walls.

- .3 In addition to any other applicable codes, standards and project requirements, exterior systems to meet or exceed the following minimum requirements:
 - .1 Environmental Separation
 - .1 Rating for windows to be selected based upon exposure to elements related to location on the façade and site conditions. Use the CSA A440 S1 Canadian supplement to AAMA/WDMA/CSA 101/I.S.2/ A440. Pass test at minimum 500 Pa.
 - .2 Glazing as part of curtain-wall system to conform to the following ratings:
 - .1 Water Tightness: Pass minimum 500 Pa test pressure
 - .2 Air Infiltration: Air infiltration/exfiltration levels to be A3 for operable products 0.5 L/sm² and fixed 0.2 L/sm² at 75Pa.
 - .2 The overall thermal transmittance of fenestration and doors shall be determined for the reference sizes listed in accordance with:
 - .1 CSAA440.2/A440.3, "Fenestration energy performance/User guide to CSA A440.2:19, Fenestration energy performance
 - .2 NFRC100, "Procedure for Determining Fenestration Product U-factors.
 - .3 The minimum overall thermal transmittance U-Factor shall be 1.9 W/m²K
 - .4 Wind Load Resistance shall meet ASTM E330.
 - .5 Resistance to Forced Entry shall be F20 (windows reachable from grade).
 - .6 Hardware to include multi-point locking with centre locking handle
 - .2 Engineering Design
 - .2 Wind Loads: Assemblies shall be reinforced where required, capable of withstanding local positive and negative wind pressures.
 - .3 Minimum 25 psf (1.2 kPa) inward and 25 psf (1.2 kPa) outward acting normal to the plane of the wall.
 - .4 Based on CAN3-S157 and allowable deflection of 1/175.
 - .3 Systems to utilize exterior rain screen deterrents, interior air seal barriers, and pressure-equalized cavities to minimize water infiltration into the internal areas of the system, while providing moisture control and drainage to the exterior.
 - .4 Curtain wall assemblies to support design loads and accommodate structural deflection, long term creep movements and drift as shown on the structural drawings without stress on glass or reduction in performance, or other detrimental effects caused by structural movement.
 - .5 Operable windows which are within 3.6 m (12') from grade to meet ASTM F 588 Grade 20 minimum for forced entry resistance.
 - .6 Fasteners:
 - .2 Exposed fasteners and anchors: aluminum, 300 series stainless steel, or nickel-plated brass.
 - .3 Concealed fasteners and anchors: aluminum, cadmium plated steel, zinc plated steel, or stainless steel.
 - .4 Concealed anchors: aluminum, or carbon steel painted after fabrication with zinc chromate or other primers not containing lead.
 - .7 At exterior locations, ensure that a peel and stick air barrier membrane (or equivalent) is installed to drain to exterior, over the entire perimeter of the opening over which the framing system is to be installed.
 - .8 Window actuator systems shall not be tied to the fire alarm system as per TG section 28 31 00.

2.2 Performance Requirements

- .1 Service Life Expectancy: 25-years.
- .2 For security reasons from within a building, EXIT alarms may be required on certain Exit-Only doors.

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 Components
 - .1 Kawneer 1600 UT
Or equivalent as approved by consultant. Provide a variance request for review and approval if proposing an equivalent. The variance request should note all design and performance evaluations made.
- .2 Door
 - .1 Refer to Section 08 41 13 Aluminum-Framed Entrance and Storefronts.
- .3 Operable Vents
 - .1 Kawneer Glassvent UT
Or equivalent as approved by consultant. Provide a variance request for review and approval if proposing an equivalent. The variance request should note all design and performance evaluations made.
- .4 Finishes
 - .1 Finishing products:
 - .2 Light and Neutral Colours: Thermosetting fluoropolymer two coat meeting the requirements of AAMA 2604.
 - .3 Dark Exterior Colours: Thermosetting enamel coating or thermosetting fluoropolymer two coat meeting the requirements of AAMA 2605.
 - .4 Clear anodized coating, AAMA Class II.
 - .5 Champagne, bronze or black coloured anodized coating to conform to AAMA Class I

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 07 00 10 Building Envelope – General Requirements
- .2 Section 07 25 00 Weather Barriers
- .3 Section 07 40 00 Cladding
- .4 Section 08 00 10 Openings – General Requirements
- .5 Section 084413 Aluminum Curtain Wall
- .6 Section 08 80 00 Glazing
- .7 Division 28 for Access and Security requirements
- .8 UBC LEED Implementation Guide
- .9 UBC Energy Modelling Guidelines
- .10 Owner's Project Requirements
- .11 UBC Resilience-Based Design Guide for Nonstructural Systems

1.2 Related External Documents

- 1. Latest edition of the British Columbia Building Code (BCBC) including accessibility requirements.
- 2. CAN/CSA-A440.2 "Fenestration Energy Performance"
- 3. CAN/CSA-A440.4 "Window and Door Installation".AAMA/ WDMA/ CSA 101/ I.S.2/ A440-17
- 4. CAN/CGSB-12.20 "Structural Design of Glass for Buildings."
- 5. NFRC 100 "Procedure for Determining Fenestration Product U-Factors"
- 6. AAMA 501.2 Quality Assurance and Water Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems
- 7. "ASTM E283, "Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors."
- 8. ASTM E330, "Structural Performance of Exterior Windows, Curtain walls and Doors by Uniform Static Air Pressure Difference."
- 9. ASTM E331, "Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Differential."
- 10. ASTM-E1105 "Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls and Doors by Uniform or Cyclic Static Air Pressure Difference."

1.3 Description

- .1 Section includes aluminum-framed glazed skylights.

1.4 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Transition Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines, including:
 - 1. Building Envelope Consultant.
 - 2. Code Consultant.
 - 3. Structural Consultant
 - 4. Energy Modeler

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures

- .2 O&M Submittals
 - 1. Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
 - 2. Environmental Product Declaration (EPD)
- .3 Shop drawings (including all enclosure interface details) sealed and signed by a professional Engineer.
- .4 Manufacturer performance test data to confirm performance criteria.
- .5 Maintenance Data
 - 1. As-installed hardware.
 - 2. Source for replacement parts.
 - 3. Maintenance instructions

1.6 Quality Control and Assurance

- .1 Installer Qualifications: Installer must have successfully installed the same or similar systems required for the project and other projects of similar size and scope.
- .2 Quality Assurance
 - .1 All structural performance requirements of this section including anchorage and fasteners to be designed and certified by a professional engineer registered in the Province of British Columbia and to provide a Letter of Assurance. Costs to be included in the contract price.
 - .2 Laboratory testing: Curtain wall manufacturer to provide as a minimum a certified copy of test report verifying compliance with the project specifications.
- .3 Quality Control
 - .1 UBC will appoint and pay for an independent inspection agency to conduct field testing for water penetration.
 - .2 Initial field test at any given location shall be paid by UBC. Number of test locations to be confirmed by the project design team and UBC. Cost of re-testing to verify corrected work shall be paid by Contractor.
 - .3 Contractor is responsible to ensure adequate power and water supply .
 - .4 Water testing to AAMA 501.2. Field water tests of Sloped Glazing Systems.
 - .5
- .4 Mock-up test procedures
 - .1 On major new projects and renewals utilizing a customized sloped glazing system, curtain wall subcontractor is required to arrange for a representative performance mock-up (PMU) to be tested in an accredited lab. Test procedures to include the following:
 - .2 Preload, static pressure air infiltration, static pressure water infiltration, dynamic pressure water infiltration, structural service loads, condensation Resistance / thermal cycling, structural ultimate loads.
- .5 Warranties
 - .1 Manufacturer shall review, verify and provide written acceptance to verify compliance for installation and provide warranty as follows:
 - .2 2-year parts and labour warranty.
 - .3 5-year water penetration.
 - .4 10-year sealed unit warranty

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements – Sloped Curtain Wall Glazing System

- .1 The aluminum framed curtain wall skylight shall be stick-built, exterior glazed two-sided pressure cap system.
- .2 Use SSG system with no pressure cap on purlins to reduce trapped water.
- .3 Minimum slope 20 degrees, maximum slope 45 degrees.
- .4 Refer to Section 08 80 00 Glazing for skylight glazing design and performance requirements.

- .5 Provide rainscreen extrusions designed to control water that penetrates past the exterior glazing seal. All functions, overlaps and joints must allow water to flow freely. All materials are to be installed in a shingled fashion without water ponding over any sealed joints.
- .6 Provide an effective air barrier at the shoulder of the system.
- .7 Provide continuous air barrier around the perimeter of the frame.
- .8 Provide drainage of curtain wall skylight to the exterior or the exterior wall rainscreen.
- .9 Any moisture in the curtain wall skylight is to be wept to the exterior without compromising the air barrier of the system.
- .10 T-bar skylight – not allowed over occupied space requiring environmental separation, however can be used as an exterior canopy system.
- .11 At exterior locations, ensure that a peel and stick air barrier membrane (or equivalent) is installed to drain to exterior, over the entire perimeter of the opening over which the framing system is to be installed.
- .12 Environmental Separation
 - .1 Glazing as part of curtain-wall system to conform to NAFS, including the following ratings:
 - .1 Water Tightness: Pass minimum 700 Pa test pressure
 - .2 Air Infiltration: Air infiltration/exfiltration levels to be A3 for operable products 0.5 L/sm² and fixed 0.2 L/sm² at 75Pa.
 - .2 The overall thermal transmittance of fenestration and doors shall be determined for the reference sizes listed in accordance with:
 - .1 CSAA440.2/A440.3, "Fenestration energy performance/User guide to CSA A440.2:19, Fenestration energy performance
 - .2 NFRC100, "Procedure for Determining Fenestration Product U-factors.
 - .3 The minimum overall thermal transmittance U-Factor shall be 1.9 W/m²K
 - .3 Wind Load Resistance shall meet ASTM E330
- .13 Structural Design
 - .1 Curtain wall assemblies to support design loads and accommodate structural deflection, long term creep movements and drift as shown on the structural drawings without stress on glass or reduction in performance, or other detrimental effects caused by structural movement.
 - .2 Wind Loads: Assemblies shall be reinforced where required, capable of withstanding local positive and negative wind pressures.
 - .1 Minimum 40 psf (1.9 kPa) inward and 40 psf (1.9 kPa) outward acting normal to the plane of the wall.
 - .2 Based on CAN3-S157 and allowable deflection of 1/175.
- .14 Fasteners:
 - .1 Exposed fasteners and anchors: aluminum, 300 series stainless steel
 - .2 Concealed fasteners and anchors: aluminum, stainless steel.
 - .3 Concealed anchors: aluminum, or carbon steel painted after fabrication with zinc chromate or other primers not containing lead.

2.2 Performance Requirements

- .1 Service Life Expectancy: 25+/-years

3.0 MATERIALS

3.1 Product Selection

- .1 Pressure Plate Skylight System
 - .1 Kawneer 2000 Skylight
 - .2 Columbia Glazing Systems - SPM Series
Or equivalent as approved by consultant. Provide a variance request for review and approval if proposing an equivalent. The variance request should note all design and performance evaluations made.

- .2 Finishes
 - .1 Light and Neutral Colours: Thermosetting fluoropolymer two coat meeting the requirements of AAMA 2604.
 - .2 Dark Exterior Colours: Thermosetting enamel coating or thermosetting fluoropolymer two coat meeting the requirements of AAMA 2605.
 - .3 Clear anodized coating, AAMA Class II.
 - .4 Champagne, bronze or black coloured anodized coating to conform to AAMA Class I.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 Section 07 00 10 Building Envelope – General Requirements
- .2 Section 07 25 00 Weather Barriers
- .3 Section 0740 00 Cladding
- .4 Section 08 00 10 Openings – General Requirements
- .5 Section 08 80 00 Glazing
- .6 UBC LEED Implementation Guide
- .7 UBC Energy Modelling Guidelines
- .8 Owner's Project Requirements
- .9 UBC Resilience-Based Design Guide for Nonstructural Systems

1.2 **Related External Documents**

- 1. Latest edition of the British Columbia Building Code (BCBC) including accessibility requirements.
- 2. AAMA/WDMA/CSA 101/I.S.2/A440-17, NAFS—North American Fenestration Standard/Specification for windows, doors and skylights (NAFS-08).
- 3. CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-17, NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights.

1.3 **Description**

- 1. Section includes exterior aluminum and fibreglass fixed and operable windows.

1.4 **Coordination**

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines, including:
 - .1 Building Envelope Consultant.
 - .2 Electrical Consultant.
 - .3 UBC IT Services, including security requirements.
 - .4 Energy Modeler.

1.5 **Submittals**

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
 - .2 Environmental Product Declaration (EPD)
- .3 Shop drawings (*including all enclosure interface details*) sealed and signed by a professional engineer registered in the Province of British Columbia
- .4 Manufacturer performance test data to confirm performance criteria.
- .5 Maintenance Data
 - .1 As-installed hardware.
 - .2 Source for replacement parts.
 - .3 Maintenance instructions

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 All structural performance requirements of this section including anchorage and fasteners to be designed and certified by a professional engineer registered in the province of British Columbia and to submit a Letter of Assurance. Costs to be included in the contract price.
- .2 Quality Control
 - .1 UBC will appoint and pay for an independent inspection agency to conduct field testing for water penetration, air leakage and pressure equalization where required.
 - .2 Initial field test at any given location shall be paid by UBC. Cost of re-testing to verify corrected work shall be paid by Contractor.
 - .3 Contractor is responsible to provide test chambers and ensure adequate power and water supply.
 - .4 Water testing to ASTM E.1105 and air leakage testing at NAFS test pressure.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Requirements are applicable to exterior aluminum and fiberglass fixed and operable window framing systems. Window systems to incorporate a thermal break.
- .2 In addition to any other applicable codes, standards and project requirements, exterior systems to meet or exceed the following minimum requirements:
- .3 Before installation ensure that a waterproofed sill pan membrane (or equivalent) is installed to drain to exterior, over the entire perimeter of the opening over which the framing system is to be installed.
- .4 Structural Design
 - .1 Curtain wall assemblies to support design loads and accommodate structural deflection, long term creep movements and drift as shown on the structural drawings without stress on glass or reduction in performance, or other detrimental effects caused by structural movement.
- .5 Fasteners
 - .1 Exposed fasteners and anchors: aluminum, 300 series stainless steel, or nickel-plated brass.
 - .2 Concealed fasteners and anchors: aluminum, cadmium plated steel, zinc plated steel, or stainless steel.
 - .3 Concealed anchors: aluminum, or carbon steel painted after fabrication with zinc chromate or other primers not containing lead.
- .6 Window actuator systems shall not be tied to the fire alarm system as per TG section 28 31 00.

2.2 Performance Requirements

- .1 Products shall conform to Performance Class CW PG40 on the basis of prior testing..
- .2 Required Water Penetration Test Pressure to be determined using CSA A440S1 methods and rounded up to nearest NAFS water penetration resistance test pressure and specified in Pascals separately from Performance Grade. Pass at minimum 390 Pa test pressure.
- .3 Air infiltration/exfiltration levels to be A3 for operable products 0.5 L/sm² and fixed 0.2 L/sm² at 75Pa.
- .4 The overall thermal transmittance of fenestration and doors shall be determined for the reference sizes listed in accordance with:
 - .1 CSAA440.2/A440.3, "Fenestration energy performance/User guide to CSA A440.2:19, Fenestration energy performance

- .2 NFRC100, "Procedure for Determining Fenestration Product U-factors.
- .3 The minimum overall thermal transmittance U-Factor shall be 1.9 W/m²K.
- .5 Windows reachable from grade to have a forced entry resistance of ASTM F 588 Grade 20. This is greater than the minimum NAFS requirement of Grade 10.
- .6 Windows in laboratory spaces to be openable only with a controlled tool, for use only in the event of mechanical system shut-down/failure.
- .7 Design Service Life Expectancy: 50-year for exterior, 25-year for interiors

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 Kawneer "AA 6400" or equivalent for aluminum window systems.
- .2 Cascadia Universal Series or equivalent for fiberglass windows.
- .3 Provide a variance request for review and approval if proposing an equivalent. The variance request should note all design and performance evaluations made.
- .4 PVC or vinyl-framed window systems are not acceptable for the academic and core components of mixed-use buildings.

3.2 **Finishes**

- .1 Finishing products (aluminum):
 - .1 Light and neutral Colours: Thermosetting enamel coating or thermosetting fluoropolymer two coat meeting the requirements of AAMA 2604.
 - .2 Dark Exterior Colours: Thermosetting enamel coating or thermosetting fluoropolymer two coat meeting the requirements of AAMA 2605.
 - .3 Clear anodized coating, AAMA Class II.
- .2 Finishing products (fibreglass):
 - .1 Fibreglass window finishes to meet AAMA 625 - Performance Requirements and Test Procedures for Superior Performance Organic Coatings on Fiber Reinforced Thermoset Profiles.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 08 00 10 Openings – General Requirements
- .2 Section 08 11 00 Metal Doors and Frames
- .3 Section 08 14 00 Wood Doors
- .4 Section 08 41 13 Aluminum Framed Entrances and Storefronts
- .5 Section 08 44 13 Glazed Aluminum Curtain Walls
- .6 Section 10 20 00 Interior Specialties
- .7 Division 26
- .8 Section 28 05 00 Electronic Security Systems: General Standards
- .9 Section 28 13 00 Access Control

1.2 Related External Documents

- 1. Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).
- 2. American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA).

1.3 Description

- 1. Section includes door hardware including electrified hardware.

1.4 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. In addition to coordination with the electrical consultant, the CRP is to coordinate door hardware (including electrified hardware) requirements with the following:
 - .1 Architectural Hardware Consultant (AHC)
 - .2 UBC Information Technology (UBC IT)
 - .3 UBC Access Services & Locksmith Shop
 - .4 UBC Technical Review Team Electrical Engineer

1.5 Submittals

- .1 Submittals – Design phase
 - .1 Provide the door and door hardware schedule for keying and hardware review and approval by UBC Access Services (including the Locksmith Shop).
 - .2 A separate and detailed Keying Schedule to be submitted which indicates each lock/core, hardware heading and door number—allow sufficient type line spacing to allow UBC to insert keying information after each lock or cylinder.
 - .3 A review package complete with a detailed Sequence of Operation for the electrified hardware, riser diagram, point to point wiring schematic and plan depicting the layout is to be provided by the AHC for acceptance by UBC Access Services, Locksmith Shop, UBC Technical Review Team Electrical Engineer prior to finalizing the hardware schedule. This package shall include functions of the Access Control system, any fire alarm activated hardware, accessibility functions, tie-ins to the ventilation system etc.
 - .4 Flag for review any specialty hardware required by the project.
 - .5 Door numbering for the hardware schedules must be coordinated with the final design drawings to ensure that the final door hardware schedules match the architectural room and door numbering system. The coordination must be made early in the design

process to ensure that UBC can program internal documentation for keys, access control, etc. that will match the record drawings.

- .2 Submittals Review – Construction phase
 - .1 Submit shop drawings and hardware schedule to UBC Access Services and Locksmith Shop for review.
 - .2 Sequence of Operation is to be submitted for review by UBC Access Services and Locksmith Shop.
 - .3 Requests for product substitutions must be made to the UBC Project Manager prior to closing of the tender submission for review by the AHC and UBC Access Services.
 - .4 UBC Project Manager to facilitate and ensure final keyway selection and detailed keying is determined between the user group, Locksmith Shop and Abloy Canada Ltd.
 - .5 Permanent lock cylinders shall be keyed according to UBC requirements.
- .3 Submittals Review – Occupancy and Handover phases.
 - .1 Provide formal and proper training to UBC Access Services and Locksmith Shop staff for the new equipment provided which should include: sequence of operation, troubleshooting, maintenance manual review, preventative maintenance requirements, and critical parts list.
 - .2 A testing and commissioning schedule is required for all electrified hardware.
 - .3 Provide a commissioning certificate for the purpose of identifying the start of the warranty period.
 - .4 Provide details of the manufacturer's extended warranties for UBC's Access Services team review.
 - .5 As-built and record drawings are required including the door hardware system wiring diagram, shop drawings or cut sheets of the electrified door hardware components, equipment and sensors, supplier and installer contact information, and warranty information for the installer and extended manufacturer warranties. This should be a dedicated section in the architectural section of the Operations & Maintenance Manual required at the time of building handover to UBC Facilities.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 AHC to prepare detailed schedule of hardware and review for field compliance.
 - .2 A hardware schedule to be prepared and hardware procured from a source of supply approved by the Consultant. Supplier to be a British Columbia distributor who is authorized by the manufacturer of the equipment. Supplier to employ one or more Architectural Hardware Consultants (AHC) who are in good standing with the Door and Hardware Institute (DHI) — the AHC must be responsible for the complete hardware subcontracts.

1.7 Warranty Requirements

- .1 Manufacturers' warranties shall be from the date of Substantial Completion.
- .2 The following minimum warranty periods are required:
 - .1 Installation labour warranty: **1.5** years from Substantial Completion to allow time for building occupant fit out, and occupant general use to identify defects. Hardware defects usually become visible after 12 months of operation.
 - .2 Door closers: 10 years.
 - .3 Exit Devices: 5 years.
 - .4 Mortise Locksets: 10 years.
 - .5 Cylindrical Locksets: 7 years.
 - .6 Power door operators: 2 years on electronics, 5 years on mechanical components.
 - .7 Electrified Locksets: 2 years on electronics, 5 years on mechanical components.
 - .8 Other electrified hardware components: 3 years.
 - .9 Other mechanical hardware: 5 years

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Buildings are to be designed with card access in general accordance with Sections 28 05 00 and 28 13 00. The design team must employ an Architectural Hardware Consultant (AHC) with a minimum of five (5) years of experience in the design of electrified hardware systems solutions.
- .2 Access systems and hardware must be scalable for future changes and additions. Provide a design solution which meets the project requirements and has the ability to meet the long-term requirements in accordance with Sections 28 05 00 and 28 13 00.
- .3 Provide submittals for review at various project phases noted in paragraph 1.6 of this section.
- .4 Exterior doors are subject to very high usage, inclement weather, wind driven rain, ice buildup, building air pressure, temperature fluctuations, and wind forces. The CRP must ensure that all exterior door hardware is selected to accommodate these variable conditions and be corrosion resistant. For aluminum framed entrances and curtain wall systems that incorporate doors, the CRP is to coordinate with suppliers of these systems to ensure that the factory supplied door hardware is appropriate.
- .5 Door pivots are not acceptable.
- .6 Avoid offset pulls due to maintenance problems resulting from torsion forces. If unavoidable, offset pulls must be through bolted.
- .7 Keyed cylinder dogging is required on all panic devices unless prohibited by code.
- .8 Keyed entry cylinders required on all doors equipped with card readers.
- .9 Each building requires a key and card tube deposit. (See 3. Materials below).
- .10 Spring loaded hinges are not to be used.
- .11 Kick plates are to be installed on all high traffic or high usage doors and service doors. . Coordinate with Section 10 20 00 Interior Specialties, item 5.0.
- .12 Where door closers are required by code, surface mounted door closers shall be used.
- .13 Where magnetic hold opens are used, surface-mounted hold-opens are to be used.

2.2 Electrified Hardware

- .1 Electrified hardware is an evolving technology which requires close coordination with Divisions 26 and 28. Please review Divisions 26 and 28 for further specifics regarding their respective components relating to electronic access equipment and standards.
- .2 Division 28 includes diagrams showing "typical door installations", the associated equipment, and a responsibility matrix indicating who is responsible for the various components of the installation. The CRP must ensure that the tender documents clearly identify the contractor's scope of work, and what work will be performed by UBC Access Services.
- .3 The AHC is to coordinate with UBC Access Services to identify pathway installation requirements for their equipment installation.
- .4 Standard Pressed Steel & Aluminum Frames: Through hole for Door Contact (DC) shall be 25mm (1") diameter and 38mm (1 ½") minimum depth. Through hole for Power Transfer Hinge (PTH) shall be 13mm (1/2") in diameter and 38mm (1 ½") minimum depth. Both DC and PTH holes shall allow for concealed, non-abrasive pathways clear of frame fill materials from said device to Div 26 pathways.
- .5 Standard Metal, Aluminum & Wood Doors: Top of door shall be prepped as such to allow for UBC Access Services installation of 25 mm (1") wide by 38mm (1 ½") deep magnet assembly without affecting door rating. Pathway (wire chase) within the door for Electrified Hardware shall be 13mm (1/2") cored hole and shall allow for concealed, non-abrasive pathway clear of door fill material, from the PTH to the electrified lockset device, without affecting the door rating. Wire chase shall allow for free and easy removal and reinstallation of cable without affecting door structure.

2.3 Performance Requirements/Standards

- .1 CSA for Heavy Duty.
- .2 All hardware to be Grade 1.

3.0 MATERIALS

3.1 Product Selection

- .1 Materials
 - .1 Lock Cylinders
 - .1 Abloy of Canada Cylinders – no substitutions allowed.
 - .2 Hinges
 - .1 Stanley/ Monthard/ Hager/ McKinney.
 - .3 Pivots – (Only if needed as this is not UBC preferred hardware).
 - .1 Dorma.
 - .2 Yale - Corbin (Rixson).
 - .4 Door Stops, Swing Stops, and Holders
 - .1 Rixson/ Dorma/ Hagar/ Gallery/ Ives/ Glynn – Johnson/ Rockwood.
 - .2 Install overhead stops, wall stops, or floor stops where required to prevent damage from door contacting a wall or another door; and provide controlled swing/stop.
 - .5 Flush Bolts
 - .1 Trimco/ Ives/ Glynn-Johnson/ Gallery/ Rockwood.
 - .2 Automatic flush bolts are not to be used due to maintenance problems.
 - .6 Mortise Locks and Trim
 - .1 Corbin ML2000 series with LWA lever.
 - .2 Schlage L9000 series with 03B lever.
 - .3 Sargent 8200 series with LNJ lever.
 - .7 Cylindrical Locks
 - .1 Corbin CL3300 series
 - .2 Schlage ND series with Vandlguard
 - .3 Sargent 10 line
 - .4 LSDA-800 series Grade 2 levers.
 - .8 Push Button Code Locks
 - .1 Schlage CO 100 x less cylinder x KP x 626
 - .2 Sargent KP Series
 - .9 Alarm Locks
 - .1 Stand-alone systems: Detex EAX500 or Alarm Lock Pilfergard PG21
 - .2 Panic Bar Style (must re-latch): Sargent, Von Duprin, Corbin, Alarm Lock, Detex
 - .10 Dead Bolt Locks
 - .1 Mortise: Corbin DL4000 series, Sargent 4800 series, Schlage L600 series.
 - .2 Cylindrical: ILCO 4514.25.1.04.04.5
 - .11 Magnetic Locks
 - .1 Magnetic locks are not acceptable and should only be used when required by code.
 - .2 Securitron M Series (if required)
 - .12 Exit Devices
 - .1 Von Duprin 98XP and 99XP series, and 33A series.
 - .2 Sargent 8000 series.
 - .3 Corbin ED5000 series
 - .13 Door Closers
 - .1 LCN 4040XP Series x 689 finish.
 - .2 Sargent 351
 - .3 Corbin 6200 / Norton 7700

- .4 Floor closers are "not" acceptable at UBC.
- .14 Power Operators and Electrified Closers
 - .1 LCN 4630/4640 Series - "Auto Equalizer" x 689 finish.
 - .2 Record-8100 Series and Record-Simple Swing units.
 - .3 No substitutions allowed.
- .15 Automatic Door Opener Push Plates
 - .1 Camden or BEA.
 - .2 36" tall vertical actuation bar, high and low push plate.
 - .3 Hardwired with 'push to open' text.
- .16 Push Plates, Pulls and Protective Plates
 - .1 Trimco/CBH/Gallery.
- .17 Thresholds and Weather-Stripping
 - .1 Pemko/Crowder/Zero.
- .18 Station Controls and Key Switches
 - .1 Von Duprin/ LCN/ RCI/ Securitron
 - .2 Camden CM-1030-7224 SPDT with red & green LED
- .19 Power Supplies,
 - .1 Use power supplies to match manufacturers' equipment when required.
 - .2 Power supplies require battery backup.
 - .3 Locknetic / Folger-Adams, Securitron, Von Duprin, Yale / Corbin
- .20 Electrified Strikes
 - .1 HES/ RCI/ Adams Rite
- .21 Transfer Hinges –12 wire standard
 - .1 McKinney with electro lynx, Stanley, Hager
- .22 Hard Wired Electrified Locksets
 - .1 Manufacturers: Schlage, Corbin, Sargent [Manufacturers are currently under review]
 - .2 Integral magnetic position indicator.
 - .3 Handle integrated request to exit function
 - .4 Integrated card / FOB reader (I-Class compatible)
- .23 Wireless Electrified Locksets
 - .1 [Manufacturers are currently under review]
 - .2 Non-proprietary battery supply only
 - .3 Minimum 50,000 cycles per battery supply
 - .4 Hard-wired power source option preferred
 - .5 Dedicated Wireless network hardware or encrypted Wi-Fi
- .24 Electrified Exit Devices
 - .1 Corbin/ Sargent / Von Duprin (QEL series)
 - .2 Electrified dogging required unless prohibited by code.
- .25 Electrified Hold-Open Devices
 - .1 Simplex RSG series or Edwards 1500 series.
 - .2 Install hold-open devices for fire separation doors in corridors and other high use areas where occupants will likely use door stops to hold the doors open, thereby compromising the fire rating of the opening.
 - .3 Concealed hold-opens within door closers are not acceptable.
 - .4 Coordinate location of surface-mounted hold-opens with the supplier to ensure sufficient wall and floor clearances are maintained.
- .26 Electrified Lock Boxes
 - .1 ProxSafe flex key management system
- .27 Electrified Hardware Communications Equipment Infrastructure
 - .1 Supplied and installed by UBC Access and Security Services.
 - .2 Contractor to supply and install power, pathways, and cabling as indicated on the drawings.
 - .3 Open source communication protocol only.
- .28 Request to Exit Device

- .1 Supplied and installed by UBC Access and Security Services where not integrated into the lockset.
- .29 Card Strikes / FOB Readers
 - .1 Supplied and installed by UBC Access and Security Services where not integrated into the lockset.
 - .2 Contractor to supply and install pathway installation only as indicated on drawings.
 - .3 I-Class compatible
- .30 Fire Department Key and Card Tube Deposit Lockbox.
 - .1 All new buildings to have a tube-shaped Fire Department lockbox installed close to the main entrance. The lockbox lid is to be installed flush with the exterior wall surface.
 - .2 Lockboxes shall be cored into concrete, installed horizontally and epoxied into place. A free-standing externally-located square-faced concrete post can be used if there is no adequate location on the exterior wall surface.
 - .3 Construction of key-deposit housing to be steel.
 - .4 Cylinder housing to be hardened steel.
 - .5 Sleeve size to be: 180 mm long x 63 mm diameter or 7 inches long x 2.5 inches diameter.
 - .6 Manufacturer to be Abloy Key and Card Tube Deposit Lockbox – Abloy Protec.
- .2 Finish
 - .1 Brushed stainless steel.

4.0 **EXECUTION**

4.1 **Prescriptive Requirements**

- .1 Only UBC's Locksmith Shop shall install permanent cylinders to ensure precise coordination of lock cylinder locations with the User's requirements.
- .2 All locks and cylinders shall be supplied with temporary construction cylinders. The Contractor is to supply and install temporary construction cylinders complete with keys for all construction locks; until UBC's Locksmiths Shop can supply and install permanent cylinders on the UBC key system. This will ensure that equipment and furniture is secured behind a locked door at all times.
- .3 Temporary construction cylinders shall be returned to the distributor on a Construction Office project. For new projects and renovations, if the Contractor has pre-ordered and supplied keyed-alike construction cylinders, the UBC Locksmith Shop shall return construction cylinders to the Contractor at the time of the permanent cylinder installation.
- .4 The Division 08 Subcontractor is responsible for the installation of all door hardware, electrified door hardware control panels, power supplies, low voltage cables, and low voltage raceways. The Division 08 subcontractor is also responsible for all 110 volt supply raceways, wiring, and dedicated circuit breakers unless they are specifically indicated on the electrical design drawings as being done by Division 26 (example: power supply required as part of a design-build electrified door hardware system installation).
- .5 All electrified openings must have a dedicated power supply circuit, and the circuit number shall be identified on the door hardware power supply and as-built drawings.

5.0 **LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS**

Items in this section are lessons learned, and may be code or industry best practices which have been missed on past projects. If not applicable to a project, a variance is not required.

- .1 Requests for having black hardware finish will not be accepted as confirmed by the Locksmith Shop, UBC Access Services - the reason being that there have been instances where a dark brown finish (likely an oil-rubbed bronze finish) has been used on campus, and which looks really bad after only a few years of installation. The finish starts coming off after repeated use and becomes even worse for door pulls.
- .2 Our review indicates that no matter how the hardware has been finished, whether electroplated, oxidized or powder coated, the black or dark bronze colour will fade over time if not properly maintained. There are a number of long-term issues that were identified as follows:
 - .1 The black or dark bronze finish is prone to damage if not handled carefully during installation and the level of damage increases when in use.
 - .2 When it comes to replacement, lead time for the standard hardware finish is 1-2 weeks, and for the black hardware is approx. 12 weeks as this finish type is not a stock item.
 - .3 It will also show up dust more and therefore need to be cleaned regularly.
 - .4 All core buildings on campus have the same level of maintenance, so an increased level of care for the hardware would not be possible for any particular project.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 Section 07 00 10 Building Envelope – General Requirements
- .2 Section 08 00 10 Openings – General Requirements
- .3 Section 0841 13 Aluminum Entrances and Storefronts
- .4 Section 08 44 14 Glazed Aluminum Curtain Wall
- .5 Section 08 50 00 Windows
- .6 UBC Bird Friendly Design Guidelines
- .7 UBC LEED Implementation Guide
- .8 UBC Energy Modelling Guidelines
- .9 Owner's Project Requirements
- .10 UBC Resilience-Based Design Guide for Nonstructural Systems

1.2 **Related External Documents**

1. Latest edition of the British Columbia Building Code (BCBC).
2. British Columbia Energy Efficiency Act.
3. National Energy Code for Buildings (NECB).
4. ANSI/ASHRAE 90.1.
5. CAN/CGSB-12 Series Standards: glass types; performance.
6. CAN/CGSB-12.20: Structural Design for Buildings.
7. IGMAC Insulating Glass Manufacturers of Canada guidelines.
8. IGMA TM-3000-90, TB-3001 and TM-1300 guidelines.
9. Glazing Contractors' Association of British Columbia (GCABC) Manual.
10. ANSI/ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtainwalls and Doors by Uniform Static Air Pressure Difference.

1.3 **Description**

1. Section includes glass and glazing.

1.4 **Coordination**

1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines, including:
 - .1 Building Envelope Consultant.
 - .2 Code Consultant.
 - .3 Energy Modeler.

1.5 **Submittals**

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Manufacturers Safety Data sheet (MSD) for all toxic or potentially toxic materials.
 - .2 Environmental Product Declaration (EPD)
- .3 Shop drawings (including all enclosure interface details) sealed and signed by a professional Engineer registered in the Province of British Columbia.
- .4 Manufacturer performance test data to confirm performance criteria.

- .5 Maintenance Data
 - .1 As-installed hardware.
 - .2 Source for replacement parts.
 - .3 Maintenance instructions
- .6 Warranties
 - .1 10-year warranty for IGU's.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Work shall be performed by a qualified glazing contractor with minimum five (5) years experience, with adequate facilities and skilled personnel suitable for this work.
- .2 Quality Control
 - .1 Drawings indicate minimum thicknesses and other requirements such as coatings, tempering and other requirements
 - .2 Final thickness, safety glazing, heat strengthening, and other performance requirements to meet codes and standards, Owner's Project Requirements, and required structural performance are the responsibility of the Contractor based on location and intended use.
 - .3 Structural performance requirements of exterior glazing, as well as exterior and interior structural glazing including anchorage and fasteners, to be designed and certified by a Professional Structural Engineer registered in the Province of British Columbia who is to also submit a Letter of Assurance.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Exterior glazing at a minimum shall be insulated sealed double-glazed units to meet as a minimum to meet fenestration overall thermal transmittance 1.9 W/m²K. Design to maximize energy performance as established by the Owners Project Requirements (OPR), including orientation and expected functional use of space where installed.
- .2 Consideration to be given to access for glass cleaning including the structural capacity of floors to support appropriate man-lifts. The use of monorail systems for interior glass cleaning is not allowed.
- .3 For design of interior full-height glazing with butt-glazed joints near an interior walking surface, ensure the deflection is not thicker than the thickness of the glass. This eliminates the possibility of someone leaning against the glass panels and causing it to deflect and preventing movement of glazing panels.

2.2 Performance Requirements

- .1 The overall thermal transmittance of fenestration and doors shall be determined for the reference sizes listed in accordance with:
 - .1 CSAA440.2/A440.3, "Fenestration energy performance/User guide to CSA A440.2:19, Fenestration energy performance,"
 - .2 NFRC100, "Procedure for Determining Fenestration Product U-factors."
- .2 The overall thermal transmittance of fenestration and doors that are not within the scope of the standards listed shall be determined from:
 - .1 Calculations carried out using the procedures described in the "ASHRAE Handbook – Fundamentals," or
 - .2 laboratory tests performed in accordance with ASTM C1363, "Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus," using an indoor air temperature of 21±1°C and an outdoor air temperature of -18±1°C measured at the mid-height of the fenestration or door.
- .3 Any staining of glass or other surfaces by alkaline materials prior to installation will be cause for rejection.

- .4 Installation of glazing to conform with IGMA TM-3000-90, TB-3001 and TM-1300.

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 Locally produced materials should be used whenever possible. Consideration to be given to the local availability of replacement glass when specifying glazing.
- .2 Manufacturer of IGU, must be IGMA certified.
- .3 Glass spacer type: thermally improved as required to meet specified energy performance requirements. Non-thermally broken aluminum spacers shall not be used.
- .4 Allowable glass types with applications (no tempered glass on buildings except where required to be safety glass in doors and sidelights:
 - .1 Exterior glazing - simple building form and small units – annealed or heat strengthened glass.
 - .2 Exterior glazing - complex building, solar shading, reflective glass, large glazing units - heat strengthened glass to reduce risk of breakage due to thermal stress.
 - .3 Exterior glazing -all buildings- low-E coating on #2 surface of the insulated glazing unit (IGU). If triple-glazed units are considered for use on a project, project team to consult with the UBCV Technical Review Team Architect/UBCO Facilities Management and the C&CP Green Buildings Manager and to confirm final location of low-e coating and ceramic fritting. A variance will need to be granted if the low e-coating is in a different location from the #2 surface.
 - .4 Exterior glazing- appropriate bird friendly design includes ceramic fritting. Acid-etched glass applications would need to be reviewed at the design stage. Consult with the UBC Technical Team Architect if acid-etched glass is proposed. Film application is not acceptable since the IGU warranty is voided as per current industry standards.
 - .5 Spandrel glass - heat strengthened glass.
 - .6 Skylight, canopy and overhead glass – fully tempered, laminated (minimum PVB interlayer 1.5mm).
 - .7 Skylight glazing - glazing to be minimum double-glazed heat strengthened glass. Inboard pane to be laminated glass with a minimum PVB film thickness of 1.5 mm. Insulated glass units to have a soft coat metallic low-e coating on surface #2. Low-e coating shall have edge deletion with warm edge spacer and argon- filled.
 - .8 Guardrail glass - Heat-strengthened and laminated glass or tempered and laminated glass.
 - .9 Safety glass in doors and sidelights: fully tempered.
 - .10 Safety glass in fire rated doors and sidelights and in all applications subject to human impact: non-wired fire-rated tempered glass or intumescent glass. Fire-rated glass installations to be certified and permanently labelled by the manufacturer.
 - .11 Clearstory and atrium vertical glazing over occupied space: heat strengthened laminated glass with a minimum 1.5 mm PVB interlayer.
 - .12 Heat soak testing required to reduce nickel sulphide impurities in spandrel glass or IGUs where heat development is a concern.
- .5 Any staining of glass or other surfaces by alkaline materials is cause for rejection.

4.0 LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS

Items in this section are lessons learned, and may be code or industry best practices which have been missed on past projects. If not applicable to a project, a variance is not required.

- .1 Item 2.1.3 notes that interior full-height, butt-jointed glazing should have restricted deflection. This requirement has come about due to complaints from user groups in buildings with examples of full-height glazing installations in research labs and boardrooms. Users have complained about the movement noted in the glass and as a consequence not feeling safe when walking past such glass walls. It is not possible to address this issue during the O&M phase without removal and replacement of the glass walls. Design teams are to ensure that glazing specifications and shop drawings adequately address this issue.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Division 03 and relevant TG sections therein
- .2 Division 04 and relevant TG sections therein
- .3 Division 05 and relevant TG sections therein
- .4 Division 06 and relevant TG sections therein
- .5 Division 07 and relevant TG sections therein
- .6 Division 08 and relevant TG sections therein
- .7 Division 09 and relevant sections therein
- .8 Section 10 00 10 Special Room Requirements
- .9 Section 20 00 05 Mechanical General Requirements
- .10 Section 26 05 00 Electrical - General Requirements
- .11 Section 27 05 05 Communication Rooms Design Guidelines
- .12 Section 27 41 52 Listening Assist Systems
- .13 UBC Campus Plan Design Guidelines
- .14 [Learning Space Design Guidelines](#)
- .15 [UBC LEED Implementation Guide](#)
- .16 [UBC Resilience-Based Design Guide for Nonstructural Systems](#)

1.2 Related External Documents

- 1. Latest edition of the British Columbia Building Code (BCBC).
- 2. Latest edition of the MPI Architectural Painting Specification Manual.
- 3. Latest edition of the Tile Installation Manual by the Terrazzo Tile and Marble Association of Canada.

1.3 Description

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.

1.4 Coordination

- 1. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 2. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 3. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

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

2.1 Design Requirements – General

- .1 Acoustic Requirements:
 - .1 An Acoustical Report is required to be prepared for all core facilities.
 - .2 Acoustical Report to coordinate acoustic requirements for learning spaces as per Section 10 00 10 Special Room requirements.

- .3 Coordinate wall, floor and ceiling assemblies and finishes with the Acoustical Report for the project.
- .2 Environmental Requirements
 - .1 Always consider the use of recyclable, recycled, non-toxic, low maintenance and durable finishes.
 - .2 Wherever possible utilize water-based, low or non-volatile organic compound (VOC) type adhesives.
- .3 Electrical Requirements
 - .1 No electrical equipment shall be concealed by architectural finishes, furniture, artwork, bulletin boards or other similar items that would delay identifying their location in an emergency.
 - .2 Coordinate with 2.1.11, Section 26 51 00 Interior Building Lighting for decorative lighting requirements.

2.2 Design Requirements - Floors

- .1 Wherever possible use low toxicity and/or sustainable materials.
- .2 Linoleum flooring to be excluded from washrooms, baths, showers and labs.
- .3 Epoxy coatings to be excluded from showers, use slip-resistant tiles (non-glazed finish).
- .4 Hardwood Floors - refer to Section 09 64 00 Wood Flooring for finishing standards.
- .5 Low Maintenance (non-wax preferred) Commercial Resilient Flooring: to be used in high traffic areas such as building entrances, corridors, hallways, laboratories, classrooms, coffee areas and lunch rooms. Only slip resistant materials should be used in wet areas, especially building entrances.
- .6 Ceramic Flooring: Slip-resistant ceramic tiles are to be used in washrooms.
- .7 Carpet, (preferably carpet tile), is to be specified for enclosed administration offices, open administration areas, staff conference and meeting rooms.
- .8 Carpet, (preferably carpet tile), may be used in lounge areas where food services are not available; otherwise use linoleum flooring wherever possible.
- .9 For ease of cleaning linoleum flooring is preferred in undergraduate areas.
- .10 In large lecture theatres or other areas where fixed seating occurs, use resilient flooring for ease of maintenance. Consideration must be given to acoustic treatment – refer to the Learning Space Design Guidelines and Section 10 00 10 Special Room Requirements for appropriate material choices.
- .11 Exposed concrete in stairs and floors to have a stain resistant sealer.
- .12 Seal mechanical, electrical and other service room floors with membrane flooring per Section 09 67 00 Fluid Applied Flooring.
- .13 Laboratory Flooring: Heat welded sheet low-maintenance (no-wax) vinyl flooring to be used. Rubber flooring can be used, however the UBC project manager and design team to ensure the user group is made aware that maintenance of this flooring type will be customer-funded. Choice of flooring must reflect slip resistance required for the installation. Confirm with UBC Risk Management Services for any special requirements for laboratories using radioisotopes.

2.3 Floor Cleaning Requirements at Handover

- 1. Prior to commencing the floor care process, a detailed construction cleanup of the immediate surrounding area must be completed. This includes wiping down of all vertical and horizontal surfaces ensuring all soil and dust is removed. This will help prevent contamination of the finish when applied.
- 2. If the project is a renovation, the entire room should be emptied of all furniture and other objects. This will allow the service workers the ability to complete the floor care procedures efficiently and safely.

3. The floor surface must be vacuumed thoroughly to ensure all loose soil has been removed.
4. IMPORTANT: These floor cleaning procedures must be followed according to UBC's standards. Nothing less than this standard will be accepted or approved.

2.4 Design Requirements – Walls

- .1 For protection of the lower 3' of walls in high traffic areas, chair rails, wall bumpers and corner guards are acceptable in coordination with user group requirements.
- .2 Use cement board behind showers or bath tubs.
- .3 Common Public Spaces:
 - .1 It is recommended that interior colour selections for public space wall areas be neutral colours. This minimizes wastage and storage costs for different colours. Where wood finishes on walls require fire retardant, use only pressure-treated fire retardant, not surface-applied.

2.5 Design Requirements - Ceilings

- .1 Ceiling finishes used should be easily accessible and should be such that they can be removed and replaced by service trades and Building Operations crews without damage and without requiring other trades or crews to provide access with special equipment. It should be noted that drop-down tiles with reveal edges are weaker than standard tiles.
- .2 Equipment that requires regular servicing or maintenance (i.e. anything with filters such as fancoils) shall not be located above wood ceilings (or other integrated ceiling systems). For example - a vav box with reheat coil can be located above a wood slat ceiling provided that access panels are provided. However, fancoils, terminal heat pumps, etc. shall be located above acoustical tile ceilings or within exposed ceilings only.
- .3 Coordinate the provision of access hatches during the design phase for wood ceilings and gypsum wall board ceilings.
- .4 Concealed-spline ceilings are not acceptable.
- .5 Fire-resistant ceilings that require the use of hold down clips must not be used.

2.6 Performance Requirements – General

- .1 Seismic Restraint
 - .1 Provide seismic restraint for suspended ceiling finishes and associated light fixtures. Refer to the UBC Resilience-based Design Guide for Nonstructural Components.
 - .2 Coordinate structural attachment and seismic restraints for finishes with the specialty structural engineer. Provide signed and sealed shop drawings by a Professional Structural Engineer registered in the province of BC.

3.0 MATERIALS

- .1 Refer to individual sections in Division 7.

4.0 LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS

Items in this section are lessons learned or misses from past projects. These may also include code or industry best practices. If not applicable to a project, a variance is not required.

- .1 One major problem with wood ceilings is access for maintenance and repair due to panel size and weight. As the ceiling systems become more complicated, sometimes removing the ceiling is more work than the maintenance itself (especially if the work is just investigation/trouble shooting), especially when multiple BOps trades are required to remove the ceiling for any mechanical/electrical work above the ceiling. With approximate panel dimensions of 2' x 4' or 2' x 6', weight of these panel sizes also needs to be

- considered for easy removal. It is strongly recommended to ensure access hatches are provided for and designed into the ceiling system.
- .2 Another issue noted from past projects is the effect of temperature and humidity changes on wood wall and ceiling panels. Experience has shown that wood ceilings in particular are sensitive to temperature and humidity changes thereby leading to warping and shrinkage. This has caused serious safety issues with ceiling panels coming loose and falling. Extensive interior wood wall and ceiling finish installations should be reviewed and coordinated with the mechanical consultant.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 03 33 00 Architectural Concrete
- .2 Section 06 10 00 Rough Carpentry
- .3 Section 07 21 00 Thermal Insulation
- .4 Section 07 25 00 Weather Barriers
- .5 Section 09 00 10 Finishes – General Requirements
- .6 Section 09 22 16 Non-Structural Metal Framing
- .7 Section 09 30 00 Tiling
- .8 Section 09 90 00 Painting and Coating
- .9 [UBC Resilience-Based Design Guide for Nonstructural Systems](#)

1.2 Related External Documents

- 1. Association of Wall and Ceiling Contractors of British Columbia (AWCC) Specifications Standards Manual.
- 2. Gypsum Association publications - GA-214, latest edition for recommended levels of finish.

1.3 Description

- 1. All gypsum wallboard work including provision of related accessories.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

2.0 DESIGN & PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Gypsum board shall be with a high percentage of recycled gypsum.
- .2 Joint compound shall be low VOC.
- .3 Joint tape shall be paper, fiberglass only where recommended by the board or surface treatment manufacturer.
- .4 Use water resistant board and other specialty boards only where absolutely necessary as these products are not easily recycled.

2.2 Performance Requirements

- .1 Use finishing techniques that reduce the amount of sanding required (i.e. finishing with a wet sponge).
- .2 Heat and ventilate area when curing to quickly remove VOC's. Avoid propane heaters due to high moisture generation.

- .3 To avoid the absorption of VOC's from other material, store gypsum in a well-ventilated area and apply paint or other surface treatment as soon as possible after installation.

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 The use of exterior "gypsum board" is not permitted in any long-term installation except at protected locations. Instead, utilize reinforced cement board or gypsum sheathing with a silicone treated gypsum core bonded to inorganic fiberglass mat both sides or, where possible, use plywood.
- .2 In wet areas use reinforced cement boards or boards with a silicone treated gypsum core bonded to inorganic fiberglass mat on both sides.
- .3 Components
 - .1 Gypsum wallboard, ASTM C36 or CSA A82.27-M, standards per AWCC Manual, and as follows:
 - .1 Type shall be regular for vertical surfaces.
 - .2 Typical thickness shall be 5/8" for public areas, 1/2" elsewhere.
 - .3 Type shall be 'X' type where required for fire-resistance-rated assemblies, or 'C' where this type is noted at ULC Designs.
 - .4 Type shall be sag-resistant type for ceiling surfaces.
 - .5 Edges shall be tapered.
 - .2 Acoustical sealant for exposed joints shall be manufacturer's standard non-sag, paintable, non-staining latex sealant to ASTM C 834.
- .4 Finishes
 - .1 As per GA-214 Manual for level of gypsum wallboard finishing.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 07 21 00 Thermal Insulation
- .2 Section 09 00 10 Finishes – General Requirements
- .3 Section 09 21 16 Gypsum Board Assemblies
- .4 [UBC Resilience-Based Design Guide for Nonstructural Systems](#)

1.2 Related External Documents

- 1. AWCC / WCI (Association of Wall and Ceiling Contractors / Wall and Ceiling Institute) Specification Standards Manual 2012 (Fifth Edition).
- 2. Seismic requirements where stipulated by the latest edition of the British Columbia Building Code (BCBC).

1.3 Description

- 1. Non-structural steel stud framing.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Quality Control and Assurance

- .1 Quality Assurance
 - .1 All seismic restraint work including provision of anchoring devices is to be designed and certified by a professional structural engineer registered in the Province of BC.
- .2 Submittals
 - .1 Shop drawings in O&M manual: required for all seismically restrained engineered studwork, bracing, and suspension systems, including where such systems act as support for work requiring seismic restraints (i.e. laboratory and other cabinets, fume hoods, vending machines, etc.).

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Maximum stud spacing: 16" oc.
- .2 Provide allowance for deflection of structure minimum 1".

2.2 Performance Requirements

- .1 Life Cycle - 25-Year

3.0 MATERIALS

3.1 Product Selection

- .1 Acceptable to UBC:
 - .1 Metal channel carriers and stiffeners: thick cold rolled steel, galvanized.
 - .2 Acoustical Sealant: meeting CGSB 19-GP-21M.
 - .3 Apply a double bead of acoustic sealant 3/8" (10 mm) from each edge, to all partition tracks prior to securing.
 - .4 Minimum Metal Stud Gauge:
 - .1 0.46 mm (25 gauge) except as otherwise required.
 - .2 0.88 mm (light duty 20 gauge) at the following locations:
 - .1 Double studs on either side of door frames and header.
 - .2 Studs supporting ceramic tile finishes.
 - .3 Ceiling deflection track.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 09 00 10 Finishes – General Requirements
- .2 Section 09 21 16 Gypsum Board Assemblies
- .3 Section 09 22 16 Non-Structural Metal Framing

1.2 Related External Documents

- 1. Latest edition of the Tile Installation Manual produced by the Terrazzo Tile and Marble Association of Canada (TTMAC).

1.3 Description

- 1. Wall and floor tiling work including related accessories.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 Provide samples for colour selection only if it is a Construction Office project.
- .3 O&M Submittals
 - .1 Provide list of tile types and colours used, complete with manufacturer/distributor name for all products used.
 - .2 Environmental Product Declaration (EPD)
 - .3 Maintenance data for all tile selections.
 - .4 Warranties.
 - .5 Material Data and Safety Sheets (MSDS).
 - .6 Maintenance data including source for replacement.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Whenever possible, obtain manufacturer extended warranties (Five- Year plus), generally available for larger tiled areas when manufacturer of tile-setting materials and accessories supplies all such materials and carries out inspections of the tile work installation.
- .2 Quality Control
 - .1 Tile installation shall be in strict accordance with the written instructions and recommendations of the tile manufacturer and related product manufacturers.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Wall tile shall be glazed finish. Typical dimensions used on UBC's campuses are no larger than 300 mm x 300 mm, no smaller than 100 mm x 100 mm. Consult with the UBCV Facilities Technical Review Team Architect or UBCO Facilities Management if large-format tiles or mosaic tiles are being considered.
- .2 Floor tile shall be slip-resistant.
- .3 Epoxy grouts introduce environmental risks and their use should be limited to areas that require the extra durability and ease of maintenance that these products offer.
- .4 Due to the toxic fungicide additives in mildew resistant sealant, its use should be limited to areas of constant moisture.
- .5 Products are to use non-toxic and non-specialized cleaning materials.

2.2 Performance Requirements

- .1 All tiles used in wet areas or entry areas to be non-slip with a static coefficient of friction of .60 or higher in accordance with ASTM C1028.
- .2 Ceramic tile must conform to the standards for stain resistance, crazing and thermal shock requirements when tested in accordance with CAN2-75.1-M77.
- .3 Concrete curing compounds, form oils and sealers may prevent adhesion: ensure proper preparation for tile work.

3.0 MATERIALS

3.1 Product Selection

- .1 Wall and Floor Tile:
 - .1 Floor tile to be slip resistant, always non-glazed.
 - .2 Wall tile shall be glazed finish.
 - .3 Refer to 2.1.1 for tile dimensions preferred..
 - .4
- .2 Divider strips in tile flooring shall be at a sufficient depth, made of zinc alloy, with non-corrosive anchors. Applicable at termination of tile flooring to other flooring finish. Set divider strips at centre of doors with top surface to be flush with finished floor.
- .3 Mortar shall be latex additive for thin-set mortar and latex grouts.
- .4 Epoxy grouts are required in all shower/change rooms, high traffic, and pools areas generally - confirm with manufacturer for pool water conditions. Other grout types may be required in special installations such as in laboratories and food services areas.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 09 00 10 Finishes – General Requirements
- .2 Section 09 21 16 Gypsum Board Assemblies
- .3 Section 09 22 16 Non-Structural Metal Framing
- .4 Section 09 90 00 Painting and Coating
- .5 UBC LEED Implementation Guide
- .6 [UBC Resilience-Based Design Guide for Nonstructural Systems](#)

1.2 **Related External Documents**

- 1. Ceiling installation shall be in accordance with ASTM-C636.
- 2. Latest edition of the AWCC / WCI (Association of Wall and Ceiling Contractors / Wall and Ceiling Institute) Specification Standards Manual.
- 3. Seismic requirements stipulated by the latest edition of the British Columbia Building Code (BCBC).
- 4. Coordination with seismic requirements of other ceiling components such as work in Divisions 20 to 28.
- 5. Ceiling suspension components shall be in accordance with ASTM-C635, “Intermediate Duty” for typical ceiling lighter weight panels such as mineral fiber panels.
- 6. Seismic design, components, and installation: in accordance with ASTM-E580, Clause 4 and subsequent clauses.

1.3 **Description**

- 1. Acoustical ceiling tiles (ACT) and associated support systems.

1.4 **Coordination**

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 **Submittals**

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 Provide samples for colour selection only if it is a Construction Office project.
- .3 O&M Submittals
 - .1 Provide list of ACT types and colours used, complete with manufacturer/distributor name for all products used.
 - .2 Environmental Product Declaration (EPD).
 - .3 Maintenance data for all tile selections.
 - .4 Warranties.
 - .5 Material Data and Safety Sheets (MSDS).
 - .6 Maintenance data including source for replacement.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 All seismic restraint work including anchoring systems shall be designed and certified by a Professional Engineer registered in BC and to submit a Letter of Assurance.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Specify ceiling systems that carry some assurance of a future supply of patterns and colours. Local suppliers are preferred.
- .2 Fire-resistant ceilings that require the use of hold down clips, and concealed spline systems must not be used at UBC.
- .3 T- bar ceilings are required to be seismically reinforced in all new construction and renovations – refer to 1.6.1.1 and the UBC Resilience-Based Design Guide for Nonstructural Components.
- .4 Ceiling finishes to have a Flame Spread Rating (FSR) of 0-25 (Class A) and is required for all core facilities. For new buildings or major renewals, FSR to be as per code consultant report.
- .5 Ceiling systems should have a high recyclable material content.

2.2 Performance Requirements

- .1 Ceiling systems should be easily accessible for any mechanical or electrical servicing required. Ceiling components should be removable and easily replaced by the Building Operations crews or external service trades without damage and without requiring other crews, trades or special equipment.
- .2 Ceiling systems shall be ISO 1400 Series Certified.
- .3 Connect T-bar to edge molding using pop rivets, matching color of suspension system, as set out for seismic restraint by ASTM Standards and UBC Resilience-based Design Guide for Nonstructural Components. 25-year service life required for ceiling suspension system.

3.0 MATERIALS

3.1 Product Selection

- .1 The following are preferred products for use as these are stocked for maintenance at UBC;
 - .1 UBC Standard Tile: 24" x 48" x 5/8" Armstrong #769 "Cortega".
 - .2 Suspension System: 15/16" exposed Tee, Armstrong "Prelude XL".
- .2 For other ceiling systems proposed, criteria for selection should include the following: ease of accessibility for mechanical/ electrical services, availability of future stock for maintenance and repair, durability, high light reflectance where required, high recyclable material content, and acoustical performance criteria as recommended by Project Acoustical Consultant.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 01 74 00 Cleaning and Waste Management for final cleaning and waste management procedures.
- .2 Section 03 33 00 Architectural Concrete
- .3 Section 10 00 10 Special Room Requirements
- .4 UBC LEED Implementation Guide

1.2 Related External Documents

- .1 National Floor Covering Association of Canada (NFCA) - Floor Covering Reference Manual.
- .2 Hardwood Sports Floor Systems - performance criteria standards and requirements to be coordinated with UBC Athletics and associated user/sports groups.

1.3 Description

- .1 Work in this section includes wood flooring and related accessories, and hardwood sports floor systems.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures.
- .2 Confirm with UBC PM and user group that gym floor markings are to current regulations and meet UBC's requirements.
- .3 Provide samples for colour selection only if it is a Construction Office project.
- .4 O&M Submittals
 - .1 Provide list of wood flooring types, colours and finishes, complete with manufacturer/distributor name for all products used.
 - .2 Environmental Product Declaration (EPD)
 - .3 Maintenance data for all tile selections.
 - .4 Warranties as per 1.6.3.
 - .5 Material Data and Safety Sheets (MSDS).
 - .6 Maintenance data including source for replacement.
 - .7 Material Data and Safety Sheets.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Trade to have recognized specialized experience, and have successfully completed 5 similar wood floor and/or sports floor system installations, including sanding and finishing, for 5 years preceding minimum.
- .2 Quality Control
 - .1 The manufacturer's representative shall inspect the work when required during the contract, and at completion prior to submitting the manufacturer's warranty.
- .3 Warranties
 - .1 2-year warranty for wood flooring.
 - .2 Warranty for sports flooring systems to be as provided by manufacturer.
- .4 Handover
 - .1 Contractor to conduct a walkthrough prior to handover to UBC Facilities with Facilities Custodial Services. Recommended maintenance procedures and products by manufacturer representative are to be provided in the presence of trade contractor.
 - .2 Refer to the CPG-01 located [here](#) for additional guidance on setting up demonstrations for UBC Facilities personnel.
 - .3 UBC Project Manager must contact the Facilities Custodial Operations Manager prior to occupancy to allow for general cleaning unless work will be carried out by the contractor to Facilities Custodial Services specifications.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 New wood floors (other than sport flooring systems) are to be factory pre-finished, complete with acrylic impregnation of the wood cells to improve indentation and wear resistance. Finish coat to be of extra-hard mineral crystals suspended in multiple coats of ultra-violet cured urethane with stain injected throughout the wear layer, to minimize maintenance requirements.
- .2 Hardwood sports flooring systems to be specified as per user group requirements, manufacturer installation and finish requirements.

2.2 Performance Requirements

- .1 Longest life finishes to be used. Sufficient ventilation to be provided as per manufacturer's recommendation, including to prevent absorption of off-gassing by other materials.

3.0 MATERIALS

3.1 Product Selection

- .1 Finishes
 - .1 Sports Floors:
 - .1 Sealer shall be two (2) coats water-based or moisture-cured urethanes.
 - .2 Line marking paint to be compatible with sealer and top coat.
 - .3 Top coat shall be water-based or moisture-cured urethane.
- .2 Refinishing of Sports Floors – for renovation projects:
 - .1 Follow manufacturer's instructions for re-finishing of sports floors.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 01 74 00 Cleaning and Waste Management for final cleaning and waste management procedures.
- .2 Section 03 33 00 Architectural Concrete
- .3 Section 10 00 10 Special Room Requirements
- .4 UBC LEED Implementation Guide
- .5 UBC Learning Space Guidelines

1.2 Related External Documents

- 1. Latest edition of the British Columbia Building Code (BCBC) for provision of assistive listening devices in classrooms, auditoria and meeting rooms over 100sqm and where such devices are to be installed under new resilient flooring.
- 2. National Floor Covering Association of Canada (NFCA) - Floor Covering Reference Manual.
- 3. Applicable product standards including CSA, CGSB and ASTM.

1.3 Description

- 1. Work in this section includes resilient flooring and bases.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 Provide samples for colour selection only if it is a Construction Office project.
- .3 O&M Submittals
 - .1 Provide list of resilient flooring types and colours used, complete with manufacturer/distributor name for all products used.
 - .2 Environmental Product Declaration (EPD)
 - .3 Maintenance data for all tile selections.
 - .4 Warranties as per 1.6.3.
 - .5 Material Data and Safety Sheets (MSDS).
 - .6 Maintenance data including source for replacement.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Flooring contractor to be a member in good standing with the National Floor Covering Association of Canada (NFCA).
 - .2 For sheet material, installer to be a certified manufacturer-trained "Master Mechanic" (or similar term), completely familiar with the products, seam welding, and the manufacturer currently recommended methods and conditions of installation. Submit certificate of qualification. This requirement is for all resilient flooring types used on the project and when available.
 - .3 Adhesives and accessories to be as recommended by each resilient flooring manufacturer.
 - .4 Flooring contractor to complete a site inspection prior to installation of flooring material.
- .2 Quality Control
 - .1 Manufacturer preference shall be a registered ISO 9001 quality system.
 - .2 Install resilient flooring only when moisture emission from concrete substrate is at or below the maximum permissible level of 8 lbs. of water per 1000 sq.ft., based on qualitative tests using calcium chloride test kits developed by the Resilient Flooring Institute, and to manufacturer's requirements.
 - .3 The manufacturer's representative shall inspect the work when required during the contract, and at completion prior to submitting the manufacturer's warranty.
- .3 Warranties
 - .1 In addition to a 2-year warranty, submit a 5-year manufacturer limited warranty for sheet flooring work.
- .4 Handover
 - .1 Contractor to conduct a walkthrough prior to handover to UBC Facilities with Facilities Custodial Services. Recommended maintenance procedures and products by manufacturer representative are to be provided in the presence of trade contractor.
 - .2 Refer to the CPG-01 located [here](#) for additional guidance on setting up demonstrations for UBC Facilities personnel.
 - .3 Contractor to protect resilient flooring in doorways with undyed card board or treated paper until floor has been handed over to and accepted by Facilities Custodial Services. UBC Project Manager must contact the Facilities Custodial Operations Manager prior to occupancy to allow for burnishing and finishing plus general cleaning unless work will be carried out by the contractor to Facilities Custodial Services specifications.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Select materials with low-VOC content, including adhesives which preferably should be water-based.
- .2 Select products with highest natural material content: Linoleum is the preferred product.
- .3 Products should be recyclable.

2.2 Performance Requirements – Not Used

3.0 MATERIALS

3.1 Product Selection

- .1 Linoleum with heat-welded seams
 - .1 Linoleum is preferable for public corridors, and may be used in lecture theatres and classrooms.
 - .2 Install linoleum in teaching labs, maker spaces wherever undergraduates work, (not carpet).
 - .3 Do not install on concrete slabs below grade, slabs on grade without a vapor barrier, wet areas such as entrance lobbies, (walk-off mats on troweled concrete is used), in washrooms, and wet laboratory areas (where chemical staining and deterioration under prolonged water saturation will occur).
 - .4 Large size linoleum tiles can be used. Their use allows Facilities to maintain the floors, which sheet goods do not.
 - .5 All linoleum products to be installed using heat-welded seams.
- .2 Sheet Vinyl with heat-welded seams
 - .1 Use typically for wet laboratories and wet areas as discussed above; include flash-coved base where cleanliness is critical (toxic or radiation areas: discuss with UBC Risk Management Services).
 - .2 Large size vinyl tiles. As with linoleum tiles this product allows Facilities to maintain the floor finish, where sheet goods do not.
- .3 Slip-Resistant Sheet Vinyl with Heat-Welded Seams
 - .1 Use (include flash-coved base).
 - .2 Washrooms and wet areas (as option to ceramic or similar tile), food service areas, janitor rooms, and wet laboratories.
- .4 Vinyl Composition Tile (VCT)
 - .1 Can only be installed in less-used, low-traffic areas such as storage rooms, electrical rooms, , vaults etc.
 - .2 Do not install VCT in well-used public areas, such as classrooms, lecture theatres, and corridors. VCT shrinks over time because the fillers dry the product out.
 - .3 VCT does not have the reinforcement strength that the old asbestos filler used to have. This allows water or traffic to release edges causing delamination. In lab areas where hazardous and often heavy materials (gas cylinders) are constantly transported, VC tiles have proved to be potentially dangerous and have caused tipping and tripping hazards. VCT has not proved to be satisfactory under life-cycle analysis.
- .5 Rubber Sheet Flooring with Heat-Welded Seams
 - .1 Should be slip-resistant and include flash-coved base.
 - .2 Acceptable for use in washrooms, exercise rooms and public corridors. In public corridors, ensure the rubber flooring type and colour is suitable for intended use and traffic.
 - .3 Acceptable for use in wet laboratories. If using in wet laboratories, all maintenance and replacement will be customer-funded.
- .6 Rubber Floor Tile
 - .1 Acceptable for use in public corridors and should be slip-resistant. Ensure the rubber floor tile type and colour is suitable for intended use and traffic.
 - .2 Can also be installed in less-used, low-traffic areas such as storage rooms. Do not install in custodial rooms or closets.
 - .3 Do not install rubber floor tiles in wet laboratories.
 - .4 Provide heat-welded seams.

- .7 Rubber Cove Base shall typically be 102 mm (4") or 6" high and to match flooring colour as chosen by the architect.

4.0 **LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS**

Items in this section are lessons learned or misses from past projects. These may also include code or industry best practices. If not applicable to a project, a variance is not required.

- .1 Rubber flooring is acceptable for use in wet labs after the following points have been taken into consideration:
 - .1 Due to the nature of a wet lab environment, it should be noted that floor restoration when a chemical burn happens is a fairly intensive process that can take time. Rust stains around the cylinder storage areas or bio-stains have been noted to be easier to clean.
 - .2 The installation of rubber flooring means that Custodial Services would need to take on maintenance programs that deviate from the maintenance materials used across the rest of campus already. If proceeding with the use of rubber flooring, any stains requiring cleaning above and beyond our regular maintenance would need to be customer-funded.
 - .3 Any repairs resulting from chemical spills or floor cracking (due to liquid nitrogen falling on the floor and freezing the rubber resulting in cracks) will also need to be customer-funded.
 - .4 A thicker (5mm) rubber flooring may be used where the use of chemicals such as liquid nitrogen is anticipated

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 01 74 00 Cleaning and Waste Management for final cleaning and waste management procedures.
- .2 Section 03 33 00 Architectural Concrete
- .3 Section 09 00 10 Finishes – General Requirements
- .4 Section 10 00 10 Special Room Requirements
- .5 UBC LEED Implementation Guide

1.2 Related External Documents

- 1. Applicable product standards including CSA, CGSB and ASTM.

1.3 Description

- 1. Work in this section includes the following:
 - .1 Waterproof membrane flooring and seamless cove base in mechanical rooms (see 2.1.1), service penthouses, and similar locations where leaks in building systems may occur and cause water damage, such as to floors below. Chosen system to have been specifically designed for this purpose.
 - .2 Epoxy floor coating in main electrical rooms.
 - .3 Waterproof traffic coating as corrosion protection for all concrete parking slabs. Chosen system to have been specifically designed for this purpose.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBC Technical Review Team Architect or UBCO Facilities.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines

1.5 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 Provide samples for colour selection only if it is a Construction Office project.
- .3 O&M Submittals
 - .1 Provide list of floor finish types and colours used, complete with manufacturer/distributor name for all products used.
 - .2 Environmental Product Declaration (EPD)
 - .3 Maintenance data for all tile selections.
 - .4 Warranties.
 - .5 Material Data and Safety Sheets (MSDS).
 - .6 Maintenance data including source for replacement.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Manufacturer licensed applicator.

- .2 Quality Control
 - .1 Strictly conform to Manufacturer written instructions, including preparation of substrates.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Membrane Flooring for Mechanical Room Floors
 - .1 Urethane elastomeric solvent-free liquid-applied seamless waterproof flexible flooring. System typically consists of a primer, primary coating, and colored top coat. Minimum 40 mil dry film thickness (DFT).
 - .2 Provide a seamless cove base trowelled in place, minimum 6" high. Ensure both cove material and flooring system are from the same supplier. Flooring and cove base to be installed as per manufacturer's recommendations.
- .2 Membrane Flooring for Main Electrical Room Floors
 - .1 Water-based epoxy floor coating with slip resistance incorporated into the floor finish such as sand granules or the equivalent.
- .3 Pedestrian Traffic Coating
 - .1 A waterproof traffic coating consisting of a flexible, liquid applied, elastomeric membrane topped with a liquid applied polyurethane wearing course containing hard aggregates and a urethane topcoat.
 - .2 The system to be totally water-proof, flexible and thermally compatible with the concrete substrate under applicable service conditions. The system to exhibit zero chloride permeability when tested in accordance with the test procedure developed by the Portland Cement Association.
 - .3 Finished surfaces to be skid resistant, wet or dry.
- .4 Vehicular Traffic Coating
 - .1 Provide traffic coating at exterior concrete slabs at loading bays which are over occupied space below.
 - .2 A modified polyurethane three-coat traffic deck coating system to be used.
 - .3 Waterproofing system to have complete adhesion, extreme impact and abrasion resistance along with chemical stability. The elastomeric properties of the system components should enable the complete assembly to give and work with the concrete slab, bridging the shrinkage cracks. Additionally, the system should protect the concrete from the damaging effects of water, de-icing salts, chemicals, gasoline, oils and anti-freeze.

2.2 Performance Requirements

- .1 Life Cycle for the flooring systems – 25 years.

3.0 MATERIALS

3.1 Product Selection

- .1 Membrane Flooring for Mechanical Room Floors
 - .1 Acceptable manufacturers are Sika, BASF, and Tremco or approved equivalent.
- .2 Membrane Flooring for Main Electrical Room Floors
 - .1 Acceptable product is Armorseal 8100, satin finish or approved equivalent.
- .3 Provide a variance request for review and approval if an equivalent product is approved for use. Variance request to include a comparison of performance characteristics.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 01 74 00 Cleaning and Waste Management for final cleaning and waste management procedures.
- .2 Section 03 33 00 Architectural Concrete
- .3 Section 09 00 10 Finishes – General Requirements
- .4 Section 10 00 10 Special Room Requirements
- .5 UBC LEED Implementation Guide
- .6 UBC Learning Space Guidelines

1.2 Related External Documents

- 1. Latest edition of the British Columbia Building Code (BCBC) for provision of assistive listening devices in classrooms, auditoria and meeting rooms over 100sqm and where such devices are to be installed under new carpet flooring.
- 2. Latest edition of the National Floor Covering Association of Canada (NFCA) - Floor Covering Reference Manual.
- 3. CCI Canadian Carpet Institute Supplement.
- 4. CAN/CGSB-4.155: Flammability of Soft Floor Coverings.
- 5. CAN/ULC-S102.2: Standard Method of Test for Surface Burning.

1.3 Description

- .1 Work in this section includes carpet tile, direct glue-down carpet and related accessories.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Before Start of Work (only for Construction Office Projects)
 - .1 Manufacturer's product data verifying compliance with specification requirements for carpet types and accessories specified.
 - .2 Manufacturer's full range of carpet colors and patterns available for specified carpet types for review and selection.
 - .3 Two 400 mm (16") square samples of each type and of each color of carpet to be used. For carpet with pattern repeat, submit a minimum of three repeats of the pattern.
 - .4 Manufacturer's product data and material / color range of carpet accessories for review and selection.
- .2 At Handover
 - .1 Manufacturer's maintenance data and cleaning instructions for each type of carpet installed.

- .2 Turn over to the UBC Project Manager all carpet pieces remaining at job completion. No carpet scraps shall be removed from the site without the UBC Project Manager's written approval.
- .3 Contractor to ensure that carpet installations are protected from traffic damage with suitable covering (such as un-dyed untreated paper) until floor finish has been handed over and accepted by the Facilities Custodial Services Operations Manager. Typically, also provide two large sections of surplus carpet cuttings and place at entry doors so that they can be used as doormats by other trade personnel entering the carpeted area.
- .4 Warranties as noted in 1.6.3.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Conform to NFCA Specification Standards Manual requirements for all products and installation, and all manufacturers' written instructions.
 - .2 Flooring contractors to be a member in good standing with the National Floor Covering Association of Canada (NFCA).
 - .3 Site inspection required prior to installation of flooring material.
- .2 Quality Control
 - .1 Hygrometer moisture tests on concrete shall not exceed 65% per CCI Manual, or stricter manufacturer requirements.
 - .2 Test new and suspect concrete floors for alkalinity and neutralize in accordance with NFCA/CCI recommendations. When installing carpet flooring on concrete, carpet manufacturer's representative to review carpet seaming and installation to ensure conformance with guarantee requirements and submit a written report to the Consultant and UBC Project Manager confirming same.
- .3 Warranties
 - .1 In addition to any other required warranties, provide the following written minimum guarantees or warranties to commence at Date of Substantial Performance, and details of guarantees or warranties that exceed noted minimum requirements.
 - .2 By Fiber Manufacturer
 - .1 Ten (10) year abrasive wear guarantee that carpet fiber will provide specified level of appearance, subject to proper care and maintenance.
 - .2 Ten (10) year color fastness to light.
 - .3 Ten (10) year color fastness to atmospheric contaminants.
 - .3 By Carpet Manufacturer
 - .1 Ten (10) year against unraveling, zippering, and delimitation / deterioration of backing not to exclude wet or steam cleaning methods.
 - .4 By Carpet Installer
 - .1 One (1) year that all seams will remain sound and tight and carpet will not break away from adhesive.
 - .5 By Adhesive Manufacturer
 - .1 Ten (10) year, including labor and material, against adhesive failure.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Carpet tiles are preferred for their ease of installation and ease of replacement.
- .2 Carpet coloration to be such that it requires minimal maintenance and cleaning.
- .3 Carpet specified shall be first quality commercial grade carpet for heavy traffic usage as manufactured by a nationally recognized manufacturer.
- .4 Cross seams shall be avoided and will only be permitted where made unavoidable by carpet width or roll length. Avoid seams at doors and pivot points.

- .5 Flammability as per CAN/ULC-S102.2 shall be Flame Spread Rating of 300; Smoke Developed Classification of 500.
- .6 Environmental
 - .1 Carpet to be 14001 certified or equal, for recycled content.
 - .2 Source
 - .1 ISO 9002 quality audit certified.

2.2 Performance Requirements

- .1 Indoor Air Quality
 - .1 Comply with the UBC LEED Implementation Guidelines for Indoor Air Quality requirements.
- .2 Contractor to ensure that glued carpets are protected against damage from rolling loads for 48 hours after installation and protected by covering with plywood or hardboard where rolling traffic will occur (i.e. moving of equipment, etc.).
- .3 Soil and stain protection:
 - .1 Soil and stain protection shall be an integral lifelong stain proofing, i.e., inherent in or bonded to nylon fiber. Topical treatments are not acceptable.
- .4 Static control shall be provided where needed.
- .5 Anti-microbial protection shall be permanent treatment to prevent bacteria, fungi and bacteria growth lasting life of carpet. Do not provide topical treatment.
- .6 Disposal
 - .1 Carpet face must be 100% recyclable.
 - .2 Submit manufacturer's recycling program for each carpet type including percentage of recycled content contained in each product.

3.0 MATERIALS

3.1 Product Selection

- .1 Carpet construction shall meet the following minimum requirements:
 - .1 Construction shall be level loop or textured level loop.
 - .2 Dye Method :
 - .1 Solution dyed or other method providing permanent stain resistance (i.e., inherent in or bonded to nylon fiber).
 - .3 Plies shall be a minimum of 3.
 - .4 Pile height shall be 5.0 mm (0.197") maximum; 4.0 mm (0.144") minimum.
 - .5 Tuft Bind shall be a minimum 12 pounds, wet or dry.
 - .6 Gauge shall be minimum 39.4 col/10 cm (1/10") or better (a looser gauge may be allowed if Kilotex rating is sufficiently high).
 - .7 Stitch count shall be a minimum 40 / 10 cm (10 per inch).
 - .8 Carpet yarn shall be 100% first quality, type 6/6 or 6 bulk continuous filament (BCF) nylon.
 - .9 Yarn face weight shall be a minimum 950 gm/m² (28 oz/sq.yd), or better (a lesser weight may be allowed with a Type 2 or 3 backing system).
 - .10 Pile density factor (ASTM D418) shall be a minimum 12 Kilotex/cm².
- .2 Adhesives
 - .1 Premium grade, low VOC (solvent-free), waterproof type for direct glue down carpet application as recommended by carpet manufacturer for backing system and substrate / grade level and usage conditions, complete with guarantee against adhesive bond failure. Spread rates stipulated by the manufacturer are to be strictly adhered to.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Division 09 and related sections therein
- .2 Related sections in Divisions 22, 23, 25, 26 and 27.

1.2 Related External Documents

- .1 Latest edition of the British Columbia Building Code (BCBC).
- .2 WorkSafeBC Regulations and Standards.

1.3 Description

- .1 Work in this section includes raised access flooring or elevated flooring systems complete with ramps, steps, guardrails and handrails, structural support and lighting as needed.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 Submittals

- .1 Before Start of Work (only for Construction Office Projects)
 - .1 Manufacturer's product data verifying compliance with specification requirements for finish types and accessories specified.
 - .2 Manufacturer's full range of finish colors and patterns available and meeting specification requirements for review and selection.
 - .3 Provide samples as requested by UBC.
 - .4 Manufacturer's product data and material / color range of carpet accessories for review and selection.
- .2 O&M manuals:
 - .1 Manufacturer's product data verifying compliance with specification requirements for finish types and accessories specified.
 - .2 Finish colors and patterns specified.
 - .3 Manufacturer's maintenance data and cleaning instructions for access floor system installed.
 - .4 Final reviewed shop drawings signed and sealed by a professional engineer registered in the Province of BC.
 - .5 Warranties as per 1.6.2.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Provide signed and sealed shop drawings by a registered professional structural engineer in the Province of British Columbia.
 - .2 Contractor to provide demonstration and training of access floor system to UBC Facilities.
- .2 Warranties
 - .1 Access floor system warranty to be provided as per project specifications.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 Loading capability and floor finish specified should be appropriate for the use of space.
- .2 Access floor systems should be designed to evenly disperse the weight of heavy equipment.
- .3 Provide steps, ramps, guardrails and handrails as needed.
- .4 Provide electrical grounding where required to dissipate static electricity that can lead to damage of sensitive equipment.

2.2 Performance Requirements

- .1 Include the engineering and anchoring of all posts.
- .2 Provide seismic restraint of components in compliance with the BC Building Code.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 01 74 19 Construction Waste Management and Disposal for paint disposal requirements
- .2 Section 09 00 10 Finishes – General Requirements
- .3 Section 05 00 00 Metals
- .4 Section 05 50 00 Metal Fabrications
- .5 Section 06 00 10 Wood Structures – General Requirements
- .6 Section 27 05 05 Communication Rooms Design Guidelines
- .7 [UBC LEED Implementation Guide](#)

1.2 Related External Documents

- 1. Master Painters Institute (MPI) published Manuals as follows:
 - .1 MPI Architectural Painting Specification Manual.
 - .2 MPI Maintenance Repainting Manual – for existing surfaces.

1.3 Description

- 1. Work in this section includes exterior and interior painting.

1.4 Coordination

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- .5 Coordinate with UBC Facilities Paint Shop for work carried out by UBC's own forces through the UBC Project Manager or Construction Office Project Coordinator.
- .6 Coordinate with the UBCV Facilities Technical Review Team Architect for any variance requests.
- .7 Coordinate with UBC Information Technology (IT) for access to server rooms. Some server rooms are on a special keying system, and can be high security.

1.5 Submittals

- .1 Before Start of Work – for Construction Office projects only
 - .1 List of all proposed paint materials for review; color samples for selection; color samples for final approval.
 - .2 MSDS Material Data Sheets for review and posting at jobsite.
 - .3 Certification reports for Eco-Logo and VOC content.
- .2 During Work
 - .1 Use MPI Accredited Assurance Association (A.Q.A.) inspector reports, or preferably MPI fully certified Architectural Coatings Inspector.
 - .2 Manufacturer Inspectors' reports when required.

- .3 O&M manual submittals
 - .1 Maintenance data: itemized list c/w manufacturer/distributor name, paint type, color formulation to be provided in the O&M manual.
 - .2 Specified paint systems as listed in the project manual and actual paint systems used.
 - .3 Warranty as per 1.6.3.

1.6 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Trade Contractor shall be a member of Master Painters and Decorators Association (MPDA). Refer to www.mpda.net.
 - .2 Follow MPI Quality Assurance Program including the MPDA Inspection and Guarantee Program.
- .2 Quality Control
 - .1 All work to be inspected by an MPI approved/appointed Inspection Agency, acceptable to the Consultant and the MPDA Accredited Assurance Association (A.Q.A.), and paid by the Trade Contractor; MPDA SSI Inspection to be carried out irrespective of type of Guarantee. (Note: on a Consultant-designed project when work of this Section is carried out by UBC's own forces, (generally smaller renovation projects), UBC will arrange and pay for MPI's inspection services only if required).
 - .2 When "special" non-MPI products or systems are to be used, the manufacturer to also carry out inspections and certify the work, following the same procedures as set out in the MPI Manual, and paid by the Trade Contractor.
 - .3 Inspection to include inspection of surfaces prior to start of work, moisture tests, preparation for painting, primer, completed work, and during and at end of Warranty including expediting correction of defects.
- .3 Warranties
 - .1 2-Year MPDA Accredited Quality Assurance Association's 2-year guarantee, or a 100% 2-Year maintenance bond issued by a surety licensed in British Columbia warranting also that painting work has been performed to MPI Manual requirements. The A.Q.A. association's guarantee shall NOT exclude any of the work carried out under this section.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 General
 - .1 Use products that are listed in MPI Manual Current Approved Product List.
 - .2 All paint systems shall be MPI "premium grade" except as noted.
 - .3 All products for each paint system applied shall be from same manufacturer for compatibility.
 - .4 Primers on steelwork shall provide MPI approved primers suitable for paint systems noted, and suitable for subsequent work carried out by this Section. Coordinate with Sections 05 00 00 Metals and 05 50 00 Metal Fabrications. Materials such as linseed oil, shellac, turpentine, etc. which are not specifically listed by brand name shall use the highest quality product.
- .2 Communications cables must not be painted. They must be masked and protected from paint overspray or direct painting.

- .3 Wall-mounted plywood back-boards inside all Communications Rooms must be painted. See Section 27 05 05 Communication Rooms Design Guidelines.
- .4 Environmental
 - .1 Source
 - .1 Preference shall be ISO 9001 2008 registered manufacturers.
 - .2 Manufacture
 - .1 Select lowest range VOC products from each MPI product category number listed in the MPI Manual current approved product list, preferably "Three-Tree" and Eco-Logo certified.

2.2 Performance Requirements

- .1 Durability
 - Choose durable paint systems for interior or exterior application uses. Interior applications should consider space usage requirements.
- .2 Life Cycle
 - .1 Exterior paint/coating expectancy shall be minimum 8 years using standard coatings. Life expectancy for High Performance Coatings shall be a minimum 15 years.
 - .2 Exterior silicate-based paints, especially on cementitious-finished heritage buildings shall be more than 60-year life expectancy.
 - .3 Interior painting coating life expectancy is 5-10 years.

3.0 MATERIALS

3.1 Product Selection

- .1 Materials
 - .1 Use MPI approved products except where noted.
 - .2 Use paint with low- VOC emissions, especially where rooms are continuously occupied.
 - .3 In keeping with 2.2.1.2 above and for low-VOC paint systems, interior alkyd systems can be replaced with a water- based light industrial, high performance architectural latex, or a latex system. These systems would be acceptable for UBC's institutional environment. Specific paint systems should be chosen to reflect the intended use of the space.
 - .4 Paint shall not contain mercury, lead, hexavalent chromium, or cadmium compounds.
 - .5 Use alkyd paints only at high impact areas.
 - .6 Use an alkyd water-based paint for handrails, door frames and doors where hand oils could cause paint breakdown.
 - .7 Services in mechanical, electrical, and similar service rooms or enclosed spaces, and concealed spaces including equipment, piping, pipe insulation, coils, ductwork, conduit, electrical and control panels, access panels, etc. are NOT to be painted, except for pre-finishing carried out by manufacturers and any make-good work.
 - .8 Exposed structural steel ready for painting to be shop finished. Detailing of steelwork to be carefully coordinated to minimize field touch-ups.
 - .9 Paint system in interiors of mechanical rooms when wall assemblies with steel stud and drywall are used: INT 9.2A Latex (over latex primer/sealer) Gloss Level 4/5 (satin/semi-gloss).
 - .10 Electrical panels, fire hose cabinets, access panels in building interior: these should match the colour of adjoining surfaces except as otherwise required by Building and/or Fire Codes.

- .2 Exterior Paint Systems – for new projects, major renewals and renovations where an architect is on board, project specifications are to include the appropriate exterior paint systems. For Construction Office or BOps Architectural projects where an architect is not present, the following paint systems can be used:
 - .1 EXT 5.1B / Inorganic Zinc Primer + High Performance Acrylic / Gloss / Exposed Structural Steel.
 - .2 EXT 5.1 C / W.B. Light Industrial Coating / Gloss / Miscellaneous Metal including railings, guardrails, bollards.
 - .3 EXT 5.1G / Zinc Rich Primer + 2-Component Aliphatic Polyurethane / shop finished exposed structural steel; detailing of steelwork carefully coordinated to minimize fieldwork touch-up.
 - .4 EXT 5.3 J / W.B. Light Industrial Coating / Gloss / galvanised hollow metal doors and pressed steel frames; roof-top ducting, vents and piping, exterior galvanized metal generally.
 - .5 Strong consideration should be given to using potassium silicate-based paints on cementitious surfaces. Silicate-based paints must be unaffected by UV, static dirt-repelling, completely breathable, inorganic/sustainable and must bond chemically with the cementitious substrate.
- .3 Exterior Renovation Work
 - .1 Strong consideration should be given to using potassium silicate-based paints on cementitious surfaces. Silicate-based paints must be unaffected by UV, static dirt-repelling, completely breathable, inorganic/sustainable and must bond chemically with the cementitious substrate.
- .4 Interior Paint systems - – for new projects, major renewals and renovations where an architect is on board, project specifications are to include the appropriate interior paint systems. For Construction Office or BOps Architectural projects where an architect is not present, the following paint systems can be used:
 - .1 INT 3.1A / Latex / Custom / Eggshell / Mechanical, Electrical Rooms, and Service Rooms.
 - .2 INT 3.1C / High Performance Acrylic / Eggshell / typical concrete surfaces.
 - .3 INT 3.1C / High Performance Acrylic / semi-gloss / concrete in washroom, janitor, and similar rooms.
 - .4 INT 3.2H / Latex Zone & Traffic Markings / nosing at stairs, conforming to BC Building Code for the visually impaired; other safety markings required by BC Building Code, authorities having jurisdiction and Worksafe BC.
 - .5 INT 4.2A / Latex / Custom / Eggshell / Mechanical, Electrical rooms, and service rooms.
 - .6 INT 4.2K / High Performance Acrylic / Eggshell / typical concrete block surfaces.
 - .7 INT 4.2D / High Performance Acrylic / semi-gloss / concrete block in washroom, janitor and similar rooms.
 - .8 INT 5.1B / High Performance Acrylic / Gloss / Structural Steel.

- .9 INT 5.1E(modified) / W.B. Alkyd / Gloss / Metal Fabrications at contact surfaces such as stairs, railings, trench gratings, trench covers and frames, access doors/panels, elevator doors and frames.
- .10 INT 5.3 L (modified) / W.B. Alkyd / Gloss / galvanized hollow metal doors, door and window frames; galvanized metal fabrications.
- .11 INT 5.3 H / W.B. Dryfall / flat / steel deck.
- .12 INT 6.4 BB / W.B. Alkyd / Gloss / wood trim.
- .13 INT 9.2A / Latex / Custom Grade / Eggshell / gypsum board in Mechanical, Electrical Rooms, and service rooms.
- .14 INT 9.2B / High Performance Acrylic / Eggshell / typical gypsum board surfaces.
- .15 INT 9.2CC / W.B. Alkyd / semi-gloss / gypsum board in washroom, janitor and similar rooms.
- .16 INT 9.2A Latex (over latex primer/sealer) Gloss Level 4/5 (satin/semi-gloss) in mechanical rooms.
- .5 Interior Renovation Work (for Construction Office or BOps Architectural Use Only):
 - .1 RIN 5.3B / Water Based Light Industrial Coating / semi-gloss / painted hollow metal doors and pressed steel frames.
 - .2 RIN 6.3P / Water Based Light Industrial Coating / semi-gloss / painted wood doors and frames.
- .6 Painted metal fabrications at or near ground level:
 - .1 Sherwin Williams colour SW 7062 – Rock Bottom (UBC Gray) is mandatory for all exterior painted metal fabrications on campus. Coordinate with Section 05 50 00 metal Fabrications for painted other exterior components on the site.
- .7 Interior white paint: In order to reduce paint wastage, all projects are to consider choosing from the following whites where possible:
 - .1 Benjamin Moore Oxford White
 - .2 Benjamin Moore Decorators White
 - .3 Benjamin Moore Distant Grey
 - .4 Benjamin Moore Cloud White

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Division 09 and related sections therein
- .2 Section 10 14 00 Room Numbering
- .3 Section 10 14 05 Sign Standards and Guidelines and UBC Interior Signage Guidelines
- .4 Section 14 20 00 Elevators for elevator machine room and closet design guidelines
- .5 Section 26 05 02 Installation Methods and Requirements – for electrical bike charging stations in bicycle rooms.
- .6 Section 26 05 00 Electrical – General Requirements for electrical service rooms and closet design guidelines.
- .7 Section 26 51 00 Interior Building Lighting for lighting controls in custodial and interior waste management rooms
- .8 Section 27 05 05 Communication Rooms Design Guidelines.
- .9 Division 27 for Audio Visual Technical Guidelines
- .10 UBC Learning Space Design Guidelines

1.2 Related External Documents

- 1. American Association of College Facilities Management.
- 2. Acoustical Report prepared by the Acoustical Consultant on a project.

1.3 Description

- 1. Section includes special requirements in for various types of rooms/spaces.

1.4 Coordination

- 2. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 3. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 4. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 5. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

2.0 DESIGN REQUIREMENTS

2.1 Main Entrances

- .1 Hand sanitizing units are to be provided for all main entrances. Units are to be free- standing within 6 feet of entranceway.
 - .1 Required product (PURELL® LTX™ or TFX™ Dispenser Floor Stand SKU:2424DX) or wall mounted (PURELL® FMX-12™ Dispenser Push-Style Dispenser for PURELL® Hand Sanitizer SKU:5120-06).

2.2 Kitchen and Lounges

- .1 Provide space between the countertop and over counter cabinets to mount paper towel dispenser and soap dispenser.

- .2 All kitchens and lounges to have paper towel dispensers installed to conform to the UBC standard:

Kimberley Clarke Professional
Type: 09990
Color: Black/Smoke
Unit Size: 12.63" x 16.13" x 10.2"

This allows for the use of generic paper refills and universal keys so all paper towel dispensers use the same key. The top of the dispenser height is not to exceed 5.5 feet for access to the key on top of the lid.

- .3 All kitchens and lounges to have hand soap dispensers installed to conform to the UBC standard:

Purell FMX 20 (SKU 5234-06)
2000 ml Purell Healthy Soap SKU 5572-02
Color: Graphite/Metallic

This allows for the use of universal keys so all soap dispensers at UBC use the same key.

2.3 Washrooms

- .1 "Airport style" washroom design without the use of doors is preferable and promotes the use of hand dryers over paper towels.
- .2 Hardwired hand dryers are required in washrooms. UBC is in the process of phasing out paper towel use in washrooms.
- .3 Refer to Section 10 28 00 and consult with UBC Facilities Custodial Services for locations where paper towel dispensers are proposed.
- .4 Floor drains are required, see Division 22 Section 22 05 00 Plumbing - General Requirements.
- .5 For plumbing fixtures, see Division 22 Section 22 40 00 Plumbing Fixtures, Section 2.0.

2.4 Showers

- .1 Shower stalls shall be white durable plastic tub/shower surround and substrate shall be cementitious board, mineral fiber board or masonry. Floors to have waterproof membrane and slope to drain. Shower stall to have 100mm curb, except in accessible shower stalls. Where possible make single stalls accessible.
- .2 For floor drain requirements, see Division 22 Section 22 05 00 Plumbing - General Requirements.

2.5 Custodial Rooms

.1 General Requirements:

- .1 Custodial rooms must be designed for ONLY custodial staff use. These spaces CANNOT be shared or be made to do double duty with any other operation in the building, because the already minimal space is then reduced to a dysfunctional level and their security access becomes compromised by other trades.
- .2 Motion detector or similar energy saving on/off light switches shall be installed in all custodial rooms.

- .3 Splash guards must be tiled and extend at least 2 feet above the janitor sink and 1 foot from the edge of the janitor sink laterally. Splash guard must be non-permeable and rust resistant, and colour should match to the extent possible the FRP panels required in 1.13.1.4.
- .4 In custodial rooms or closets only, provide fiberglass reinforced plastic (FRP) panels to a height of 1200mm (48") from finished floor level. FRP panels to be Class C, white or grey in colour. This requirement is in addition to the tiled splash guard at the mop sink as per 1.13.3.
- .5 All custodial rooms shall be designed for detergent mixing stations and require 3/4" hot and cold backflow preventers installed above the mop sink. Refer to Section 22 11 18 for more information.
- .6 Floor Finishes - exposed concrete with non-porous sealer is preferred. If not possible to provide, vinyl or elastomeric flooring would be acceptable.
- .2 **Main Floor Custodial Room in Loading Bay – Space Allocation**
 - .1 400 square feet per major building is required. Room is to be located very close to a loading bay.
 - .2 Dimensions: 20 feet by 20 feet
 - .3 Door width: 48 inches; in-swinging with door stop. Door to be hollow metal body construction to allow for pallet delivery and mitigate damage.
 - .4 Electrical: two – one rated at 15 amps, one rated at 20 amps with 110 volt duplex receptacle outlets. 500 lux maintained lighting levels.
 - .5 Plumbing: Floor drain in centre; floor mounted custodial mop sink c/w 150mm curb with notched front for easy tilting to empty mop bucket, with stainless steel splash guard shield on wall.
 - .6 Shelving: 16 inches deep; adjustable height; two rows at 36 inches, 48 inches on the longest wall.
 - .7 Mop hanger: Continental # 515; steel with rubber cam, grips 7/8" to 1 1/4" diameter handles; three mop hangers to be located 70 inches over the floor mounted custodial sink.
 - .8 Typical supplies and equipment to be stored would consist of: paper supplies, 20 + gallons of chemicals, pails, brooms, mop & bucket, floor pads and scrubbing brushes, safety signs, wet/dry vacuums, extension cords, chalk, small liners, large liners, dust mops, vacuums, buffing machines, burnisher, stripping/finishing supplies, custodial cart, carpet cleaning, autoscrubber, and miscellaneous cleaning items.
- .3 **Standard Custodial Room (Typical for all other floors)**
 - .1 120 square feet required per floor. It will serve the needs of the assigned area for each custodian (approximately 25,000 to 30,000 square feet of building area).
 - .2 Dimensions: 10 feet by 12 feet
 - .3 Door width: 36 inches; in-swinging with door stop.

- .4 Electrical: one – rated 15 amps, 110 volt duplex receptacle outlet.
- .5 Plumbing: Floor drain in centre; floor mounted custodial mop sink c/w 150mm curb with notched front for easy tilting to empty mop bucket, with stainless steel splash guard shield on wall.
- .6 Mop hanger: Continental # 515; steel with rubber cam, grips 7/8 to 1 ¼" diameter handles; three mop hangers to be located 70 inches over the floor mounted custodial sink.
- .7 Shelving: Heavy duty steel shelving; 16 inches deep; adjustable height; two rows at 36 inches, 48 inches; on longest wall.
<https://www.homedepot.ca/en/home/p.48-inch-w-5-level-heavy-duty-steel-shelving-unit-in-black.1000674332.html>
- .8 Typical supplies and equipment to be stored would consist of: paper supplies, wet/dry vacuums, buffing machine, autoscrubber, canister vacuum, pacer 30" vacuum, custodial cart, mop & bucket, up to 20 gallons of chemicals in 1 gallon containers, brooms, wet mops, and cleaning supplies.

2.6 Interior Waste & Recycling Room in Loading Bay – Space Allocation

.1 General Requirements:

- .1 Secure and externally accessible storage room, located near service entry to the building that can accommodate short term storage of waste materials (e.g. garbage, recyclables, and confidential shredding material and special wastes). The minimum dimensions for the storage room are to be 22'-0" x 22'-0". Consult UBC Waste Management and Custodial Services to confirm storage specifications for recycling and waste.
- .2 Waste and recycling room must be designed for ONLY waste management and custodial staff use. These spaces CANNOT be shared or be made to do double duty with any other operation in the building.
- .3 Motion detector or similar energy saving on/off light switches shall be installed in this room.
- .4 Door to waste and recycling room to swing out.
- .5 The floor in the waste room shall be coated with durable industrial grade non-slip coating. (Floor finish to be as per TG Section 09 67 00, item 2.1.1)
- .6 Room to be plumbed with a floor drain and a hose bib.

2.7 Electrical Rooms

- .1 The preferred location for Main Electrical Rooms is on North or East exterior building wall (for cooling and to allow for direct ventilation). Main Electrical Rooms, Local Electrical Rooms and Electrical Closets are considered Restricted Access Service Rooms/Closets. These rooms/closets are to be designed for housing electrical distribution equipment, electrical metering equipment, life safety equipment, lighting control equipment only.
- .2 Main Electrical Rooms, Local Electrical Rooms and Electrical Closets are not to be used as conduits (pass through/feed through) for other building systems serving other areas such system include HVAC, communications and security.

- .3 All electrical distribution equipment, electrical metering equipment, life safety control equipment, Transfer Switches, lighting control equipment including panelboards are to be located in Main Electrical Rooms, Local Electrical Rooms and Electrical Closets. Electrical distribution equipment, electrical metering equipment, life safety equipment, lighting control equipment including panelboards shall not be installed in any other room including Communication Rooms, Custodial Rooms, Laboratories, Audio Visual Service Rooms, Classrooms, Lecture Theatres, Offices or Corridors. Mechanical Rooms may contain Motor Control Centres, Variable Speed Drives, Distribution Centres and Panelboards for mechanical loads.
- .4 All Electrical Rooms and Closets shall be designed and located in the building so that direct access is from a common or non-secure area such as a public corridor. Electrical Rooms and Closets shall not be located behind other rooms that might have specialized or secure locks installed; for example, a custodial room, server room, machine shops, etc.
- .5 All Electrical Rooms and Closets shall be designed so that no equipment will be installed above a door or behind an inward opening door swing.
- .6 All Electrical Rooms and Closets shall have 1.2 m horizontal by floor to ceiling vertical, of open wall space to allow for installation of future equipment.
- .7 All Electrical Rooms shall be located and constructed to allow for replacement of installed equipment. All possible challenges must be considered such as structural loading, size of doorways and access corridors and exterior access.
- .8 All Electrical Rooms and Closets housing transformers shall be insulated to prevent sound transmission to adjoining spaces.
- .9 Pressurized/unpressurized piping systems are not permitted to enter electrical rooms. The only exception is sprinkler system branch lines and fan coil lines that serve the electrical room.
- .10 Refer to Section 09 67 00 Fluid-Applied Flooring for floor finish type in the main electrical room. On upper floors of a building where electrical closets are accessed from a public corridor, it will be acceptable to have polished concrete or resilient flooring in electrical closets to match the use of these finishes when used in public corridors.
- .11 User owned electrical equipment that is not part of base building electrical shall not be installed in any electrical room. This includes but is not limited to distributions, transformers and UPS systems.

2.8 Mechanical Rooms

- .1 Refer to Section 09 67 00 Fluid-Applied Flooring for floor finish and cove base type plus height in mechanical rooms.

2.9 Elevator Machine Rooms

- .1 Elevator Machine Rooms shall contain: elevator controllers, elevator power disconnects, elevator cab lighting disconnects, communication demarcation, fire alarm system interface relays and any other equipment directly related to elevator operation. Elevator Machine Rooms are required when a machine is hoistway mounted.

- .2 Systems or equipment not directly related to elevator operation shall not be installed within Elevator Machine Rooms.
- .3 Elevator Machine Rooms shall be constructed so that ceiling mounted lighting, smoke detectors and other equipment can be safely accessed for maintenance and replacement.
- .4 Minimum size of Elevator Machine Rooms shall allow for replacement of controllers from at least 3 non-proprietary manufacturers. At no times shall the Elevator Machine Room be smaller than 1.5 m deep by 2.2 m wide by 2.4 m high.
- .5 Elevator machine rooms and closets shall be designed to have adequate space to safely maintain and replace any and all equipment safely. The ability for a worker to access ceiling mounted equipment from a step-ladder is required. No equipment, other than what is required by applicable codes and standards shall be installed in an elevator Machine Room or Closet. No equipment shall be mounted above 2 m unless required by applicable codes or standards.

2.10 Communications Rooms

- .1 A Communications Room is a service room designed to safely house telecommunications equipment. It is also used to mount and terminate voice, data, RF, and when approved by UBC IT – security cables security cables and their associated terminating and distribution systems.
- .2 Communications room construction shall meet all applicable building, fire, electrical and safety codes and regulations as stated by UBC. No fire separation or resistance rating is required on the walls or ceilings provided the walls are constructed of 16mm Type X GWB on both sides of stud walls. Hub Rooms shall be constructed to meet a 1 hour fire separation. A smoke detector, connected to the fire alarm system, shall be installed in all communications rooms.
- .3 Each campus building will contain a Main Communications Room and possibly many Local Communications Rooms. The Main Communications Room may be used as a floor serving facility in addition to a Local Communications Room serving facility. No other building systems are to be installed in the Main Communications Room.
- .4 Local Communications Rooms or Closets are used as a floor serving facility for mounting and terminating approved communications cabling and hardware only. No other building systems are to be installed in the Local Communications Room.
- .5 Details of communications systems function and installation are handled by Division 27.
- .6 False ceilings are not permitted in communication rooms.
- .7 Communications Rooms and Closets have special requirements addressed in Division 27 of the Technical Guidelines, Section 27 05 05 Communication Rooms Design Guidelines. They shall only contain approved equipment and systems as indicated in Division 27.
- .8 All Communications Rooms shall be designed and located in the building so that direct access is from a common or non-secure area. Communications Rooms are not to be located behind other rooms that might have specialized or secure locks installed; for example, a custodial room.

2.11 AV and Equipment Rooms

- .1 AV rooms to be used as theatre projection rooms have special requirements. The UBC AV group shall be consulted in these situations.

2.12 Biohazard Labs

- .1 Please contact UBC Safety and Risk Services if special facilities are to be designed. For any assistance with coordination, the Facilities Transition Team can be contacted.
- .2 For floor drains, see Division 22 Section 22 05 00 Plumbing - General Requirements.

2.13 Radioisotope Labs

- .1 Please contact UBC Safety and Risk Services if special facilities are to be designed. For any assistance with coordination, the Facilities Transition Team can be contacted.
- .2 For floor drains, see Division 22 Section 22 05 00 Plumbing - General Requirements.

2.14 Animal Care Facilities

- .1 Design and construction to be completed in accordance with the latest CCAC guidelines.

2.15 Central Receiving & Campus Mail Rooms (UBC Okanagan Only)

.1 Central Receiving

.1 CRMS and Residences

- 1. All UBC Okanagan central receiving rooms for Canada Post and/or courier deliveries must be designed to be secure at all times, with access to mail and packages restricted to receiving room staff. This is especially important as these rooms sometimes receive deliveries of research materials classified as dangerous goods.
- 2. Central receiving rooms cannot be made to do double-duty with other campus or residences services.

.2 Campus Mailrooms

.1 General Requirements

- 1. Mailrooms must be designed for CRMS use only. These spaces cannot be shared or made to do double duty with any other operation in the building because the already minimal space is then reduced to a dysfunctional level and their security access is compromised by other users of the space.
- 2. Mailroom can be located within a business workroom, provided that it is a separate room, with a door, used only for mail (no photocopier can be located in mailroom).
- 3. Must be a minimum of one mailroom per floor for every floor containing a business workroom.

.2 Mailrooms for all buildings

- 1. Minimum 49 square feet required per mailroom (minimum 6.5 feet width or length).
- 2. Minimum door width: 30 inches, out-swinging.
- 3. Doors to the mailroom must be openable with SALTO access only.

4. Must have at least one Mailsorter per mailroom (similar to U-line Mail-Sorter Model H-8349: dimensions: 60 x 30 x 72-80 inches).

2.16 Bicycle Rooms

- .1 Coordinate design requirements with Section 26 05 02 , Installation Methods and requirements, 2.0.2.17 for electrical bike charging stations in bike rooms.
- .2 Due to increased fire risk associated with such charging stations, CRP to coordinate any fire-suppression or fire-rating requirements for bike rooms with UBC Safety and Risk Services.

2.17 Classrooms

- .1 Design requirements are to be as per the UBC Learning Space Design Guidelines.
- .2 Refer to Audio Visual Services, UBC IT, for sound, video and control systems guidelines. Provide for adaptability due to technological changes.
- .3 Demonstrate active and passive acoustic strategies.
- .4 Coordinate with the **Acoustical Design Standard for UBC Classrooms** requirements as noted in 2.18 below.

2.18 Acoustical Design Standard for UBC Classrooms

.1 Scope

This standard pertains to the design of acoustical environments in spaces for teaching and learning ('classrooms') at UBC, and to related non-acoustical issues. It is relevant to the design of the geometry of the spaces, their bounding surfaces, their internal surface finishes, their contents, their mechanical, electrical and other systems, and their audio-visual systems. This standard specifies acoustical performance criteria that must be met to ensure high quality acoustical environments.

.2 Classroom Categories & Acoustical Criteria

- .1 This standard considers six (6) categories of classrooms, as follows:
 - .1 **Type 1:** Theatre/Large Classroom (75 to 500 seats, rectangular / non-rectangular geometry, with a speech-reinforcement system)
 - Reverberation Time (s) in the range 0.75 to 0.85 s
 - Maximum noise level = NC 30
 - .2 **Type 2:** Classrooms (30 to 120 seats, rectangular geometry, no speech-reinforcement system)
 - Reverberation Time (s) in the range 0.45 to 0.60 s;
 - Maximum noise level = NC 30
 - .3 **Type 3:** Seminar Rooms (8 to 40 seats, rectangular geometry, no speech-reinforcement system)
 - Reverberation Time (s) in the range 0.35 to 0.50 s;
 - Maximum noise level = NC 30

- .4 **Type 4:** Informal Learning Space Collaboration/Learn Labs (capacity for 2 to 100, open areas in building designed for quiet study, individual or study work, group study, collaborative work, etc.
 - Reverberation Time (s) in the range 0.45 to 0.60 s;
 - Maximum noise level = NC 35
- .5 **Type 5:** Collaboration/Learn Labs (capacity for 2 to 100, rectangular geometry, no speech-reinforcement system)
 - Reverberation Time (s) in the range 0.45 to 0.60 s;
 - Maximum noise level = NC 35
- .6 **Type 6:** Critical Classrooms (e.g., for distance learning, conferencing and /or media capture).
 - Reverberation Time (s) in the range 0.45 to 0.55 s;
 - Maximum noise level = NC 25.
- .2 Reverberation-time criteria (RT60) refer to the average values of RT60 over the octave band frequency spectrum between 250 Hz and 4000 Hz in the unoccupied condition, which will also be the testing conditions.
- .3 Noise Criteria (NC) levels refer to the unoccupied classroom (i.e., excluding student-activity noise) with mechanical services (e.g., the HVAC system) in typical operation, with normal activity occurring outside the classroom, and the classroom doors and windows closed.
- .4 For all room categories, it is critical that there is adequate sound isolation between the rooms and adjacent spaces. The adjacent spaces may include, but are not limited to, projection booths, other learning spaces, meeting rooms, washrooms, and corridors.
 - .1 All perimeter walls should achieve a Sound Transmission Class (STC) rating of STC 55.
 - .2 Doors should be solid core with acoustic seals to provide the noted STC rating above.
 - .3 Noise isolation to rooms above and below should be a minimum STC rating of 50.
 - .4 Alternative criteria may be acceptable subject to the building type (i.e., administrative spaces); liaise with UBC representative.
- .5 Sound Transmission Class (STC) is a single number method of rating how wall partitions, floors and ceilings reduce sound transmission.
- .6 Classroom equipment (projectors, computers, AV furniture ventilation fans, etc.) should be chosen to meet these criteria.
- .3 **Objectives**
 - .1 This standard presents acoustical performance criteria that will ensure that the acoustical environments in UBC classrooms are of high quality for the majority of instructors and students.

- .2 It ensures that excellent verbal communication is possible between students and teachers. This is achieved by ensuring, at all seats, sufficiently high speech levels and sufficiently low noise levels, as well as appropriate reverberation.
 - .3 Spaces with acoustical environments that do not meet these criteria would be expected to present barriers to teaching and learning.
- .4 Design Constraints**
- .1 The development of these acoustical standards was based on the following assumptions, and took into account the following constraints, in part imposed by current UBC policy:
 - .1 Classrooms are minimum 70 % occupied when used for teaching and learning;
 - .2 new UBC classrooms will normally have resilient flooring with plastic seating but could have carpets/carpet tile, upholstered seating and/or sound-absorptive wall treatments;
 - .3 many UBC classrooms have ceiling absorption – often form all or part of a suspended acoustical ceiling – to control the classroom reverberation, in-class student-activity noise and impact noise from spaces above the classroom;
 - .4 Given the above, the main source of sound absorption is the occupants of the classroom. Classrooms need to be designed to have optimal acoustic properties with minimum 70% occupancy, resilient flooring, plastic seating and T-bar ceilings.
- .5 Controlling Classroom Sound**
- .1 Acoustical design is a complex inter-disciplinary task that must be considered in the design or renovation of all classrooms.
 - .2 An acoustical consultant must be involved at the inception of all projects. The acoustical consultant should work closely with UBC Facilities Planning Learning Spaces, UBC IT Audio Visual, the Project Architect and other Consultants designing building systems.
 - .3 Coordinate with other UBC Technical Guideline sections relating to Acoustics:
 - .1 Section 08 00 10, Openings- General requirements, 1.3.7, for sound attenuation rating requirements.
 - .2 Section 09 00 10 – Finishes- General Requirements, section 1.3 Acoustic Requirements
 - .3 Section 09 00 10 – Finishes – General Requirements, 2.2.11 Flooring Materials and Design Requirements for lecture theatres and areas with fixed seating.
 - .4 Section 09 00 10 – Finishes – General Requirements, 5.1.5 Ceiling Materials to coordinate for noise and sound reduction requirements.
 - .5 Section 09 51 00 Acoustical Ceilings, section 2.0 for ceiling materials requirements.
 - .4 Controlling and optimizing the acoustical conditions in a classroom, or other rooms for speech, involves three fundamental considerations:
 - .1 Promoting high speech levels by:

- .1 Avoid excessive volume due to high and vaulted ceilings.
- .2 Use geometries that direct sound to the back of the room.
- .3 Avoid long and wide rooms.
- .2 Use speech-reinforcement system Control background noise (NC) by:
 - .1 Avoid open-plan design.
 - .2 Control the noise and vibration of mechanical services.
 - .3 Choose quiet equipment for use in the classroom, or enclose them in properly designed enclosures.
 - .4 Impact noise due to student activity.
 - .5 Provide adequate sound isolation; in critical cases, this might require the use of non-openable windows, entrance vestibules and quality door seals.
- .3 Optimizing reverberation (RT60) by:
 - .1 Apply appropriate sound-absorptive materials to the room surfaces.
 - .2 Avoid applying sound absorption to surfaces that can provide strong early reflections. This may be the front of a lecture theatre, or the central portion of a meeting room, for example.

.6 Verification and Commissioning

- .1 During the design process, a representative set of rooms should be modelled to ensure they meet the required acoustic properties outlined above and test results are to be provided to verify rooms meet UBC Acoustic Criteria.
- .2 Commissioning is to be done by an independent third party acoustic commissioner retained by the Owner's Representative to ensure rooms meet the design requirements.
- .3 The list of rooms to be included in the commissioning and verification report shall be selected and approved by UBC Facilities Planning, noting that site conditions may require alternative rooms to be tested.
- .4 Upon completion of construction and mechanical system balancing, commissioner to perform acoustic verification for the selected rooms. Commissioner to carry all costs of acoustic verification and provide verification report upon completion.
- .5 Allow for testing and verification of acoustic parameters by commissioner. Verification report to include the ambient noise level due to HVAC systems, in terms of NC, measured and calculated in accordance with ANSI S12.2 "Room Noise Criteria"; and the reverberation time, in terms of RT60, measured in accordance with ISO 3382 (Part 1, or Part 2, as relevant to the space-type).
- .6 Allow time and material for full participation in the commissioning process in line with the commissioning plan at no additional cost to the project.
- .7 Acoustic commissioning to be coordinated with the Cx Authority and Facilities Transition Team.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 UBC Signage – Interior Signage Guidelines
- .2 UBC Wayfinding – Exterior Signage Standards and Guidelines
- .3 UBC Protocol for Space Inventory Designation
- .4 Section 10 14 01 Door Identification

1.2 **Description**

- 1. Section includes special requirements in for room numbering in a building.

1.3 **Coordination**

- 1. The project team is to coordinate with UBC Facilities Facility Information & Inventory Systems (FIIS) at fd.fis@ubc.ca.
- 2. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 3. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 4. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 5. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 The Facility Information & Inventory Systems (FIIS) unit of UBC Facilities, Customer Service and Informatics approves room numbering in accordance with the following:
 - .1 Architectural floor plans at the design development phase must be submitted with proposed room numbers in conjunction with the proposed door identification tags following the Door Identification guidelines (Section 10 14 01) to the FIIS Unit for approval.
 - .2 Once room numbers are approved, any further change to room numbers must be re-submitted to FIIS for approval.
 - .3 Approved room numbers must be incorporated in drawings issued for construction. Further changes during construction must be reviewed and approved by FIIS.
 - .4 Room numbers must only consist of alphanumeric characters and must not contain any special characters.
 - .5 A maximum of 6 digits for room numbers - refer to guidelines below.

2.2 **Design Intent**

- .1 Life Safety: Identify each space in case of emergency.
- .2 Maintenance: Identify each space for maintenance purposes.
- .3 Wayfinding: Make wayfinding through the building as simple and logical as possible.
- .4 Operational use: Plan for various operations and system applications dependent on room

numbers

2.3 Room Numbering Allocation

Room numbers are to be assigned to:

- .1 Every corridor that changes direction from the adjacent corridor.
- .2 Every lobby space that might be considered as a separate space from the adjacent corridor.
- .3 Every room that has a door or that is separate from the adjacent room.
- .4 Exit stairs should be numbered separately as ST1, ST2, and etc.

2.4 Room Numbering Guidelines

- .1 First basement floor shall be numbered B100's.
- .2 Additional underground floors shall be numbered B200's, B300's etc.
- .3 Level 1 use 100's etc. (for larger buildings use 1000).
- .4 Level 2 use 200's etc. (for larger buildings use 2000).
- .5 If necessary, the numbering can be changed to 1000's to accommodate a large number of rooms. In that case, the floors would be 1000, 2000 etc. and the first basement level would

be B1000, with additional underground floors following the B2000, B3000 series. (For lower basement floors, the interior rooms can now be assigned a maximum of 6 digits, i.e. B1000A. (Recent UBC database improvements now allow a 6 digit limitation.)

- .6 The mechanical room (and/or penthouse) shall be designated a level number and room number consistent with the 100's, 200's system.
- .7 The numbering pattern of each floor should be as consistent as possible with the numbering of other floors within the same building.
- .8 Lobbies and corridors to take on the 10's, (e.g. 120, 130, 220, 230 etc.).
- .9 Odd numbers on one side (e.g. 131, 133 etc.) Even numbers on opposite side (e.g. 132, 134 etc.). *See 1.8.7.1 and 1.8.7.2.
- .10 Washrooms to follow guidelines of a typical room.
- .11 Stairwells to be numbered prefixed with "ST" (e.g. ST1, ST2, ST3, etc.)
- .12 Start numbering with the lowest numbers at the main entrance and continue following the main circulation flow.
 - .1 Where a main entrance separates two or more building wings, give each wing a distinct set of numbers that flows logically from the adjacent wing (e.g. Wing A: rooms 1000-1099; Wing B: rooms 1100-1199).
 - .2 Refine the room numbering system according to how a visitor might logically move through the building in search of a room number.
- .13 When approaching from the entrance,
 - .1 In double loaded corridors, odd numbers should be on the left and even numbers on the right.
 - .2 In single loaded corridors, assign numbers consecutively.
 - .3 It is acceptable to skip numbers to allow for future renovations.
 - .4 Where a large suite of rooms is accessed from the circulation corridor by a single entry door, use a distinct set of consecutive numbers that follow the main entry room number.
 - .5 For a room, which is accessible only from another room, (a "sub-room"); label the sub-room by adding a letter to the number of the room from which the sub-room is accessed, e.g. 124 & 124A.

2.5 Associated Numbering

- .1 Exterior Doors - Label all doors leading into the building (but not the interior doors) with letters (A, B, etc.) starting from the main entry door and following clockwise.
- .2 Signs at Elevators, Elevator Call Buttons, Fire Alarm Annunciator Panels and Exit Stairs – For signs denoting floor numbers assign floor numbers as follows:
 - .1 Basement floors are to be shown as "B1, B2, and B3 etc."
 - .2 Level 1, first or main floor is to be shown as "1".
 - .3 Level 2 or second floor is to be shown as 2, and etc.

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 08 00 10 Openings – General Requirements
- .2 Section 10 14 00 Room Numbering
- .3 Section 10 14 05 Signage Standards and Guidelines

1.2 Description

- 1. Section includes special requirements in for door numbering in a building.

1.3 Coordination

- 1. The project team is to coordinate with UBCV Facilities Facility Information & Inventory Systems (FIIS) at id.fis@ubc.ca.
- 2. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 3. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 4. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 5. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

2.0 DESIGN REQUIREMENTS

2.1 Design Requirements

- .1 The Facilities Information & Inventory Systems (FIIS) unit of [Customer Service and Infomatics, UBCV Facilities](#) approves interior and exterior door identification in accordance with the following:
 - .1 At the design development phase, architectural floor plans must be submitted with proposed door numbers in conjunction with proposed room numbers following room numbering guidelines (in coordination with Section 10 14 00) to the FIIS Unit for approval.
 - .2 Once door numbers are approved, any further changes to the design affecting room numbers must be re-submitted to FIIS for approval.
 - .3 Approved door IDs must be incorporated in drawings issued for construction & door hardware schedule. Further changes during construction must be reviewed and approved by FIIS.
 - .4 Door IDs must be uniquely identified.
 - .5 Door IDs must consist of alphanumeric characters and must allow for special characters for separation of values

2.2 Design Intent

- .1 Secure Access: Granting and revoking access to the building occupants, students, faculty, staff and other select groups within the UBC community.

- .2 Locksmith Shop: Identifying associated hardware components and build for maintenance purposes.
- .3 Operational use: Planning for various operations and system applications dependent on door numbers.

2.3 Door Identification Allocation

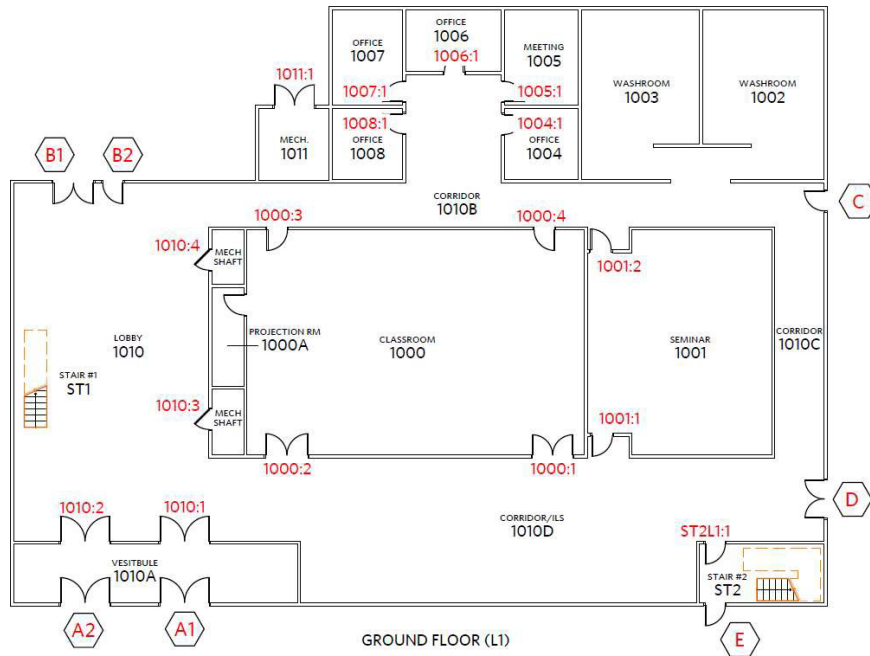
Door IDs tags are assigned to:

- .1 Every door that has lockable/latching hardware.
- .2 Every door that secures a room/s, mechanical airways or shaft/s, electrical or custodial closets.

2.4 Door Numbering Guidelines

- .1 Interior Door Identification
 - .1 The door IDs are assigned based on the room being secured.
 - .2 Door IDs are assigned using the room number followed by a colon (:) and the door tag starting at 1. *For example: Room 100 will have a door ID 100:1*
 - .3 For rooms with multiple doors, door IDs are assigned in sequence for room, starting from the main entrance and continuing clockwise, e.g., 201:1, 201:2, and etc.
 - .4 Doors leading into stairwells are tagged according to the stair number and floor.
 - Stair 2 level 1 (ST2L1:1)
 - Stair 2 level B1 (ST2B1:1)
 - .5 Airway/Shaft door IDs are associated with the room number of the corridor. Doors leading into corridors will take priority in door sequences, e.g., 1000:1, 1001:2. Airway/shaft doors then follow, e.g., 1000:3, 1000:4, etc.
- .2 Exterior Door Identification
 - .1 Label all doors leading into the building with letters (A, B, etc.) starting from the main entry door and following clockwise. Except for letter I and O.
 - .2 Exterior entrances using double doors will be grouped as one letter but separated by numeric number, e.g., A1, A2, etc.
 - .3 Exterior doors that does not lead to the main portion of the building will follow the interior door ID guideline.

Sample floorplan



2.5 Associated Numbering

- .1 Room numbers – coordinate with Section 10 14 00.

END OF SECTION

1.0 **GENERAL**

1.0 Related Work and UBC Guidelines

- .1 Section 10 14 00 Room Numbering
- .2 Section 10 14 01 Door Identification
- .3 UBC Interior Signage Guidelines
- .4 UBC Exterior Signage Guidelines
- .5 UBC Learning Space Design Guidelines
- .6 UBC Inclusive Washroom Guidelines

1.1 Description

- 1. Section includes guidance on signage and wayfinding requirements for buildings.

1.2 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

2.0 **DESIGN REQUIREMENTS**

2.1 Interior Signage and Wayfinding – UBC Interior Signage Guidelines

- .1 The interior signage guidelines can be found at
https://www2.infrastructuredevelopment.ubc.ca/docs/UBC_INT_SIGNAGE_GUIDELINE.pdf
- .2 Modifications to or creation of existing interior signage:
 - .1 UBC Vancouver Campus - please submit a service request to:
<https://facilities.ubc.ca/services/>
 - .2 UBC Okanagan Campus, contact Facility Management at
facilities.ok@ubc.ca
- .3 New interior signage or to obtain interior signage approvals: please contact:
 - .1 UBC Vancouver Campus:
Technical Review Team Architect
 - .2 UBC Okanagan Campus:
Campus Planning and Development (CP+D):
<https://operations.ok.ubc.ca/submit-request/>

2.2 Exterior Signage and Wayfinding – UBC Exterior Signage Standards and Guidelines

- .1 The exterior signage guidelines can be found at
http://assets.brand.ubc.ca/downloads/ubc_%20signage_standards_and_guidelines_2019.pdf

For additional information regarding external signage, please contact Carmen Rida at carmen.rida@ubc.ca or 604-822-0464.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 [Section 12 20 00 Window Coverings and Blinds](#)
- .2 [UBC Vancouver Solid Waste Infrastructure Guidelines](#)
- .3 [UBC Resilience-Based Design Guide for Nonstructural Systems](#)

1.2 Description

- 1. Section includes products and installations above and beyond base building components.

1.3 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. Coordinate seismic restraint of equipment with project structural engineer.
- 6. Coordinate washroom and wall/door protection specialties with UBCV Facilities Technical Review Team Architect. For UBCO projects, coordinate with UBCO Facilities Management.

1.4 Quality Control and Assurance

- .1 Quality Assurance
 - .1 Seismic restraint work including anchoring devices to be designed and certified by a Professional Engineer registered in the Province of BC, and at completion, to Letter of Assurance. Costs to be included in Contract.
- .2 Submittals in O&M manual:
 - .1 Shop drawings: required for all seismically restrained engineered studwork, bracing, and suspension systems, including where such systems act as support for work requiring seismic restraints (i.e. laboratory and other cabinets, fume hoods, vending machines, etc.). Shop drawings to be signed and sealed by a professional engineer registered in the Province of BC.
 - .2 Manufacturer's data including product and colour specifications.
 - .3 Maintenance instructions.

2.0 DESIGN REQUIREMENTS

2.1 General Requirements

- .1 Provide materials and systems suitable for occupancy and use, durability, and reuse during renovations.
- .2 For renovation projects re-use existing equipment where possible and specify equipment that can be re-used. For re-use of equipment, coordinate with the UBCV technical Review Team Architect or UBCO Facilities Management.
- .3 For renovation projects where existing equipment and materials are to be turned over to UBC for re-use or parts – coordinate with UBC Project Manager who in turn will consult with the

UBCV Technical Review Team Architect or UBCO Facilities Management.

2.2 Entrance Mats

- .1 Mat wells shall not be used, only walk-off mats shall be used.
- .2 Institutional grade entry mats are required in all entries to reduce cleaning, and to provide sufficient non-slip flooring at entrances.
- .3 Any exterior or interior vestibule doors that swing over walk off mats must have sufficient clearance underneath to accommodate the mats without having to make special provisions in the mats such as cutaways.
- .4 All main entrances must contain 8 to 12 feet of interior matting from entrance doors. Matting must include one outdoor scraper style mat with one indoor scraper/wiper style mat.
- .5 All mats to have cart-edging.

- .6 Outdoor scraper style mat to be similar in construction to the 3M™ Nomad™ 9100 Terra Entrance Matting and to extend 6 to 8 feet from the entrance. Width to cover width of doorway.
- .7 Indoor scraper/wiper mat to meet same specifications as Source Floor & Specialties Inc Grizzly FX Matting, dryer-scraper mat. Dimensions to be as per 2.4 depending on anticipated building traffic and space restrictions. Width to cover width of doorway entirely.

2.3 Interior Guardrails for Elevated Service Walkways

- .1 In the design of elevated service walkways, the use of 1500 mm (5'-0") high guards is preferred rather than the BCBC minimum guard height of 1068 mm (3'-6").

2.4 Wall Protection

- .1 Corner guards shall be provided in high traffic corridors, and generally in areas subject to abuse. In corridors, wall protection to be at least 3'-0" from finished floor.
- .2 Corner guards shall be 18 gauge stainless steel, no. 4 brushed finish and a minimum height of 40" from finished floor to a width of 4" each side.
- .3 Provision of crash rails/wall bumpers to be coordinated with the user group/s needs. Acrovyn wall protection products or equivalent are acceptable.

2.5 Door Protection

- .1 Kickplates to be at least one foot high from base of all high traffic doors.
- .2 All doors leading to and from bike storage areas to include metal kick plates that are half door high. Smaller kick plates do not work for these doors. Usually it is noted that bicyclists trying to keep the door open with their bicycles resulting in damage to the doors.

2.6 Retractable Stanchions

- .1 Open entrances to multi-stall gendered or gender-neutral washrooms to have a retractable stanchion added at the entrances.
- .2 Mounting hardware: 3 inch x 4 inch metal plate mounted at each side of entrance, no jagged edges or catching surfaces for users as they enter.

2.7 Demountable Partitions

- .1 Consider the use of demountable partitions when frequent changes (such as office areas) are expected.
- .2 Selection of such systems to be based on long-term availability of components and finishes.
- .3 The design of demountable partitions should be complimented by equally flexible design of mechanical and electrical systems.
- .4 Carefully establish and coordinate electrical and communications requirements and components with UBC IT Services.
- .5 Include engineering and anchoring of all structural bracing. Coordinate with ceiling system installation where full-height partitions are used.

2.8 Interior Recycling Waste Stations

- .1 Interior space shall be allocated on floor plans for multi-stream recycling stations in accordance with Recycling Infrastructure Guidelines for UBC Buildings.
- .2 Consult with UBCV Technical Review team Architect to confirm locations and selection of appropriate equipment.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 For floor drains, see Section 22 05 00 Plumbing - General Requirements
- .2 [Recycling Infrastructure Guidelines for UBC Buildings](#)
- .3 [UBC Resilience-Based Design Guide for Nonstructural Systems](#)

1.2 **Co-ordination Requirements**

- .1 Coordinate seismic restraint of equipment with Structural Engineer.
- .2 Coordinate washroom and wall/door protection specialties with UBCV Facilities Technical Review Team Architect plus Facilities Custodial Services. For UBCO projects, coordinate with UBCO Facilities Management.

1.3 **General Requirements**

- .1 Provide materials and systems beneficial to use and occupancy, durability, and reuse during renovations.
- .2 For renovation projects re-use existing equipment and specify equipment that can be re-used.
- .3 For renovation projects existing equipment and materials to be turned over to UBC for re-use or parts - consult UBC Project Manager.
- .4 Submittals in O&M manual:
 - .1 Where applicable, provide shop drawings and also signed and sealed by a professional engineer registered in the Province of BC.
 - .2 Manufacturer's data including product and colour specifications.
 - .3 Maintenance instructions.
 - .4 For blinds, refer to Section 12 20 00 – Window Coverings and Blinds.
- .5 Quality Assurance
 - .1 Where seismic restraints are required, coordinate with the UBC Resilience-based Design Guide for Nonstructural Components. Seismic restraint work including anchoring devices to be designed and certified by a Professional Engineer registered in the Province of BC, and at completion, to Letter of Assurance. Costs to be included in Contract.

2.0 **ENTRANCE MATS (previously in Section 09 00 10)**

- 2.1 Mat wells shall not be used, only walk-off mats shall be used.
- 2.2 Institutional grade entry mats are required in all entries to reduce cleaning, and to provide sufficient non-slip flooring at entrances.
- 2.3 Any exterior or interior vestibule doors that swing over walk off mats must have sufficient clearance underneath to accommodate the mats without having to make special provisions in the mats such as cutaways.
- 2.4 All main entrances must contain 8 to 12 feet of interior matting from entrance doors. Matting must include one outdoor scraper style mat with one indoor scraper/wiper style mat.
 - .1 All mats to have cart-edging.

- .2 Outdoor scraper style mat to be similar in construction to the 3M™ Nomad™ 9100 Terra Entrance Matting and to extend 6 to 8 feet from the entrance. Width to cover width of doorway.
- .3 Indoor scraper/wiper mat to meet same specifications as Source Floor & Specialties Inc. Grizzly FX Matting, dryer-scraper mat. Dimensions to be as per 2.4 depending on anticipated building traffic and space restrictions. Width to cover width of doorway entirely.

3.0 INTERIOR GUARDRAILS - Elevated Service Walkways

- 3.1 In the design of elevated service walkways, the use of 1500 mm (5'-0") high guards is preferred rather than the BCBC minimum guard height of 1068 mm (3'-6").

4.0 WALL PROTECTION AND CORNER GUARDS

- 4.1 Shall be provided in high traffic corridors, and generally in areas subject to abuse. In corridors, consider wall protection to 3'-0" from finished floor.
- 4.2 Corner guards shall be 18 gauge stainless steel, no. 4 brushed finish and a minimum height of 40" from finished floor to a width of 4" each side.

5.0 DOORS & WASHROOM ENTRANCES

- 5.1 There should be a provision for kickplates at least one foot high from base of all high traffic doors.
- 5.2 All doors leading to and from bike storage areas to include metal kick plates that are half door high. Smaller kick plates do not work for these doors. Usually it is noted that bicyclists trying to keep the door open with their bicycles resulting in damage to the doors.
- 5.3 Open entrances to multi-stall gendered or gender neutral washrooms to have a retractable stanchion added at the entrances. Preferred mounting hardware, 3 inch x 4 inch metal plate mounted at each side of entrance, no jagged edges or catching surfaces for users as they enter.

6.0 DEMOUNTABLE PARTITIONS

- 6.1 Consider the use of demountable partitions when frequent changes (such as office areas) are expected.
- 6.2 Selection of such systems to also be based on long-term availability of components and finishes.
- 6.3 Carefully establish and coordinate electrical and communications requirements and components with UBC IT Services.
- 6.4 Include also the engineering and anchoring of all lateral bracing, which is to be independent of, or coordinated with, metal suspension systems for ceilings.

7.0 WASHROOM MILLWORK

- 7.1 Washroom millwork shall be in accordance with Section 06 40 00 Architectural Woodwork.

8.0 RECYCLING AND WASTE MANAGEMENT RECEPTACLES & WASTE STATIONS

8.1 Recycling and Waste Receptacles

- .1 Multi-stream recycling stations shall be provided in accordance with the [Recycling Infrastructure Guidelines for UBC Buildings](#). Consult with *Facilities* Custodial Services to confirm locations and selection of appropriate equipment.

8.2 Space for Recycling and Waste Stations

- .1 Interior space shall be allocated on floor plans for multi-stream recycling stations in accordance with [Recycling Infrastructure Guidelines for UBC Buildings](#). Consult with Facilities Custodial Services to confirm locations and selection of appropriate equipment.

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work & UBC Guidelines**

- .1 Section 05 50 00 Metal Fabrications (Engineered Metal Suspension Systems)
- .2 Section 10 28 00 Toilet, Bath and Laundry Accessories
- .3 [UBC Inclusive Washroom Guidelines](#)
- .4 [UBC Resilience-Based Design Guide for Nonstructural Systems](#)

1.2 **Related External Documents**

- .1 Latest version of the BC Building Code.
- .2 CSA-B651-12 - Accessible Design for the Built Environment.
- .3 Combustibility testing of partitions must be compliant with latest version of the ASTM-E84 standards and National Fire Protection Agency (NFPA) standards.

1.3 **Description**

- .1 [Section includes](#) toilet, change room and shower partitions, urinal screens.

1.4 **Coordination**

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- .5 Coordinate seismic restraint of equipment with project structural engineer.
- .6 Coordinate washroom and wall/door protection specialties with UBCV Facilities Technical Review Team Architect. For UBCO projects, coordinate with UBCO Facilities Management.

1.5 **Submittals**

- .1 O& M manual submittals:
 - .1 Final reviewed shop Drawings shall include complete backing/support requirements and engineering data.
 - .2 List of hardware and fittings provided.
 - .3 Colour specification.
 - .4 Maintenance data shall include graffiti removal techniques.
- .2 Warranty:10-year manufacturer's warranty.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 Toilet Count

Where classrooms and lecture theatres exist, the number of toilets and sinks in proposed women's washrooms is required to be increased by one third over the number required by the current version of the BC Building Code. This is due to greater demand between scheduled classes.
- .2 Seismic restraint for partitions shall be designed by a professional structural engineer registered in the Province of BC.
- .3 Washroom compartments may be floor or wall-mounted partitions. Ensure adequate

- mounting for full-height partitions where used.
- .4 For renovation projects, re-use partition panels whenever possible.

2.2 Performance Requirements – Not Used

3.0 MATERIALS

3.1 Product Selection

- .1 Partition systems to be Solid Phenolic partition systems with a Class A flame spread rating.

3.2 Hardware

- .1 Locking hardware to be as per the latest version of BCBC. Each compartment to be complete with the following hardware:
 - .1 Combination coat hook/door bumper for single toilet compartments.
 - .2 Door bumper as required for outward-opening accessible compartments.
 - .3 Hook for accessible stalls to be mounted on front wall and not on door so as not to be a hazard to persons with low vision. Hooks for accessible stalls to be installed at accessible height per BC building Code. The preference is for two hooks installed at different heights for flexibility.
 - .4 Combination stop/ latch - with emergency lift feature.

- .2 Non-removable self-closing hinges - with emergency lift feature. Hinges to function per requirements of the BC Building Code for accessible compartments.
- .3 Door pulls to be provided for accessible compartments.

3.3 Partition-Mounted Accessories

- .1 Accessories to be as per Section 10 28 00 Toilet, Bath and Laundry accessories.
- .2 Partition panels should be capable of accepting surface-mounted accessories such as grab bars, toilet paper dispensers and sanitary napkin dispensers and bins.
- .3 Where grab bars are mounted directly on partitions, panels and connections shall be designed by a professional structural engineer registered in the Province of BC, per loading requirements in the BC Building Code.

3.4 Fabrication

- .1 Edges are to be beveled and/or rounded.

3.5 Finishes

- .1 All toilet partitions shall have durable, institutional grade finishes that require minimal maintenance while being resistant to graffiti and cleaning chemicals..

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 06 10 00 Rough Carpentry – backing for toilet and shower accessories.
- .2 Section 10 21 13 Toilet Compartments
- .3 Section 22 40 00 Plumbing Fixtures – plumbing fixtures and use of motion sensor-activated fixtures
- .4 UBC Inclusive Washroom Guidelines
- .5 UBC Solid Waste Infrastructure Guidelines

1.2 **Description**

- .1 Section includes toilet and shower accessories.

1.3 **Coordination**

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.4 **Submittals**

- .1 Submittals in O&M manual:
 - .1 Final reviewed shop drawings, complete with specified finishes and maintenance requirements.
- .2 Handover/ Turn-Over Procedures
 - .1 Final cleaning inspection to be conducted by a Facilities Custodial Services Representative prior to occupancy.
 - .2 Cleaning and floor finishing work to be performed to Facilities Custodial Services Standards.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 Double toilet roll dispensers are to be used in all washroom types. Although a single toilet roll dispenser type has been provided, a single roll toilet dispenser can be used only where absolutely required. Installation of single toilet roll dispensers will require a variance request. A variance will be granted only if acceptable to Facilities Custodial Services.
- .2 In new construction or major renovations, provide the required electrical wiring for hand dryers and terminate the wiring in a suitable location in a junction box recessed in the wall with a stainless steel decorative cover plate (close to the sinks). For hand dryer type, see paragraph 3.1.8..
- .3 Ensure sufficient backing for secure mounting of accessories is provided.

2.2 **Performance Requirements – Not Used**

3.0 MATERIALS

3.1 Product Selection

- .1 Double Toilet Roll Dispensers
 - .1 Kimberley Clarke Professional, 09551 Twin Toilet Tissue Dispenser
 - .2 Colour: Black/Smoke
 - .3 Unit Size: 20.43" x 13.12" x 5.8" (51.9 cm x 33.3 cm x 14.7 cm)
- .2 Single Toilet Roll Dispensers
 - .1 San Jamar, R2090TBK Oceans 9" Single Roll Jumbo Toilet Tissue Dispenser
 - .2 Colour: Black Pearl
 - .3 Single toilet tissue dispensers are to be used only if acceptable to Facilities Custodial Services. Consult with the UBCV Technical Review Team Architect for such installations first.
- .3 Soap Dispensers
 - .1 Veritiv Supply, Purell FMX 20 (SKU 5234-06)
 - .2 Colour: Graphite/Metallic.
 - .3 Dispenser type: 2000ml
 - .4 Dispensing system using a refillable dispenser with front button operated valve.
 - .5 Product refill 2000ml Purell Healthy Soap SKU 5572-02
 - .6 Install at a location in reach of seated position in front of lavatory.
- .4 Sanitary Napkin Dispensers
 - .1 Frost Products Limited, Double Combo, Frost ref. # 608-3 in stainless steel.
 - .2 Mechanism shall be 25 cent.
 - .3 Product must be on FREE vend system only. Require coinless units only.
 - .4 Note: In accessible washrooms, accessible toilet compartments and compartments for persons with limited mobility, install within reach of toilet seat and located so as to maintain toilet compartment and grab bar clearances required by the BC Building Code.
- .5 Sanitary Napkin Disposal Bins
 - .1 Frost Products Ltd., # 622.
 - .2 Colour: Brushed stainless steel.
 - .3 Note: In accessible washrooms, accessible toilet compartments and compartments for persons with limited mobility, install within reach of toilet seat and located so as to maintain toilet compartment and grab bar clearances required by the BC Building Code.
- .6 Grab Bars
 - .1 Installed as per latest edition of BCBC requirements with tamper-proof fasteners and non-slip surface.
- .7 Garbage Containers (Large)
 - .1 Rubbermaid Marshall Classic Container # 8170-88.
 - .2 Colour: Black.
 - .3 Unit size: 18' x 42" high, 23lb./10.4Kg.
 - .4 This garbage bin type to be purchased for washrooms with paper towel dispensers or baby change tables only.
 - .5 Wall-mounted and millwork-installed garbage containers are not allowed.
 - .6 Garbage container must not interfere with clear floor areas required by the latest edition of the BC Building Code, including clear floor areas around doors.
- .8 Hand Dryers
 - .1 Dyson Airblade HU02 or Dyson Airblade 9kj.

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- .2 Either type of hand dryer must be supplied with wall mounted backplate in brushed stainless steel when mounted on drywall surfaces.
 - .3 Only hand dryers are to be installed in new buildings, major renewals and renovations.
 - .4 Hand dryers to mounted as close as possible to accessible lavatories to limit the distance that people in wheelchairs have to move to access them. Mount hand dryers at accessible heights per BC Building Code.
 - .5 Installation of paper towel dispensers in addition to hand dryers will require a variance request. A variance will be granted only if acceptable to Facilities Custodial Services.
- .9 Toilet Seat Lids used as Back Rests:
- .1 Toilet seats in regular toilet stalls should not have a lid attachment.
 - .2 For accessible washrooms, accessible toilet compartments and compartments for people with limited mobility, toilet seat lids are to be used as back rests.
 - .3 Toilet seat lids when used as back rests should not interfere with the flushing mechanism.

4.0 LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS

Items in this section are lessons learned or misses from past projects. These may also include code or industry best practices. If not applicable to a project, a variance is not required.

- .1 Use of single versus double toilet roll dispensers:
 - .1 As mentioned frequently to project teams, the double roll dispenser works well for UBC particularly for accessible washrooms as there is a backup when one roll runs out. It would be far worse to let a user run out of toilet paper, and it is always best to have the option of using another roll.
 - .2 The use of a double roll dispenser also ends up being a more sustainable option compared to the single roll dispenser. Due to the cleaning cycles implemented in buildings, even if there is some paper/tissue remaining, rolls in single dispensers need to be changed out and replaced resulting in much more waste.
 - .3 It is not possible to ask user groups to take on monitoring of washrooms that have single toilet roll dispensers to ensure toilet rolls are available for use at all times.
- .2 Toilet back rest in accessible washroom:
 - .1 UBC Facilities ask that the toilet seat lid be used as a backrest instead of using the small backrest panel over the flush valve if possible. This change of providing toilet seat lids is for accessible washrooms only. The TG's note that that toilet seat lids should not be provided, but an exception will be made only for accessible/universal washrooms.
 - .2 Coordination will be needed with the flush valve specified to ensure that one does not push on the manual or auto flush button, causing the toilet to flush unintentionally and repeatedly. (Also happens if you lean back where there is a toilet seat lid). This would be extremely annoying and unhygienic for anyone trying to use the toilet with no lower body strength.

*****END OF SECTION*****

1.0 **GENERAL**

1.0 **Related Work and UBC Guidelines**

- .1 Section 06 10 00 Rough Carpentry – backing for toilet and shower accessories.

1.1 **Co-ordination Requirements**

- .1 The University Branch of the Vancouver Fire Department – [Vancouver Fire and Rescue Services](#) - to confirm current requirements for each individual project.

1.2 **Description**

- .1 Fire Extinguishers, Cabinets, Accessories and their installation.

1.3 **Coordination**

- .1 The University Branch of the Vancouver Fire Department – [Vancouver Fire and Rescue Services](#).- to confirm current requirements for each individual project.

1.4 **Performance Standards**

- .1 BC Fire Code, NFPA #10.

1.5 **Submittals**

- .1 Proposals shall be submitted to the Fire Protection Manager, Vancouver Fire [and Rescue Services](#), phone number: 604-665-6068.
- .2 Shop Drawings and Maintenance Instructions are to be submitted to the UBC Branch of the Vancouver Fire Department – [Vancouver Fire and Rescue Services](#).

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 Fire extinguishers to be installed in locations, recesses, or cabinets so that they do not project more than 100 mm horizontally into exit passageways, public corridors, corridors used by the public or corridors serving classrooms or patient's sleeping rooms, and in a manner not to create a hazard for visually impaired persons traveling.
- .2 Where fire extinguishers are installed in cabinets they are to be provided with a sign acceptable to the Vancouver Fire Department.
- .3 Where fire extinguishers are installed on walls they are to be installed on UBC Standard backing boards. The backing boards are available in standard sizes and finishes from Building Operations Stores, at a cost to be confirmed with Building Operations.

2.2 **Performance Requirements – Not Used**

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 **Acceptable Fire Extinguisher Types**
 - .1 All new extinguishers to be made available to the UBC Branch of the Vancouver Fire Department for bar coding and applying a UBC Security number onto the extinguisher.
- .2 Dry Chemical - Ansul Cartridge operated only - ABC or BC rating (typical).

- .3 CO2 - as per B.C. Fire Code Regulations. (For specific installations only, see Vancouver Fire Department.)

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 12 35 53 Laboratory Casework
- .2 [Section 20 00 08 Mechanical Identification for fume hood labelling type](#)
- .3 [Section 23 38 00 Fumehood, Lab and Contaminated Exhaust System for fume hood labelling requirements.](#)
- .4 [UBC Resilience-Based Design Guide for Nonstructural Systems](#)

1.2 **Related External Documents**

- 1. Part 30 Laboratories, of the Occupational Health and Safety (OHS) Regulation under the inspection jurisdiction of WorkSafe BC, and the
- 2. Latest edition for CSA-Z- 316.5 Fume Hoods, and Associated Exhaust Systems.
- 3. Canadian Biosafety Standard 3rd Edition, (latest revision), published Public Health Agency of Canada.
- 4. Containment Standards for Veterinary Facilities, Canadian Food Inspection Agency, Publication 1921/E (latest revision).
- 5. Canadian Nuclear Safety Commission Standard GD-52, Design Guidelines for Basic and Intermediate Level Radioisotope Laboratories (latest revision).
- 6. NSF (National Science Facilities) standards (latest revision): for all biosafety cabinets; fully reticulating HEPA filters typical.

1.3 **Description**

- .1 Section includes design and fabrication of fume hoods and bio-safety cabinets.

1.4 **Coordination**

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- .3 These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 The selection of fume hoods and biological safety cabinets is to be made in consultation with UBC Safety and Risk Services (UBC SRS), UBC Facilities and the principal researcher to ensure that the scientific, safety and engineering concerns are properly addressed.
- .5 Review design intent and additional requirements with UBC SRS. Coordinate with UBC SRS early in the design process.
- .6 Consult with UBC Facilities on requirements to tie fume hoods into existing Building Management Systems (BMS).
- .7 Consult with UBC Facilities on requirements for fume hood modifications in existing buildings and tie-in with existing Building Management Systems (BMS).
- .8 The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 **Quality Assurance and Submittals**

- .1 Submittals in O&M manual:
 - .1 Manufacturer's data including product specifications.

.2 Maintenance instructions.

.2 Handover/Turn-Over Procedures

.1 Projects are responsible for commissioning and testing all fumehoods and BSC's. Provide a testing and commissioning report for SRS' review.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 All fume hoods and exhaust systems shall conform to Part 30 Laboratories, of the Occupational Health and Safety (OHS) Regulation under the inspection jurisdiction of WorkSafeBC, and the latest edition for CSA-Z- 316.5 Fume Hoods, and Associated Exhaust Systems, and show evidence of being performance tested in accordance with ASHRAE 110, Method of Testing Performance of Laboratory Fume Hoods.
- .1 Fume hoods shall conform to the function-specific requirements as applicable in Section 1.2.
- .2 Controls for the operation of the fume hood and service fixtures must be located external to the fume hood, per WorkSafeBC.
- .3 Set the fume hood sash at 15"-18" (381 mm -457 mm).
- .4 The correct maximum operating height of the sash must be clearly marked on the cabinet frame.
- .5 A fume hood must be connected to a local exhaust ventilation system which will provide air velocities over the operational face area of the hood that meet the current WorkSafeBC / OHS Requirements.
- .6 All fumehoods and mechanical sash stops shall be installed with an airflow monitor which complies with WSBC 30.9(5), (6). Any fumehoods within a project's boundaries (i.e. lab renovation) that do not have an existing airflow monitor shall have an airflow monitor installed as part of the project. A recess mounted electronic air monitor shall be mounted on the front face of the hood, indicating high, normal and low air flows, complete with audio and visual alarms.
- .7 Design of building structure to accommodate the provision of shielded radio isotope hoods (UBC to establish which hoods).
- .8 Design and construction must satisfy the containment levels required for foreseeable usage. Whenever a project permits, design and conform to Containment Level 2 requirements to allow flexibility of use even if foreseeable use requires only Containment Level 1.
- .9 Hoods intended for use with Perchloric acid shall be specifically designed for that use and shall be reviewed with UBC Safety & Risk Services and Building Operations, Technical Services. Material that is resistant to Perchloric Acid must be used for the fume hood, duct work, fans and stacks. Stainless steel is not an acceptable material for this service. Wash down systems must extend to the height of the stack.
- .10 Hood baffles are required with top and bottom ventilation slots. These must be fully adjustable and of the same material as the hood liner.

- .11 Fume hoods and biological safety cabinets shall be equipped with a positive lockable latching system. The locking system must allow for the addition of a tradesman's lock that complies with lockout procedures.
- .12 Where provided, the hood accessories must conform to the following specifications:
 - .1 Provide outside controls for all fume hoods as per OHS requirements.
 - .2 Sinks must be integrally welded to the work top or, if epoxy, sealed and recessed into the counter with 38 mm tail pieces.
 - .3 Flush type electrical receptacle consisting of a box 120 volt 15 amp U ground duplex stainless steel face plate must be located on the exterior of the fume hood preferably on the vertical stile.
 - .4 The fume hood must be prewired and CSA approved.
 - .5 The hood must be equipped with a vapor proof lamp and light switch and all wired to a junction box on top of the hood.
- .13 Operable windows are not to be installed in labs in order to allow negative pressures to be maintained relative to adjacent spaces and to prevent draft conditions.
- .14 For new lab buildings with numerous fumehoods, manifolded central systems which meet the requirements of ANSI Z9.5 are generally preferred complete with variable volume hoods, redundant high plume central fans and pressure independent air control valves. In situations with only a few hoods, constant volume hoods with a 1:1 hood to fan ratio may be more economical, simpler and have lower operating costs.
- .15 Seismic restraint requirements to be incorporated in the manufacture of fume hoods and bio-safety cabinets. Restraints and anchorage shall be designed to the BC Building Code. Coordinate with the [UBC Resilience-Based Design Guide for Nonstructural Systems for any requirements above and beyond the BCBC](#).
- .16 UBC Safety and Risk Services to determine additional regulatory and construction standards.

2.2 Performance Standards

- .1 Performance.
 - .1 Life Cycle Costing is to be calculated based on a 15 year life.

2.3 Certification and Commissioning Requirements

- .1 Testing of fume hood airflow performance shall be done by a party approved by UBC. Note that the face velocity requirement is more stringent than WorkSafeBC and that efforts shall be made to ensure that all tests are in the middle of their range. The reason for this is that fume hoods which are passed near the limit of the passing values have been found to be less likely to pass their annual re-certifications for the life of the fume hoods. The test report requires the following results as part of UBC Safety and Risk Services' requirement to approve fume hoods for occupancy:
 - .1 Average face velocity is measured between 0.43-0.57m/s (85-115FPM).

- .2 No single point in the average face velocity is less than 80% of the average face velocity.
 - .3 No single point in the average face velocity is greater than 120% of the average face velocity.
 - .4 **Maximum** cross draft measurements are less than 50% of the average face velocity (as measured 45cm from the face of the sash, using the procedure described in CSA Z316.5).
 - .5 Good smoke containment shown with a smoke test.
- .2 It must be demonstrated to UBC **Facilities** and UBC **Safety and Risk Services** that the fume hoods have been designed and installed to meet all requirements of the UBC Technical Guidelines.

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 Consult with UBC **Facilities**, **Building Operations** for mandatory, approved, or not approved products and materials.
- .2 Fume hoods to be either stainless steel lined or epoxy lined. All fume hood materials must be non-flammable. Radioisotope hoods to be of stainless steel construction.
- .3 Type 316L 16 gauge stainless steel number #4 finish and be of seamless one piece construction with all corners coved and radii.
- .4 All welds ground smooth and polished. A liner must be bolted and cemented to the steel framework forming a rigid and completely sealed chamber.
- .5 The duct stub must be 316L stainless steel.
- .6 The vertical sliding sash must be full view type with 6 mm thick tempered safety glass panel and stainless steel pull, and be counter balanced for smooth operation. Sash shall latch when fully open and when released shall automatically close by gravity.
- .7 For a stainless steel liner, hood work surface must be type 316L 16 gauge stainless steel, seamless welded and integral with liner. The work surface must have 6 mm high marine type edge. The underside of the work surface must have a 20 mm thick plywood sheet bonded to it for rigidity and sound deadening.
- .8 For an epoxy lined hood, the hood work surface must be 20 mm solid black epoxy sealed to the hood liner with a 6 mm high marine type edge sealed to the hood liner.
- .9 Hoods intended for use with radioisotopes to have a reinforced work surface capable of supporting 500 kg.
- .10 Window sash to be equipped with a tempered safety glass.
- .11 Majority of bio-safety cabinets will be Class II Type A2. UBC **Safety and Risk Services (SRS)** to determine if Class II Type B1 or B2 cabinets are required at a meeting between the Consultants and UBC **SRS and end users**.

- .12 As per BCOHS regulation 30.21; an exhaust duct wash-down system shall be part of the design in perchloric acid fume hoods. Wash-down must extend to height of stack and rinsate collected in a reservoir for testing prior to release.

3.2 Finishes

- .1 All fittings or trim in fume hoods to be non-corrosive. Chrome-plated or similar types of 'non-corrosive' finishes are not acceptable.

3.3 Fabrication

- .1 The fume hood must be double walled construction permitting mechanical and electrical service fittings to be mounted on the vertical front stiles.
- .2 Heavy duty galvanized steel framework as well as the service fixture valves and boxes must be housed and concealed within the service chase on both sides of the hood.
- .3 Exterior or interior panels must be independently mounted and easily removable, complete with panels required completing service connections. Exterior service panels are preferred where the installation permits.
- .4 The exterior panels and front stiles must be minimum 1.2 mm powder coated epoxy steel. Air foil must be Type 316L 1.5 mm gauge stainless steel, number 4 finish.

3.4 Service Connection to Biological Safety Cabinets

- .1 Natural Gas
 - .1 Natural gas connections to Biological Safety Cabinets are not permitted by the Public Health Agency of Canada (PHAC).
- .2 Water, Drain and Vacuum Services
 - .1 Water, drain, air and vacuum are normally not recommended. In instances where users request any of these services, the Consultant/s to discuss and obtain approval from UBC SRS.
- .3 Electrical
 - .1 A duplex outlet is required adjacent to each cabinet supplied from two separate circuits.

2.11 Labelling

- .1 Refer to UBC Technical Guideline Sections 20 00 08 and 23 38 00.

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 12 35 53 Laboratory Casework
- .2 UBC Resilience-Based Design Guide for Nonstructural Systems
- .3 UBC Interior Signage Guidelines

1.2 **Related External Documents**

- 1. National Fire Protection Association (NFPA) Standards.
- 2. Latest edition of the British Columbia Building Code (BCBC).

1.3 **Description**

- 1. Requirements for flammable liquid storage cabinets and corrosives storage cabinets.

1.4 **Coordination**

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.5 **Quality Control and Assurance**

- .1 Submittals
 - .1 Shop drawings.
- .2 Warranties
 - .1 Provide written manufacturer's warranty.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 **Flammable Storage Cabinets:**
 - .1 Construct flammable liquid storage cabinets in accordance with the requirements of the B.C. Fire Code. Storage capacity must comply with the B.C. Fire Code.
 - .2 Consult with the UBC Fire Department and UBC Safety and Risk Services for review of the cabinet size and exact location for each installation.
 - .3 Flammable cabinets must not be vented without risk assessment and approval by the chemical safety officer, UBC Safety and Risk Services.
 - .4 Where venting is approved, units must be visibly and durably labelled as vented at time of installation.
- .2 **Corrosive Storage Cabinets:**

The final [selection](#) must be approved by the chemical safety officer, UBC Safety and Risk Services.

- ~~.1 Construction to be similar to the requirements for flammable liquids storage cabinets except as noted below.~~
- .2 Corrosive cabinets must not be vented without risk assessment and approval by the chemical safety officer, UBC Safety and Risk Services
- .3 Where venting is approved, units must be visibly and durably labelled as vented at time of installation.

2.2 Performance Requirements

- .1 Seismic restraints and anchorages shall be engineered to the BC Building Code.

3.0 MATERIALS

3.1 Requirements

- .1 Materials:
 - .1 Products **must meet NFPA Standards** (UBC **mandatory**, approved, or not approved for UBC projects - typ.).
- .2 Components
 - .1 Flammable Liquid Storage Cabinet
 - .1 **Cabinets must meet NFPA Standards**
 - .2 **Corrosive** Storage Cabinet
 - .1 **Provide certified cabinets.**
 - .2 **Cabinet signage to conform to UBC Interior Signage Guidelines.**
 - .3
- .3 Finishes
 - .1 Factory finish.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 Related Work and UBC Guidelines

- .1 Section 03 30 00 Concrete for floor slab loading requirements

1.2 Description

1. Section includes special requirements for cranes and hoists.

1.3 Coordination

1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 Design Requirements

1. Each crane and hoist shall have a separate disconnect switch capable of being locked in the open position. The switch shall be horsepower rated and capable of interrupting the locked rotor current of the crane or hoist motor.

2.2 Performance Requirements

1. Equipment design and installation requires full compliance with all applicable regulatory bodies including:
 1. Worksafe BC
 2. CSA B167-96
 3. ASME B30.2-2001

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 07 50 00 Membrane Roofing
- .2 Section 07 55 63 Vegetated Protected Membrane Roofing
- .3 Section 07 61 00 Sheet Metal Roofing
- .4 Section 07 62 00 Sheet Metal Flashing and Trim
- .5 Section 07 72 00 Roof Accessories

1.2 **Related External Documents**

- 1. Latest edition of the British Columbia Building Code (BCBC)
- 2. Province of British Columbia Industrial Health and Safety Regulations pursuant to WorkSafe BC.
- 3. CAN/CSA-Z91-M90 Safety Code for Window Cleaning Operations.

1.3 **Description**

- .1 Section includes design and installation of fall protection systems for UBC maintenance personnel (particularly when parapets are less in height than required for guards), and for window washing equipment and personnel.

1.4 **Coordination**

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. All proposed exterior or interior fall arrest or fall restraint systems for new buildings, renewals and roof replacements must be reviewed and signed off by UBC Facilities Building Operations. The UBCV Facilities Technical Review Team Architect or UBCO Facilities Management is to be contacted for assistance with coordination of the review by Building Operations prior to tendering.

1.5 **Submittals and Handover**

- .1 Submittals
 - .1 Shop Drawings
 - .1 Shop drawings to be signed and sealed by a professional engineer registered in the Province of BC and to submit Letter of Assurance ensuring code compliance. Include final reviewed shop drawings and Letter of Assurance in the O&M manual at project completion.
 - .2 Anchor design and load rating drawings shall be provided for each type of anchor in the system.
 - .3 Anchor fastening details must be provided for each type of fastening. The fastener load ratings must be indicated.

- .4 At project completion, submit as-built and record drawings.
- .2 An annual inspection checklist indicating each anchor shall be developed. Every anchor on the roof shall be uniquely identified, and the checklist will correspond to these identifiers. The checklist shall be prepared on 8.5" x 11" sheets. A copy of the checklist will be left in a mounted pouch at the entrance of the fall protection area for review by personnel accessing the fall protection area.
- .3 Provide a comprehensive and detailed description of anchor inspections needed to allow anchors and fastening mechanisms to be inspected by third party personnel. This information is to be included within the O&M manual.
- .4 Provide instructions on the proper use and limitations of the system and testing requirements and frequency.
- .2 Handover/Turn-Over
 - .1 Provide two (2) copies of a reduced plastic laminated record drawing showing anchor locations and detailed fall protection plan clearly depicting the intent and usage of each component and overall system. Copies to be supplied to the UBC Project Manager for posting near roof entrances.
 - .2 Provide drawing(s) indicating the anchoring locations and instructions for use regarding angles and tie off locations. Indicate ground areas requiring pedestrian protection while suspension equipment (bosun's chairs, swing stages etc.) is being used for maintenance, areas over doorways, etc. The drawing shall be printed on a durable medium and mounted at each rooftop access location and fall protection access location inside of buildings.
 - .3 The drawings shall include instructions on any protection requirements for the building parapet walls and/or flashings to ensure that the ropes do not damage the building components and the building components do not damage the ropes.
 - .4 Roof anchor designer/manufacture to provide a comprehensive seminar or demonstration to UBC Facilities Building Operations staff on the components and use of the roof anchor and lifeline anchoring system installation.
 - .5 Window cleaning requirements are to be documented and provided for use by Facilities Custodial Services.
- .3 Quality Assurance
 - .1 Work to be carried out by a company specializing in the type of safety equipment required.
 - .2 All components to be designed and certified by a professional engineer registered in the Province of British Columbia.
 - .3 Roofing penetrations to conform to Roofing Contractors Association of BC (RCABC) standards.
 - .4 Follow manufacturers and roofing inspector's recommendations.
- .4 Quality Control
 - .1 Design structural engineer to carry out site reviews and submit a Letters of Assurance certifying that the anchors meet the performance requirements of CSA Z91M.

- .2 RCABC Inspector to review roof anchor installation to ensure all penetrations are weathertight and detailed to RCABC standards.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements for Exterior Fall Arrest or Fall Restraint System**

.1 **Buildings or rooftop surfaces less than 10 feet above grade**

- .1 Fall protection design is not typically required unless the hazard of falling is greater than the hazard of impacting a flat surface. Consideration must be given to what periodic maintenance is required to be performed while on these surfaces to ensure that safe access is achievable using ladders, et.al.

.2 **Buildings or surfaces greater than 10 feet but less than 25 feet above grade**

- .1 A fall protection system design is required for use by maintenance personnel for the purpose of fall restraint and fall arrest at this height. Guardrails are the preferred method for fall protection. If guardrails are not used, a variance request will be required for approval. Design for window cleaning is only required on buildings where access is not practical from the ground via extension poles or a mobile lift.

.3 **Buildings or surfaces greater than 25 feet above grade**

- .1 A fall protection system design is required for use by maintenance personnel for the purpose of fall restraint or fall arrest and window cleaning via a bosun's chair at this height. Guardrails are the preferred method for fall protection. If guardrails are not used, a variance request will be required for approval. Attachment mechanisms for swing stage or other roof supported maintenance equipment should only be designed if specifically required for the project; like a high-rise building. A wall stabilization anchoring system is to be provided to prevent the working platform from dangerously swaying in the wind while suspended, where required by code or deemed necessary due to the combination of building accessibility, building height and wind speeds.

.4 **Fall arrest or fall restraint system designs shall include:**

- .1 Fall arrest or fall restraint system to meet all requirements of the Province of British Columbia Industrial Health and Safety Regulations as per WorkSafe BC regulations.
- .2 Installation of an exterior monorail system for servicing is not acceptable.
- .3 All roofing work and roof repair work around roof anchors shall be in accordance with Section 07500 - Membrane Roofing.
- .4 The fall arrest or fall restraint system shall incorporate the use of rust resistant (e.g. galvanized metal), railing anchors, horizontal life lines, signage, etc.
- .5 Roof anchor design must allow for window cleaning and include safety provisions such as a safety lines for the person (safety line) and suspension lines for the suspension equipment (bosun's chairs, swing stages etc.).
- .6 Adhesive and expansion shield anchors are not be used due to load testing inspection requirements.
- .7 Anchors must be certified that they meet the performance requirements of CSA Z91M.

- .8 Imposed loads on the parapet walls shall be identified on the drawings and the information provided to the [Coordinating Registered Professional \(CRP\)](#) , to ensure that parapets are designed accordingly.
- .9 The [Coordinating Registered Professional](#) must ensure that rooftop mounted equipment, ducting, skylights, piping, vent stacks, etc. are taken into account and do not impact the operation of the fall restraint or fall arrest system.
- .10 Areas of the roof that are accessible to the general public shall use guardrails that are side-mounted to the parapet or guardrail-height insulated parapets to ensure protection against falls. Coordinate with section 07 00 10 – Building envelope- General Requirements.

2.2 Design Requirements for Interior Fall Protection System

- .1 Installation of an interior monorail system for servicing is not acceptable.
- .2 Special consideration shall be applied to mechanical and electrical equipment including light fixture and sprinkler head installation locations in atriums, common public areas and other unique interior locations that have high ceilings above 10'-0".
- .3 All building equipment and fixtures that require periodic maintenance are to be located in areas that do not require fall protection. If not possible, access should be provided for an appropriately-sized man lift to provide servicing needs of mechanical/electrical equipment, light fixtures and sprinklers located in high ceiling areas.
- .4 Related to item #3 above, the Lighting System Maintainability Plan as per Section 26 51 00, 2.1.8. is to be reviewed with the UBCV Facilities Technical Review Team or UBCO Facilities Management.
- .5 Ensure that floor structure loading, elevator loading plus car dimensions and door heights and widths are adequately-sized to allow a manlift to be brought into the building.
- .6 If manlift access into the building is needed for repair and maintenance activities, lift types and loading diagrams on floor finish types within a project to be reviewed with the UBCV Facilities Technical Review Team or UBCO Facilities Management prior to tender.

2.3 Performance Requirements

- .1 Anchor supplier's structural engineer to design a complete fall protection system to prevent a worker from falling according to WorkSafe BC requirements.

3.0 [MATERIALS](#)

3.1 Product Selection

- .1 Cast-in-place material: stainless steel type 304.
- .2 Exposed anchor surfaces and exposed structural components: stainless steel type 304.

END OF SECTION

1.0 **GENERAL**

1.1 Related Work and UBC Guidelines

- .1 Section 10 00 10 Special Room requirements – for interior waste room requirements
- .2 UBC Vancouver Solid Waste Infrastructure Guidelines
- .3 UBCV and UBCO Campus Plan
- .4 For hazmat waste storage and pickup requirements, coordinate with UBC Safety and Risk Services

1.2 Description

- .1 Section provides information on exterior waste enclosures, waste and recycling infrastructure dimensions, dimensions of waste trucks used on UBC campuses and access route provisions required.

1.3 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. Any proposed waste management systems or equipment within the building that differ from the standard equipment types listed in this TG section, or any anticipated need to recycle or dispose any significant amount of “specialty” waste materials that would require additional storage or handling equipment are to be identified for UBC Facilities review. The UBCV Facilities Technical Review Team Architect or UBCO Facilities Management is to be contacted for assistance with coordination of the review by UBC Facilities staff at the design development stage.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 Design Requirements

.1 Loading Docks / Loading Area

Building designs need to allow adequate exterior service area space for garbage and recycling containers to be stored and collected or emptied with UBC Facilities waste management vehicles. Containers and vehicles are described in 3.0 below. Minimum requirements for most buildings include:

- .1 Concrete pad for placement of front-load waste containers to prevent long-term surface damage.
- .2 Direct in-line service access to front-load waste containers at least 1.5 times the length of an industry standard front-load compactor truck.

- .3 Outside service area to allow for recycling cart pickup using an industry standard side-load truck which loads from the right side only.
- .4 Ramp or ground level access from the interior waste and recycling storage area to the exterior service area to be provided to allow recycling carts to be wheeled easily to the designated outside pickup area. Refer to Section 10 00 10 for coordination with the interior waste and recycling storage area requirements.
- .5 Service lane widths, turning radii and load bearing capability sufficient to accommodate all waste collection vehicles noted above. Fire truck access standards are typically sufficient and work well for UBC waste trucks.
- .6 Minimum vertical clearance above waste containers to be 23' (feet).

.2 Exterior Waste Enclosures

- .1 3-sided enclosure around concrete pad such that waste bins are visible only from the direction of service vehicle approach. Design to be as per the UBCV/UBCO Campus Plan.
- .2 Minimum access width of 12' (feet) to any front-loading waste container enclosures.
- .3 Refer to the UBC Solid Waste Infrastructure Guidelines, Section 5.1 for additional requirements.

.3 Access Route

- .1 The access route and loading area must be designed in such a way as to allow collection vehicles to enter the site, collect the waste and exit without the need to back up onto a public street.
- .2 Access driveways must be a minimum of 6 meters wide at the point of ingress/egress to the site and a minimum of 4.5 meters wide throughout the site with an unencumbered vertical clearance of 4.4 meters. Consideration should be made regarding width requirements for right or left-hand turns.
- .3 A turnaround area allowing for a three-point turn of not more than one truck length or a drive through access route are acceptable options. The approximate dimensions of the collection vehicle that must be accommodated are presented in paragraph 2.2.
- .4 Turning radii of 9.5 meters inside and 14 meters outside should be available throughout the access route. The slope of the access route shall not exceed 8% and provide adequate vertical clearance throughout the access route.
- .5 Where delivery trucks and waste management trucks have to pass under building overhangs or canopies, provide a minimum of 2' (610mm) clearance above trucks to underside of finished soffit or canopy.

2.2 Performance Requirements (Not Used)

3.0 MATERIALS (EQUIPMENT)

3.1 Waste Containers and Recycling Bins

UBC Municipal Services uses a number of standard waste management containers and utilizes the same types throughout UBC's campuses. Refer to the UBC Solid Waste Infrastructure Guidelines, Section 5.2 for detailed information.

3.2 Typical Recycling, Garbage and Cardboard Collection Vehicles

Standard dimensions of waste collection vehicles are as follows:

Vehicle Type	Size (W x D x H)	Gross Vehicle Weight (kg)
Front-Load Compactor Truck	8.5 x 32.5 x 13.5'	25,000
Roll-Off Container Truck	9.75 x 33.3 x 9.75'	25,000
Side-Load Recycle Truck	9.5 x 31.5 x 12.5'	17,000
Side-Load Truck Extended	12.5 x 31.5 x 16.0'	-

- .1 Typical dimensions for collection trucks used on campus are provided below together with diagrams:

Front Loading Collection Truck

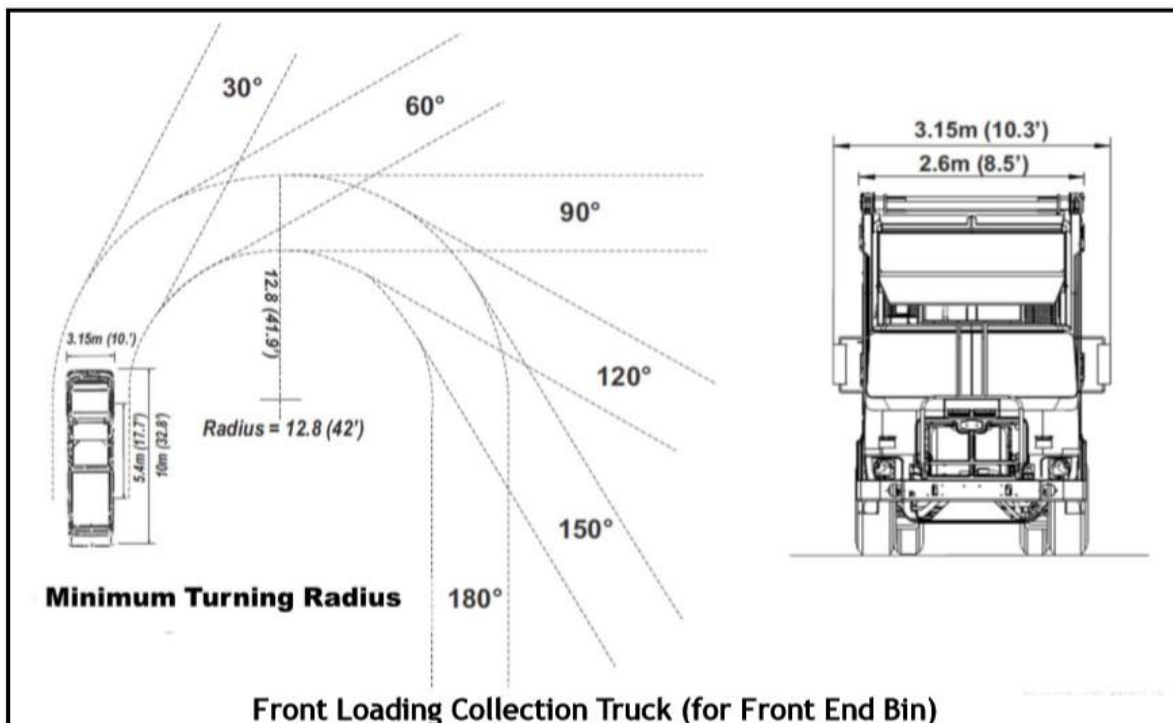
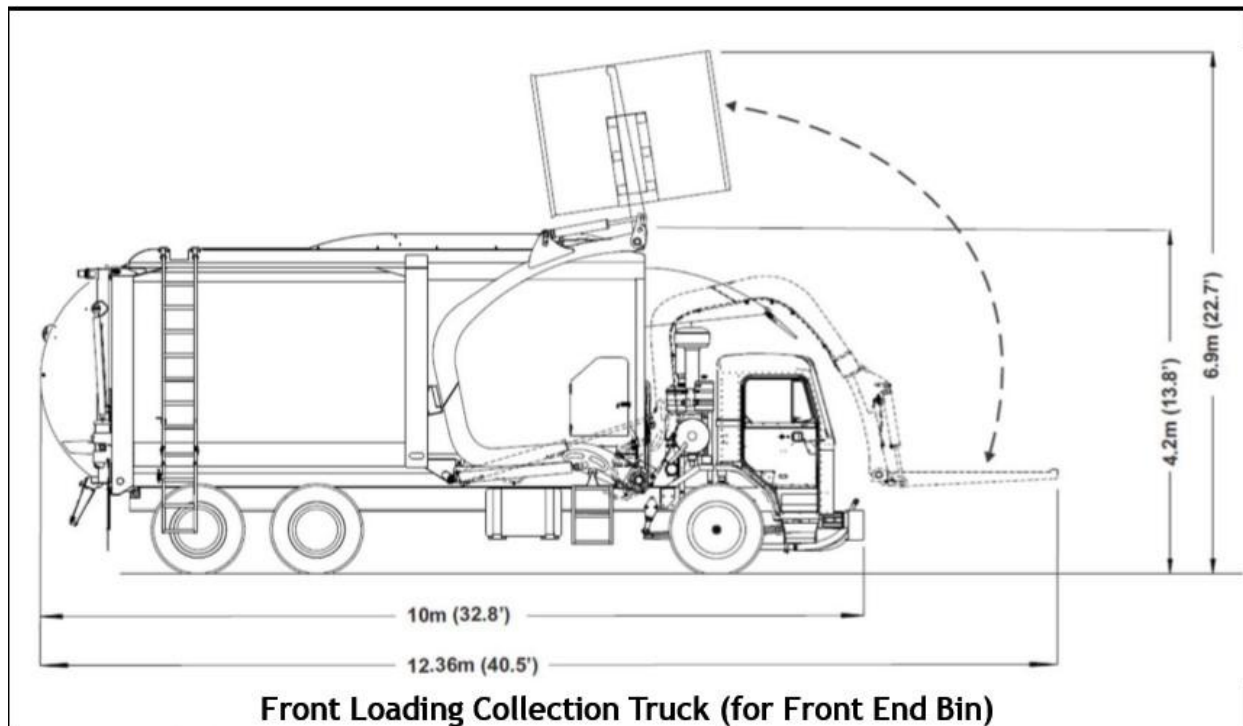
- (approximate) Length 10.0 m - 12.4 m
- Width 3.2 m Minimum inside turning radius 10.0 m
- Minimum outside turning radius 12.8 m
- Height clearance 6.5 m - 7.5 m
- Width clearance 4.0 m
- Length clearance 15.2 m

Side Loading Recycling Truck

- (approximate) Length 10.0 m - 12.4 m
- Width 3.2 m Minimum inside turning radius 10.0 m
- Minimum outside turning radius 12.8 m
- Height clearance 6.5 m - 7.5 m
- Width clearance 4.0 m
- Length clearance 15.2 m

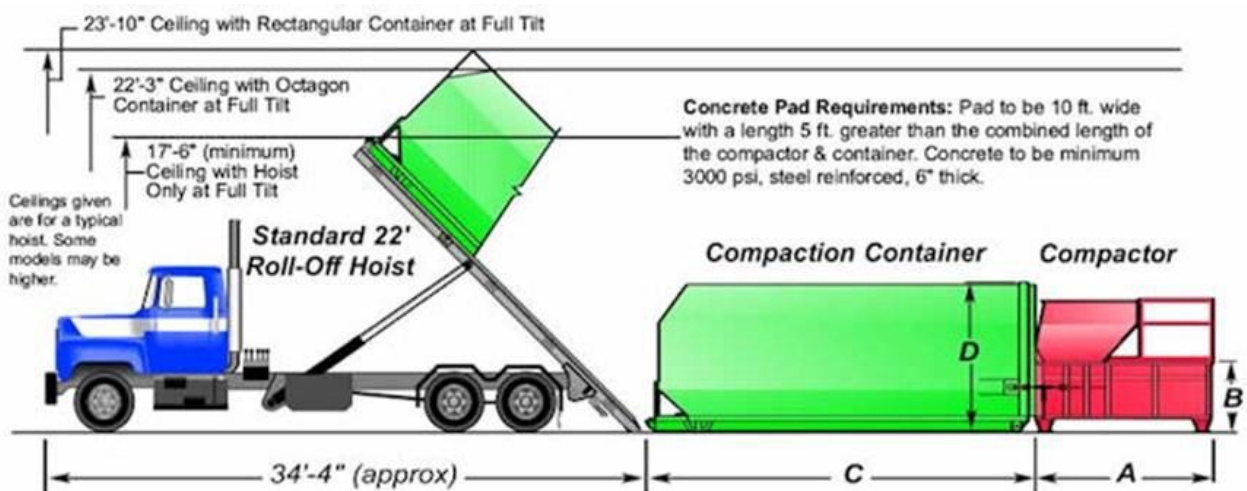
Compactor, Roll-Off Bin and Collection Truck

- (approximate) Length 10.0 m - 12.4 m
- Width 3.2 m Minimum inside turning radius 10.0 m
- Minimum outside turning radius 12.8 m
- Height clearance 6.5 m - 7.5 m
- Width clearance 4.0 m
- Length clearance 15.2 m





Typical Compactor, roll-off bin and collection truck dimensions





	Left Turn	Right Turn	Tolerance
Wall to Wall Diameter (ft)	90.1	80.3	+/- 3.0
Curb to Curb Diameter (ft)	88.6	78.6	+/- 3.0
Turning Radius (ft)	43.6	38.6	+/- 1.5

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 06 40 00 Architectural Woodwork
- .2 Section 12 20 00 Window [Treatments](#)
- .3 Section 12 30 00 Fabricated Casework
- .4 Section 12 35 53 Laboratory Casework
- .5 Section 27 05 28 Pathways for Communications Systems
- .6
- .7 Learning Space Design Guidelines
- .8 UBC LEED Implementation Guide
- .9 UBC Guidelines for Seismic Protection of Building Contents

1.2 **Related External Documents**

- 1. Latest edition of the British Columbia Building Code (BCBC)
- 2. Latest edition of the British Columbia Fire Code
- 3. Relevant CSA Standards for various furnishing types

1.3 **Description**

- .1 [Furnishings for various UBC space types.](#)

1.4 **Coordination**

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. The UBCV Facilities Technical Review Team or UBCO Facilities Management is to be contacted for assistance with coordination of furnishings review by UBC Facilities staff when the furnishings package is available. UBC Facilities staff involved in the review would include at a minimum; UBC Facilities Planning, UBC Building Operations Electrical, Accessible Buildings Planner and UBC IT.

1.5 **Submittals and Handover**

- .1 Submittals
 - .1 Shop Drawings
 - .1 Provide final reviewed shop drawings in O&M manual at project completion. Shop drawings to include product and colour specifications and maintenance requirements.
- .2 Warranty
 - .1 Furniture (hard goods) shall have a standard minimum 10-year written manufacturer's warranty on all components.

- .2 Electrical components shall have a standard minimum 5-year written manufacturer's warranty on all components.
 - .3 Upholstered furniture (soft seating) shall have a standard minimum 5-year written manufacturer's warranty, fabric included.
 - .4 Learning Spaces furniture shall have a minimum standard 10-year written manufacturer's warranty
- .3 Handover/Turn-Over
- .1 Provide a walkthrough for UBC Facilities prior to handover.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Design Requirements**

- .1 Contact Facilities Planning for furnishings guidelines.
- .2 Ensure all products comply with CSA Standards, latest edition of the BC Building Code, and BC Fire Code.
- .3 Ergonomics: Furniture should meet current ANSI/BIFMA and CSA standards.
- .4 Specify durable materials for long-term, institutional use. . Residential quality furniture is not permitted due to concerns over fire safety and durability standards.
- .5 Specify products with reduced environmental impact. Consider items with certifications such as Greenguard, [BIFMA Level](#), Cradle-to-Cradle (C2C), Green Seal, and FSC Chain of Custody. Specify locally manufactured products whenever possible (within 500km radius).
- .6 Coordinate furniture [layout](#) with electrical and communications outlets.
- .7 [At a minimum](#), design for the seismic restraint of shelves, cabinets, fixtures and vending machines, according to BC Building Code Part 4 and CSA S832-06 'Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings'.
 - .1 Lobby areas to include seismic restraint for vending machines.
 - .2 Seismic restraint of artwork (where provided) is required.

2.2 **Office Spaces:**

- .1 Office furniture: Design desks and workstations to support the work tasks of the user(s). Configurations may include a [height-adjustable desk](#), a lockable box/file pedestal and/or a lockable 2-drawer file pedestal (keyed alike); a task light; a tack board; overhead storage or shelving; an adjustable keyboard tray with provision for computer mouse; an adjustable task chair; and one or two guest chairs as required.
- .2 Office shelving: Typical enclosed offices shall have wall-mounted or freestanding shelving to meet user requirements. Install wall-mounted shelves utilizing slotted vertical standards securely fastened to reinforced walls, laid out in +/-800 mm bays, complete with +/-300 mm deep adjustable shelves. Alternately, provide freestanding bookcases securely fastened to the wall.
- .3 Filing: File cabinets shall meet current ANSI/BIFMA and CSA standards. Securely fasten filing cabinets that are 3-drawers high or taller to walls and adjacent cabinets (where present).

- .4 Seismic [Restraint](#): Securely fasten all taller loose furniture such as shelving and cabinets to floors or walls to meet seismic requirements as per 2.1.7.
- .5 Where feasible, re-use or re-furbish existing furniture. Alternately, specify new furniture that is durable and provides an extended service cycle that will also provide future opportunities to be re-purposed or recycled.

2.3 Conference Rooms

- .1 Seating in [meeting](#) and [conference](#) rooms should be upholstered and height-adjustable with fixed arms. Specify to meet user requirements.
- .2 Tables shall be easily movable.
- .3 Table edges should be durable and scratch resistant.

2.4 Learning Spaces:

- .1 Coordinate design of learning spaces with the Learning Space Design Guidelines.
- .2 Provide designs suitable for appropriate quantities of left-handed people.
- .3 If specifying upholstery, ensure it is durable and easy to clean.
- .4 Specify frame finishes for durability.

2.5 Drapery

- .1 Where drapery is required to be fire retardant [such as at stage openings](#), use only inherently permanent fire-retardant fabrics. (Fabrics manufactured utilizing Trevira and/or Avora polyester fibers are considered inherently fire-retardant).
- .2 [Window drapery is not permitted. Where required under special circumstances, a variance request will be required for approval. Refer to section 12 20 00.](#)

2.6 Laboratories

- .1 Refer to Section 12 35 53, Laboratory Casework for additional information.
- .2 Laboratory chairs and stools shall be durable, easy-to-clean seats in a non-absorptive material. Where appropriate and applicable, consider ergonomic task seating.

2.7 Libraries

- .1 Contact
- .2 Provide seismic restraint [as per BCBC requirements and coordinate with the UBC Guidelines for Seismic Protection of Building Contents](#).
- .3 Tables shall be easily movable.
- .4 Edges of tables and other furniture shall be durable and scratch resistant.
- .5 Coordinate [furniture](#) layouts with electrical and communications outlets.

2.8 Performance Requirements (Not Used)

3.0 MATERIALS (Not Used)

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 06 10 00 Rough Carpentry
- .2 Section 09 21 16 Gypsum Board Assemblies
- .3 Section 09 51 00 Acoustical Ceilings
- .4 Section 09 90 00 Painting and Coating
- .5 Section 27 05 28 Pathways for Communications Systems
- .6 Learning Space Design Guidelines
- .7 UBC LEED Implementation Guide
- .8 UBC Guidelines for Seismic Protection of Building Contents

1.2 Related External Documents

- 1. Latest edition of the British Columbia Fire Code
- 2. Latest edition of the British Columbia Electrical Code

1.3 Description

- .1 Window treatments (blinds and shades).

1.4 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. The UBCV Facilities Technical Review Team or UBCO Facilities Management is to be contacted for assistance with coordination of furnishings review by UBC Facilities staff when the furnishings package is available. UBC Facilities staff involved in the review would include at a minimum; UBC Facilities Planning, UBC Building Operations Electrical, Accessible Buildings Planner and UBC IT.

1.5 Submittals and Handover

- .1 Submittals
 - .1 Shop Drawings
 - .1 Provide final reviewed shop drawings in O&M manual at project completion. Shop drawings to include product and colour specifications and maintenance requirements.
 - .2 Submit a window treatment schedule with same room designations indicated on the Drawings; including but not limited to opening sizes and key to typical mounting details.

- .3 Maintenance Data: Submit instructions and precautions for cleaning and maintenance, operating hardware and controls as applicable.
- .2 Warranty
 - .1 Lifetime warranty for components which make up the window covering (brackets, wands, caps, etc.).
 - .2 Five-year warranty for motors and motorized products from the date of purchase.
- .3 Handover/Turn-Over
 - .1 Demonstrate blind operation to UBC Facilities Building Operations. Blinds to be kept in a fully raised position during construction.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

2.1 **Window Blinds**

- .1 Provide heavy duty, commercial quality blinds for offices and labs. Blinds are not to be used for classrooms.
- .2 For renovation work, match blinds of remainder of room where appropriate. Blinds to be prefinished aluminum or clear anodized..
- .3 Curtains, drapes or interior shutters are not to be used except in special circumstances. A variance request will be required for approval if any of these window treatment types are desired.

2.2 **Window Shades – including Black-Out Shades**

- .1 Provide manual or motorized shades on all windows.
- .2 Use heavy duty commercial quality for offices or labs.
- .3 Curtains, drapes or interior shutters are not to be used except in special circumstances.
- .4 Side tracks to secure from lateral loads and light-seal blinds, and prevent rattle.
- .5 Roller type blinds to be specified with chain operator (no cranks).
- .6 Provide side tracks to secure blinds from lateral loads and shall not rattle in tracks.
- .7 For renovation work, match shades of remainder of room where appropriate.

2.3 **Motorized Shades and Blinds**

- .1 Motorized shades and blinds shall be provided in AV-enabled spaces at the following locations to improve the user experience in academic or administrative spaces:
 - .1 Window size is 60" wide by 60" high or larger, or
 - .2 Manual operation is inhibited due to location.

- .2 UBC IT Audio Visual or Facilities Planning may determine that motorized coverings or blinds shall be provided despite the minimum requirements such as for security reasons.
- .3 Coordinate requirements for power supply conduit and wiring, and integration conduit required for motorized coverings and blinds with Division 26.
- .4 Battery powered motorized coverings or blinds are not permitted.
- .5 Wall switch shall be provided to control the motorized coverings and blinds separately from the AV system. Switches shall be grouped together where multiple [switches](#) are required.
- .6 Integration with a third-party AV control system shall be provided via RS-232 or LAN connection.
- .7 Motorized blinds are required to have a local disconnecting means for power. This is required to allow maintenance personnel to work on blinds without involving an electrician to operate a panelboard or hardwired connection. An acceptable disconnection [on](#) means for 120VAC systems is a cord connected end into a receptacle. For blinds operating at voltages below 120VAC, a cable connector that can be unplugged/plugged without any special tools is acceptable.

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 06 40 00 Architectural Woodwork
- .2 Section 12 00 00 Furnishings
- .3 Coordinate with requirements of Divisions 26 and 27
- .4 Learning Space Design Guidelines
- .5 UBC LEED Implementation Guide
- .6 UBC Guidelines for Seismic Protection of Building Contents_for requirements above and beyond the BCBC

1.2 **Related External Documents**

- 1. Latest edition of the British Columbia Building Code (BCBC)
- 2. Latest edition of the British Columbia Fire Code
- 3. Latest edition of the North American Architectural Woodwork Standards (NAAWS).

1.3 **Description**

- .1 Pre-assembled or modular furniture such as cabinets, bookshelves, and storage units, manufactured off-site and delivered to construction sites for assembly.

1.4 **Coordination**

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. The UBCV Facilities Technical Review Team or UBCO Facilities Management is to be contacted for assistance with coordination of casework review by UBC Facilities staff when the casework package is available. UBC Facilities staff involved in the review would include at a minimum; UBC Facilities Planning, UBC Building Operations Electrical, Accessible Buildings Planner and UBC IT.

1.5 **Submittals and Handover**

- .1 Submittals
 - .1 Shop Drawings
 - .1 Provide final reviewed shop drawings in O&M manual at project completion.
 - .2 Shop drawings to include product and colour specifications and maintenance requirements.
- .2 Warranty
 - .1 Work to be in accordance with grades specified in the North American Architectural Woodwork Standards (NAAWS), current edition at time of tender.

- .2 Guarantee and Inspection Service:
 - .1 Architectural woodwork shall be manufactured [and/or] installed to NAAWS current edition at time of tender and shall be subject to an inspection at the factory and/or site by an appointed AWMAC Certified Inspector. Inspection costs shall be included in the tender price for the project.
 - .2 Shop drawings submitted to the AWMAC Chapter office for review before work commences. Work that does not meet the NAAWS as specified, shall be replaced, UBC Technical Guidelines Section 06 40 00 UBC Vancouver and UBC Okanagan Architectural Woodwork November 2023 Revision Page 2 of 3 reworked and/or refinished by the architectural woodwork contractor, to the approval of AWMAC, at no additional cost to UBC.
 - .3 If the woodwork contractor is an AWMAC manufacturer member in good standing, a two (2) year AWMAC Guarantee Certificate will be issued. Issuance date should match the date of Substantial Performance of the project. The AWMAC Guarantee shall cover replacing, reworking and/or refinishing deficient architectural woodwork due to faulty workmanship or defective materials supplied [and/or] installed by the woodwork contractor, which may appear during two (2) year period following the date of issuance.
 - .4 If the woodwork contractor is not an AWMAC Manufacturer member they shall provide the owner with a two (2) year maintenance bond, in lieu of the AWMAC Guarantee Certificate, to the full value of architectural woodwork contract
- .3 Woodwork Manufacturer Qualifications:
 - .1 Member in Good Standing of AWMAC.
 - .2 Minimum 5 years of production experience similar to this project, and qualifications that indicate ability to comply with requirements of this Section.
 - .3 Minimum one project in the past 5 years where the value of woodwork is within 20% of cost of woodwork for a project.

2.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

- 2.1 On shelving designed for use as chemical storage, a 50 mm clear acrylic plastic lip must be installed on the shelf edge.
- 2.2 Provide seismic restraint for all cabinets and shelving.
- 2.3 Provide low VOC products, and use products that comply with LEED requirements such as high recycled content, GreenGuard/FSC certified.

3.0 **MATERIALS (Not Used)**

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 Section 06 40 00 Architectural Woodwork
- .2 Section 11 53 13 Fume Hoods
- .3 [Section 11 53 33 Emergency Safety Appliances](#)
- .4 [Section 23 38 16 Fume Hood Exhaust Systems](#)
- .5 UBC Guidelines for Seismic Protection of Building Contents

1.2 **Related External Documents**

- 1. Latest edition of the British Columbia Building Code (BCBC)
- 2. Latest edition of the British Columbia Fire Code

1.3 **Description**

- 1. Cabinets, countertops, and storage solutions specifically designed for use in laboratories.
- 2. Casework for laboratories designated for biohazard containment levels:
 - .1 Containment Level 1.
 - .2 Containment Level 2.
 - .3 Containment Level 3.
- 3. Whenever project permits, conform to the requirements of Containment Level 2, to allow flexibility of use.

1.4 **Coordination**

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. The UBCV Facilities Technical Review Team or UBCO Facilities Management is to be contacted for assistance with coordination of casework review by UBC Facilities staff when the casework package is available. UBC Facilities staff involved in the review would include at a minimum; UBC Facilities Planning, UBC Building Operations Electrical, Accessible Buildings Planner and UBC IT.
- 6. An overall coordination with Section 11 53 33 Emergency Safety Appliances, Section 11 53 13 Fume Hoods, Section 12 35 53 Laboratory Casework, and Section 23 38 16 Fume Hood Exhaust Systems will be required by project teams.
- 7. At design development, coordinate with UBCV Safety and Risk Services (SRS) or UBCO Health, Safety and Environment for review of design intent and additional requirements.

1.5 **Quality Assurance and Submittals**

- .1 Submittals
 - .1 Shop Drawings

- .1 Provide final reviewed shop drawings in O&M manual at project completion. Shop drawings to include product and colour specifications and maintenance requirements.
- .2 Warranty
 - .1 Provide manufacturer's written warranty.
- .3 Quality Assurance
 - .1 Professional Engineer registered in BC, engaged by manufacturer, to seal shop dwgs and carry out site reviews, confirmed by Letters of Assurance, for seismic restraints including anchorage.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

2.1 Design Requirements

- .1 General
 - .1 Select recognized manufacturer specializing in the manufacture and installation of laboratory casework and fittings of the type required for project.
 - .2 Tops to be continuous with no open seams, integral with backsplash, sealed joints to walls etc.
 - .3 Rounded edges to be provided. This requirement is mandatory when positive pressure suits are worn.
 - .4 Minimize joints generally, and seal well.
 - .5 Maximize spacing of legs to maximize free under counter space and flexibility.
 - .6 Provide under-slung relocatable modular units (e.g. drawer / shelf units), generally 12" free of floor.
 - .7 Design casework for vibration control.
- .2 Environmental
 - .8 Avoid adhesives, preservatives, hardeners, and synthesizing agents and finish coatings that contain formaldehyde and high V.O.C. content.
 - .9 Minimize use of packing materials such as cardboard for shipping and if used, recycle. Use blanket wraps for shipping whenever feasible.

2.2 Performance Requirements

- .1 Conform to function-specific requirements, including as applicable:
 - .1 Canadian Biosafety Standard, 3rd Edition, Public Health Agency of Canada.
 - .2 Containment Standards for Veterinary Facilities, Agriculture & Agri-Food Canada, Publication 1921/E.
 - .3 Canadian Nuclear Safety Commission Standard R-52, Design Guidelines for basic and intermediate level radioisotope laboratories.
- .2 Seismic Restraint
 - .1 Restraints and anchorage engineered to BC Building Code. Coordinate with UBC Guidelines for Seismic Protection of Building Contents.
 - .2 Provide edges to shelving and similar features to minimize spillage including during seismic activity.
 - .3 Provide marine edging or similar at countertops to contain spillage.
- .3 Finishes

- .1 Select finishes to suit required resistance to:
 - .1 Chemicals including corrosives and solvents.
 - .2 Heat
 - .3 Moisture and humidity
 - .4 Abrasion
 - .5 Impact
 - .6 Radioisotope chemistry
- .2 Surfaces and coatings, including case work, to be:
 - .1 Cleanable
 - .2 Nonabsorbent
 - .3 Resistant to scratches and damage.
- .3 Life Cycle Costing
 - .1 15-year
 - .2 Provide adjustable modular components to facilitate changes in lab procedures.

3.0 **MATERIALS**

3.1 **Product Selection**

- .1 Materials
 - .1 "No-Wood" policy within laboratories, including casework, trim, wood doors and frames., ~~etc. unless approved by UBC SRS .~~
- .2 **Finishes**
 - .1 Worktop Material
 - .1 Solid cast epoxy resin.
 - .2 Stainless steel preferred
 - .3 Resin-impregnated natural stone.
 - .4 Laboratory grade plastic laminate.
 - .5 Other proposed materials need to be reviewed with UBCV Facilities Technical Review Team Architector UBCO Facilities Management, and UBCV SRS or UBCO Health, Safety and Environment. A variance request will need to be submitted for approval.
- .3 Execution
 - .1 Installation shall be by manufacturer-trained and certified installer.

END OF SECTION

1.0 **GENERAL**

1.1 **Related Work and UBC Guidelines**

- .1 [Section 10 00 10 Special Room Requirements](#)
- .2 [Division 26](#)
- .3 [Section 27 05 08 Cable Infrastructure Design Guidelines](#)

1.1 **Related External Documents**

- 1. [Latest edition of the British Columbia Building Code \(BCBC\)](#)
- 2. [Latest edition of the CSA B44 Safety Code for Elevators and the requirements of the BC Elevating Devices Safety Act and Regulation](#)

1.2 **Description**

- .1 UBC requirements for elevators. Items with **(Vancouver)** or **(Okanagan)** apply to the respective campus.

1.3 **Coordination**

- 1. [The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.](#)
- 2. [In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.](#)
- 3. [These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.](#)
- 4. [The Coordinating Registered Professional \(CRP\) is required to coordinate these requirements with other disciplines.](#)
- 5. [The UBCV Facilities Technical Review Team or UBCO Facilities Management is to be contacted for assistance with coordination of the elevator review by UBC Facilities staff at the design development stage. UBC Facilities staff involved in the review would include at a minimum; UBC Building Operations Electrical, Accessible Buildings Planner and UBC IT.](#)

1.4 **Quality Control and Assurance**

- .1 [Submittals](#)
 - .1 [Shop Drawings](#)
 - .1 [O&M manual information shall be sufficiently detailed and shall include spare parts lists, drawings, adjustment procedures, testing procedures, diagnostic instructions troubleshooting procedures, diagnostic instructions, recommended spare part lists and the manufacturers recommended maintenance tasks and frequencies.](#)
 - .2 [Provide final reviewed shop drawings and Letter of Assurance in the O&M manual at project completion. Shop drawings to show general arrangement and layout of cabs and entrances.](#)

- .3 The supplier shall include all technical information required for performing maintenance of the equipment, including all diagnostic efforts made during construction to determine the cause of malfunction. Technical information shall include complete as-built electrical drawings, parts list, and instruction manuals as listed below.
 - .4 One additional copy of technical information [noted in item #3 above](#) shall be provided in PDF format.
 - .5 Two (2) copies of complete operating and maintenance manuals complete with up to date technical bulletins. O&M manual shall contain complete parts lists with exploded views of all assemblies. One digital copy is required.
 - .6 Three (3) copies One copy of complete adjusting, start-up, diagnostic and troubleshooting manuals and diagnostic codes. One digital copy is required.
 - .7 Three (3) copies of as built wiring diagrams. One digital copy is required.
 - .8 **(Vancouver)** Provide one (1) archive copy of the elevator contract data for purposes of reinstallation in the event the contract chip becomes corrupted and the data is lost. This is not intended to be a copy of the entire operating software of the elevator system.
- .2 Elevator Warranty
- .1 [Provide a one year \(12 months\) warranty from certified date of substantial performance of the Project.](#)
 - .2 Documentation requirements during the maintenance period:
 - .1 All maintenance including: regular inspections, adjustments, lubrications, call back for faulty operation, and the replacement of all parts and components which fail for any reason shall be documented by the elevator sub-contractor. This shall include parts replaced as part of warranty as well as parts to be replaced due to normal wear and tear.
 - .2 The elevator sub-contractor shall respond without extra charge to call backs on a 24 hour basis. However, all work other than call backs shall be done during regular working hours.
 - .3 The elevator sub-contractor shall provide a monthly summary of work performed for all service calls to UBC Facilities Electrical (Vancouver) / Facilities Management (Okanagan) for the entire maintenance (warranty) period.
 - .3 Validation of elevator performance during the maintenance period:
 - .1 An example of the permissible number of call backs and percent improvement required each year is indicated in the table below based on year 1 performance:

Number of Call Backs			Min. % Improvement Required Each Year
Year 1	Year 2	Year 3	
³ 10	8	² 4	33%
5 - 10	6	² 4	25%
4	4	² 4	0%

- .2 The elevator sub-contractor shall review the performance statistics in person prior to the expiration of the warranty period each year with UBC Facilities Electrical.
- .4 UBC Facilities Electrical at their discretion can put any new elevator equipment under the global maintenance contract for the campus or enter into an extended maintenance term with the original equipment manufacturer.
- .3 **Quality Assurance**
 - .1 Elevator Manufacturer and Equipment Requirements
 - .1 Contractor must be willing to fully comply with the non-proprietary requirements and demonstrate that technical support and parts can be made available to third parties.
 - .2 Controllers and other pieces of equipment to be non-proprietary. Controllers must come equipped with any special diagnostic tools, or any diagnostic software and connections available with a PC with manuals clearly defining the diagnostic codes and adjustment parameters.
 - .3 Any remote conduit and wiring required shall be the responsibility of the elevator trade contractor.
 - .2 **Elevator Consultant Qualifications**
 - .1 All elevators at UBC must be designed and approved by an Elevator Consulting Engineer as well as approved by UBC Facilities Electrical (Vancouver) / Facilities Management (Okanagan).
- .4 **Quality Control**
 - .1 Elevator consultant to carry out site reviews and submit a Letter of Assurance certifying that the elevators meet the requirements of CSA B44.
- .5 **Handover/Turn-Over**
 - .1 Prior to commencement of the warranty maintenance period, provide an orientation and demonstration session for the preventive maintenance, repair and trouble-shooting of the new equipment and control systems for UBC Facilities Electrical / Facilities Management elevator staff. Refer to CPG-01 (Vancouver).
 - .2 The orientation and demonstration shall be hands on at the elevator equipment and all drawings and manuals and the information contained in them shall be covered and verified at the site.

- .3 Provide a walkthrough session prior to completion of the warranty period as a handover.
- .4 A minimum of five (5) copies of each key used except keys specifically for maintenance and inspection personnel.

2.0 GENERAL MATERIAL AND DESIGN REQUIREMENTS

2.1 General Requirements

.1 Electrical

- .1 Elevators shall always be fed from a 600V source. 208V is only permitted if the main incoming feed for the building is at 208V.
- .2 Surge Protective Devices are required to be installed on any distribution containing elevator the elevator controller and motor.

2.2 Design Requirements for Passenger Elevators

.1 Elevator Type

- .1 Where the choice could be made for either hydraulic or traction, the decision should lean towards traction elevators. Where initial cost is the prime consideration, and the traffic demand will be light, and if there are no soil problems, then the hydraulic type may be considered.
- .2 For buildings with 2 or 3 stops, a twin post holeless hydraulic should be specified to eliminate the need for well hole drilling and eliminate the risks of buried cylinders. Telescopic plungers can be considered on a case by case basis but should be limited to three (3) stop elevators.
- .3 Roped hydraulic elevators shall not be considered.
- .4 Direct acting holed hydraulic elevator with buried cylinders will be considered only by prior written approval from UBC Facilities Electrical.
- .5 For buildings with 4 to 12 elevator stops, use high efficiency, environmentally-friendly gearless traction elevators or conventional geared or gearless traction elevator equipment.
- .6 For buildings exceeding 12 elevator stops, generally use gearless traction elevator, with machine room located overhead.
- .7 Lifts for persons with disabilities, handicapped lifts or Limited Use Limited Application (LULA) lifts shall not be acceptable as passenger elevators as directed by the B44 Safety Code for Elevators and the Elevating Devices Safety Regulation.

.2 Size of Elevators

- .1 Passenger elevators shall have a minimum capacity of 1135 kg for basic single unit applications unless building requirements mandate a larger platform size. Larger buildings with more than one elevator shall typically use 1360 kg to 1820 kg platform sizes based on the demand and other building requirements. Elevator sizes shall be

chosen from typical North American manufacturer's standard sizes unless the needs of the building dictate the use of non-standard sizes. Elevators shall be of adequate size and loading class to transport equipment required for building/department operation and maintenance.

.3 Location of Elevators

- .1 Elevators should be located centrally in the building or where the walking distance to any point on the floor plate does not exceed a maximum of 45 m. Where the location of the elevator(s) exceeds 45 m from any point in the building then separate elevator service should be provided in distributed segments of the building where the walking distance from any point in the building to the elevator(s) does not exceed 45 m.
- .2 All elevator landings shall be located in conditioned lobbies

.4 Number of Elevators

- .1 For buildings with 3 or less elevator stops, and a gross area of less than 5,000 m², provide two elevators.
- .2 For buildings with 4 or more elevator stops, use traction type elevators. If the gross area exceeds approximately 6000 m² provide a group of two elevators. If the gross area of the building exceeds 10,000 m² provide a group of three elevators.

Note - The quantity of elevators should be selected based on providing a % of handling capacity based on the gross building population rather than square footage. Likewise, a requirement for a maximum waiting time should be considered. The "waiting" time is measured in a dimension called an "interval" that is measured in seconds. These vary for building type and usage, for instance a busy classroom or office block the handling capacity should be 10-12% of the building population in a five minute interval and the interval should not exceed 35 seconds. A residential building should have a handling capacity of 5-7% of the building population and a maximum interval of 40 seconds.

- .3 If distributed elevator configurations are used then the total number of elevators required shall be increased by approximately 65% to account for the inefficiencies of the distributed arrangement and imbalances in demand.

.5 Speed of Elevator

- .1 The speed of the elevator shall be within the following ranges and chosen to suit the specific building requirements;
- .2 Hydraulic passenger elevators to be 0.5 to 0.75 m/s.
- .3 Geared or High Efficiency Gearless traction passenger elevators to be 1.5 to 2.0 m/s.
- .4 Gearless elevators to be 2.5 m/s and greater.

.6 Door Type and Size

- .1 At least one (1) elevator must meet the BC Building Code requirements to be able to carry a stretcher (or gurney) in the prone position. It is generally accepted that a 1135 kg elevator with 1066 (42") wide side-opening doors meets this criteria.

- .2 Where traffic demand is expected to be light, the "stretcher" elevator (in US English = a Gurney) can have a single speed side-opening door, in which case a standard 1,135 Kg passenger elevator meeting the stretcher requirements is adequate.
 - .3 Where there is already an elevator which can accommodate a stretcher the remaining passenger elevator(s) in the building should be provided with centre-opening doors for efficiency.
 - .4 Front and rear door arrangements should be avoided, and used only where the design of the building makes any other solutions impossible. Where there are "staggered" floor levels which have to be served by an elevator, then rear doors are unavoidable.
- .7 Elevator Machine Rooms and Closets**
- .1 Elevator machine rooms and closets shall be designed to have adequate space to safely maintain and replace any and all equipment safely. The ability for a worker to access ceiling mounted equipment from a step-ladder is required. No equipment, other than what is required by applicable codes and standards shall be installed in an elevator Machine Room or Closet. No equipment shall be mounted above 2 m unless required by applicable codes or standards.
 - .2 **Traction elevators:** the machine room shall be located directly overhead unless a variance is requested. **Machine Room Less elevators are not accepted.**

2.3 Design Requirements for Freight and Service Elevators

.1 Elevator Type and Class

- .1 Elevators required specifically for freight and freight handlers only shall be designated as true freight elevators. Where a combination of freight and passenger use is required the elevator shall be designated as a passenger elevator but shall be designed with the freight use in mind to provide a service type elevator.
- .2 Provide Class C3 loading where single piece or large concentrated loads must be moved which will exceed 25% of the rated capacity of the elevator (but will not exceed the rated capacity of the elevator). Provide Class C1 or C2 loading as appropriate where the elevator is required to be loaded or unloaded by an industrial truck.
- .3 The use of freight platform lifts or material lifts as defined in the B44 Safety Code for Elevators shall not be acceptable unless very special conditions exist to justify these restricted use configurations.

.2 Number of Elevators

- .1 Where a freight elevator is required, generally one (1) will be adequate except where demand may require more.

.3 Size of Elevators

- .1 Freight and Service elevators shall be sized to suit the largest object which has to be moved and the capacity rating shall be appropriate for the anticipated needs. Elevator sizes shall be chosen from typical North American manufacturer's standard sizes unless the needs of the building dictate the use of non-standard sizes.

.4 Speed of Elevator

- .1 The speed of the elevator shall be within the following ranges and chosen to suit the specific building requirements; Service elevators shall be treated as passenger elevators for determination of speed and other criteria.
- .2 Hydraulic freight elevators 0.3 to 0.5 m/s.
- .3 Geared traction freight elevator up to 2000 Kg 1.0 to 0.5 m/s – 1.75 m/s (i.e. 100 – 350 fpm).
- .4 Geared traction freight elevator > 2000 kg. 0.5 m/s – 1.0 m/s.

.5 Type of Doors

- .1 For Service (Passenger) elevators provide power operated horizontally sliding passenger doors. The use of two (2) speed side-opening or two (2) speed centre-opening doors may be utilized to provide a wider opening to suit the anticipated needs. The use of three (3) speed doors or other special arrangements such as swing doors is not acceptable unless very special conditions exist to justify these more unusual arrangements.
- .2 Vertical sliding bi-parting doors shall only be used on true freight elevators where no passenger use is required and where a maximum of opening width is required. Vertical sliding bi-parting doors shall be power operated.

.6 Size of Doors

- .1 Standard door width for horizontally sliding Service (Passenger) elevator doors is 1070 mm, although larger sizes are available. Where possible doors shall be chosen from sizes in 150 mm increments. A standard door height of 2135 mm should be used unless higher doors are required in which case 2440 mm high doors should be chosen.
- .2 The minimum width for vertical sliding bi-parting doors should be 1830 mm and larger doors shall be chosen from 610 mm increments where possible to stay within typical standards.

.7 Manufactured Equipment

- .1 All components used in the installation of new elevators, or the modernization of existing elevator systems, shall have an established reliability record of at least 3 years.

3.0 MATERIALS AND SPECIFIC MECHANICAL/ELECTRICAL REQUIREMENTS

3.1 Requirements for All Elevator Types

Provide Seismic Safety Features in compliance with the latest version of the B44 Elevator Safety Code.

.1 Car Top Guard Rail.

- .1 Provide a car top guard rail that meets the requirements of the code and the following requirements:
 - .1 The guardrails shall not defeat any isolation between the car frame and the car cab. The preferred installation is to have the guard rail tied to the cross head.

.2 Allowance for Additional Weight

- .1 The complete elevator including the drive, support and counterweight shall be designed such that the weight of the basic cab can be increased with additional finishes or other additional equipment totaling not more than 350 Kg per cab.

.3 Guides

- .1 Provide roller guides consisting of polyurethane tired wheels, at least 150 mm diameter for the car guides and 75 mm diameter for counterweight guides where applicable for all passenger elevators. Guides on freight elevators shall consist of solid slippers or sliding guide shoes.

.4 Travelling Cable

- .1 Provide spare conductors in the travelling cables and communication wiring as follows; Provide spare wiring consisting of the greater of a minimum of 10% or ten (10) individual conductors and provide a minimum of eight (8) twisted shielded pairs of 20

AWG communication conductors for other equipment which maybe provided, over and above any pairs required by the elevator control system.

.5 Door Operators

- .1 Automatic car door operators shall be of the heavy duty, high performance type designed for high performance and long life. Light or medium duty door operators are not acceptable.
- .2 All door operators shall be provided with closed loop feedback operators capable of adjusting the closing torque to suit changing building conditions.
- .3 Where front and rear doors are used provide full selective control of the door operation.

.6 Car Operating Panel

- .1 Where centre-opening doors are provided, the elevator cab shall have two car operating panels, one on each side of the cab. Where front and rear doors are used the elevator cab shall have two car operating panels, one on the front side and one on the rear side of the cab. Where space permits, car operating panels shall be mounted on the door return panels, otherwise shall be on the side walls adjacent to the door return panel.
- .2 In-car stop switches shall be key-operated.
- .3 Car operating panels with angled buttons designed to be universally accessible for use by both standing and seated persons are encouraged.
- .4 Where possible mount the car call buttons in a single vertical column.
- .5 Provide the following keyed switches and related features for each elevator; Light Switch, Fan Switch, Independent Service Operation Switch, Inspection Switch, Emergency Light Test Switch. Provide two (2) cutouts per panel with blank inserts for the future addition of other keyed switches. Any elevator equipped with Phase I Emergency Recall shall also be equipped with Phase II In-Car Emergency Service Operation and the related keyed switch.
- .6 Buttons shall be of the vandal resistant type. Approved products are Dupar US84, 90 or 91 available from Dupar Controls. Car Tactile markings shall be Dupar US89, California Style white on black. All devices shall be mounted and secured to endure minor acts of vandalism. Approved keying shall be Dupar standard. Push buttons from the manufacturers standard range of products shall also be considered providing that spare parts are easily attainable, they are of a vandal resistant design and meet the performance requirements of these guidelines or approved equivalent.
- .7 A separate telephone activation button shall be provided. See details under Voice Communication of this Technical guideline (5.6).
- .8 All illuminating devices shall be provided with long life LED illumination which is clearly visible in the ambient lighting level of the cab.
- .9 The panel face plate shall be professionally engraved to identify each component, the position of switches, the elevator capacity, the owner's identification number as well as any jurisdictional identification numbers applicable to the installation.

- .7 Hall Buttons
 - .1 The lights shall be from a long-life LED source.
 - .2 Hall button face plates shall be engraved to include the required message to not use the elevator in case of fire.
- .8 Hall Lanterns
 - .1 Where there are two or more elevators in a group, there shall be hall lanterns at all entrances.
 - .2 Lanterns shall be of the vandal resistant type and shall be located above or adjacent to the entrance. The illuminating elements shall be LED with a minimum usage rating of 100,000 hours. An electronic chime shall be provided which will sound when the lantern illuminates. The audible signal shall be a soft "chime" type sound, with adjustable intensity not less than 24 DBA. Harsh electronic beepers are not acceptable, and the type of chime is subject to owner approval. Sound the gong once for Up Bound, twice for Down Bound.
- .9 In-Car Lanterns
 - .1 Where a single elevator is being provided, it shall have an in-car direction lantern on each car door post.
 - .2 Where there are front and back entrances, there shall be such a pair of lanterns on each entrance, and it will operate in unison with the corresponding entrance. The illuminating elements shall be LED with a minimum usage rating of 100,000 hours.
- .10 Voice Announcer
 - .1 Provide equipment to allow an audible announcement in each elevator cab. The messages shall be appropriate to reflect the conditions pertinent to the elevator and shall be subject to the owner's approval.
 - .2 Connect the equipment to the elevator control system and determine the necessary inputs so that the messages reflect the conditions pertaining to the respective elevator or group function.
 - .3 Mount the remote speaker in the car operating panel behind a protective grille. Ensure that the location of the speaker will allow the announcements to be clearly audible both in the car and in the adjacent hallway when the elevator doors are open. The system shall be equipped with site adjustable volume control.
 - .4 As a minimum the system shall include, but is not restricted to the following announcements:
 - .1 Announcement of the floor designation that the elevator is about to stop at.
 - .2 Announcement of the direction of travel of the elevator. The announcement shall be made when opening the doors in response to car or hall calls.
 - .3 An announcement warning to stay clear of the doors if the car door nudging feature is activated.
 - .4 An announcement warning that the elevator has been recalled to the ground floor as a result of emergency recall or other similar feature.

- .5 The equipment provided shall be flexible and shall permit site programming so that the messages may be changed at any time to suit changing conditions in the building. All announcements shall be available in either English or both English and French. The voice shall be male or female as selected by UBC.
- .6 The system shall have adequate capacity to store up to 40 different announcements and a total of 4 minutes of recording, as a minimum.
- .7 Audible signals should still be provided in hall lanterns.
- .11 Position Indicators
 - .1 In addition to the car position indicator required for Barrier Free Access each elevator shall be provided with a digital position indicator over the main floor entrance. Position indicators shall be LED or Vacuum Fluorescent type dot matrix or digital segment displays with characters at least 35 mm high.
- .12 Emergency Cab Light
 - .1 A battery powered emergency cab light device shall be provided for each elevator. The illumination source shall be an integral part of the car operating panel or as a separate inconspicuous fixture.
- .13 Firefighters Emergency Operation
 - .1 The fire alarm system shall have an "elevator bypass" system provided to allow the fire alarm system to be tested without disrupting elevator service.
- .14 Group Operation
 - .1 Where two or more elevators are operating in a group, the operation shall be a group supervisory system, providing automatic collective control for each elevator and a group dispatching and hall call allocation system.
- .15 Control Equipment
 - .1 The control equipment will be primarily solid state, micro processor based.
 - .2 All elevator controllers shall be equipped with easily accessible trip counters that will increment once for each elevator trip (not re-levelling or door cycling). Counters may be discrete counters that are accessible by on board diagnostic tools.
 - .3 Control systems shall include non-proprietary diagnostic systems. Where special diagnostic tools are required these must be provided with the equipment along with appropriate instructional manual and documents. Any such tools and supporting documentation shall become the property of UBC.
- .16 Provisions for Card Readers
 - .1 All elevator controllers should come equipped with a specially wired terminal strip so that an external card reader system can easily be added. The terminal shall have a pair of terminals for each car call other than the ground floor, such that if the terminals are 'jumped' the car call will operate, if not 'jumped' the car call cannot be registered. The control shall be arranged so that if an elevator is operating as a fire fighter elevator this security feature is overridden.

- .2 Travelling cables with adequate conductors to provide signals from the elevator card reader in the cab shall be provided. As a minimum this shall be three (3) spare shielded pairs.
- .17 Independent Service Operation
 - .1 There shall be independent service operation on each elevator. This will be initiated by a keyed switch in the car.
- .18 Inspection Operation
 - .1 Each car shall be equipped with an inspection switch to remove the car from service and prevent operation from any means other than the inspection operation manual controls.
- .19 Hoist way Access Operation
 - .1 A hoist way access keyed switch and operation shall be provided for each elevator at the top and bottom landings landing for access to the elevator car top regardless of the floor to floor height or speed of elevator. Keys must be submitted for UBC's maintenance personnel.
- .20 Electrical Requirements
 - .1 Elevators shall always be fed from a 600V source. 208V is only permitted if the main incoming feed for the building is at 208V.
 - .2 Surge Protective Devices are required to be installed on any distribution containing elevator the elevator controller and motor.
- .21 Emergency Power Operation
 - .1 Where standby power is provided, provide two (2) separate signals. One (1) pair to advise that the elevators are on standby power and the second pair to advise of the imminent transfer of standby power or back to normal power. The purpose of this signal is to allow the elevator to park only until power is transferred. Upon transfer to emergency power, the elevators shall resume normal operation.
 - .2 When emergency power operation is provided include, as part of the control system, suitable circuitry to shut down a moving car at the next possible floor when an advanced warning contact opens. The advanced warning contact will be supplied by the owner and will open 20 seconds prior to the activation of the transfer switch.
 - .3 The operation and proper operation of the test procedures, including the proper operation of the advanced warning signals shall be tested by the elevator contractor, the generator contractor and a written report and operation instructions shall be provided prior to occupancy.

3.2 Requirements for Hydraulic Elevators

- .1 Tank Heater

- .1 A thermo statically controlled tank heater to maintain the oil at a constant minimum operating temperature is required. Alternatively a viscosity control feature is also acceptable.
- .2 Oil Level Indicator
 - .1 An outside oil level indicator is required to determine the oil level without removing the reservoir cover.
- .3 Gate Valves
 - .1 A tank shut-off valve or gate valve is required in both the machine room and the pit.
- .4 Motor Soft Start
 - .1 An electronic motor soft-start device is required and must be fully adjustable to limit the peak starting current to as little as 150% of the full load running current.
- .5 Duty Rating
 - .1 All hydraulic elevator components including motor, pump, valve, piping and muffler shall be designed for a minimum duty of 80 up starts per hour.
 - .2 Provide Seismic Safety Features in accordance with the latest version of the B44 Elevator Safety Code, for pipe rupture valves, pre-Approved products are Maxton OSVB44
- .6 Sound Isolation
 - .1 Hydraulic elevators shall be equipped with sound isolation between the oil reservoir and the floor in the form of a sound-isolation based rubber mat.

3.3 Requirements for Traction Elevators

- .1 Sound Isolation
 - .1 Traction machines must be mounted on sound isolating pads, isolated in all directions.
- .2 Car Balancing
 - .1 With car empty and doors closed, remove the upper car guides. Add suitable weights to the car so that it hangs plumb in this condition. Then adjust the counter weight so that the car and counter weight are in balance with a load in the car which is between 42% and 44% of the rated load.
- .3 Motor & Drive
 - .1 Provide high efficiency permanent magnet AC motors with matching variable frequency/ variable voltage drive system of the flux vector type. Control and drive systems shall be closed loop which include position and velocity feedback devices to regulate the speed of the elevator within +/-2% of contract speed with any load from empty to rated capacity.
 - .2 There shall be an isolation transformer between the power and the elevator drive system. The total harmonic and individual harmonic distortion shall not exceed 5%

and 3% respectively and the requirements of IEEE-519 shall be adhered to with respect to power harmonics. For purposes of measurement the Point of Common Coupling (PCC) shall be defined as the elevator power supply terminals located in the elevator machine room.

- .3 For geared and gearless elevators provide a full re-generative drive system to return power generated during dynamic braking or running with over hauling loads to the power supply lines.

- .4 Automatic Rope Lubricators

- .1 Provide automatic rope lubricators which consist of natural fiber pads connected to a lubricant reservoir. The devices shall be mounted adjacent to the hoist ropes in a manner that allows them to be adjusted to contact the ropes when desired.

3.4 Finishes

- .1 Elevator finishes shall be selected from the list below. Provide a variance request for approval by the UBC Facilities Technical Review Team for variations to the finishes..
- .2 Where glass is used in or as part of cab enclosures, it must be laminated safety glass.
- .3 Finishes for Passenger and Service Elevators
 - .1 Landing door panels and entrance frames to have plain white prime coat paint finish.
 - .2 Hall operating and signal fixtures to be stainless steel brushed finish.
 - .3 Car operating and signal fixtures to be stainless steel brushed finish.
 - .4 Car door panels to be stainless steel brushed finish.
 - .5 Cab front and/or rear return panels, door jambs and header/lintel to be stainless steel brushed finish.
 - .6 Cab ceiling to be 14 gauge factory baked enamel finish or other durable finishes..
 - .7 Cab lighting to be energy efficient fluorescent lighting, consisting of T8 lamps and electronic ballasts.
 - .8 LED illumination make LED recessed pot lights a power smart option.
 - .9 Cab walls to be raised, horizontal, removable plastic laminated panels above the cab handrail. Raised stainless steel brushed #4 finish removable panels below the cab handrail. Plastic laminate or stainless steel panel reveals.
 - .10 Cab kick plate/ base plate to be stainless steel #4 brushed finish.
- .4 Finishes for Passenger Elevators Only
 - .1 Suspended ceiling and lighting coves – suspended ceiling types to be durable and easily accessible for maintenance. Lighting coves to be on the cab side walls with factory baked enamel finish.
 - .2 Preferred cab finished flooring to be linoleum flooring.. Where moisture is anticipated, flooring shall be resilient sheet vinyl flooring. Porcelain or ceramic tiled flooring is not acceptable.
 - .3 Cab handrails to be standard 1½" tubular stainless steel handrails on all non-access walls.
 - .4 **(Vancouver)** Finishes for passenger elevators to be reviewed by the UBC Accessible Buildings Planner.

.5 Finishes for Service Elevators Only

- .1 Suspended ceiling/lighting coves -suspended ceiling type to be durable and easily accessible for maintenance. Lighting coves to be two (2) light coves on the cab side walls with factory baked enamel finish.
- .2 Cab finished flooring to be steel checker plate.
- .3 Cab handrails to be 4" high flat bar stainless steel.

.6 Finishes for Freight Elevators

- .1 Freight elevators shall be equipped with steel checker plate floors and painted metal cab and entrance finishes.
- .2 Cab finishes including cab walls, doors or gates, ceiling, etc. shall be finished in a factory applied powder coat or baked enamel finish.. Entrance components including frames, headers and landing door panels shall be finished in a factory applied prime coat finish suitable for finished painting by others.
- .3 Lighting for freight elevators to consist of recessed fluorescent light fixtures.
- .4 Provide bumper rails to prevent damage to cab walls from pallet jacks etc.

3.5 Rails

- .1 Standard size "T" section car and counterweight guide rails, with tongue and groove joints, together with suitable splice plates at the connections are required. As a minimum use 22 Kg/m rails for the car.

3.6 Voice Communications

- .1 For each elevator, provide a hands-free emergency voice communication system and mount as a separate fixture or as an integral part of the car operating panel. Provide a telephone system for communications to be monitored by UBC Security via an auto dialer.

(Vancouver) Provide a telephone for mounting behind the car operating panel faceplate. Make all connections required to activate the communication device with the wiring provided. Program the device to dial the number(s) provided by the Owner. A separate telephone activation button shall be provided. This button shall be provided with a tactile and Braille marking displaying the international symbol for a telephone.

(Okanagan) All elevator Emergency phones are monitored by security and must dial 78111. Each elevator emergency phone shall have a dedicated cable run to the building communication room and terminated as specified in Division 27 of the Technical guidelines.

- .2 The telephones shall be non-proprietary third party phone systems that can be easily adjusted, reprogrammed, volume adjusted or other features easily adjusted.
- .3 **(Vancouver)** The auto dial number to be programmed in all elevator cars for UBC Point Grey campus (except for SHCS Buildings) is 604-822-0445.

- .4 UBC Information Technology (IT) requires a demarcation point for each telephone line installed for elevator use. This demarcation is typically located in the elevator machine room. It allows UBC IT to test the phone line without entering the elevator equipment.
- .5 The elevator contractor shall test the operation of the communication system from each elevator cab to a Lobby Station (when provided) and to UBC Security. Provide UBC Facilities Electrical (Vancouver) / Facilities Management (Okanagan) with a report containing the total time from in cab activation until UBC Security could both identify the cab and communicate with the person in the cab.

3.7 Door Protection

- .1 Door re-opening devices shall be of the multi-beam infrared light detector type designed to detect obstructions without contact. Approved products are Janus - Panaforty, Formula Systems - Safe screen 547 and Otis - Lambda.

3.8 Hall Tactile Markings

- .1 Provide quality embossed metal jamb plate markings. Provide EJ3 markings with WB Finish and four-hole mechanical mounting available from Stencil Cutting and Supply Company, Ph. 1-800-783-4633 or approved equivalent product. Markings shall be attached with pins or other mechanical means. Do not use stamped or etched plates, and do not use only adhesive for attaching.

4.0 LESSONS LEARNED AND COMMON MISSES ON UBC PROJECTS

Items in this section are lessons learned or misses from past projects. These may also include code or industry best practices. If not applicable to a project, a variance is not required.

- .1 Some buildings do not have service/freight elevator and passenger elevators are used for deliveries. Heavy load deliveries damages porcelain/ceramic tiled flooring. This flooring type is not be used for any elevator type.

END OF SECTION

1.0 GENERAL

1.1 Related Work and UBC Guidelines

- .1 Section 14 20 00 Elevators

1.2 Related External Documents

- 1. Latest edition of the British Columbia Building Code (BCBC).
- 2. Latest edition of the CSA B44 Safety Code for Elevators and the requirements of the BC Elevating Devices Safety Act and Regulation.

1.3 Description

- .1 Platform lifts and other elevating devices to increase accessible circulation options in buildings.

1.4 Coordination

- 1. The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- 2. In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect and UBCO Facilities Management.
- 3. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- 4. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.
- 5. The UBCV Facilities Technical Review Team or UBCO Facilities Management is to be contacted for assistance with coordination of the elevator review by UBC Facilities staff at the design development stage. UBC Facilities staff involved in the review would include at a minimum; UBC Building Operations Electrical, Accessible Buildings Planner and UBC IT.

1.5 Quality Control and Assurance

- .1 Refer to requirements of Section 14 20 00 Elevators.

2.0 DESIGN AND PERFORMANCE REQUIREMENTS

- .1 Platform lifts or other “elevating devices for disabled persons” may be deemed to provide an acceptable alternative to an elevator or ramp for access only in situations where they can be shown to reasonably meet the intent of the B.C. Building Code. Use of all such lifts in UBC projects shall be avoided unless it can be demonstrated that the use of such a device is the best solution and does not compromise long term solutions.
- .2 Where it is deemed necessary to provide a lift for barrier free access, a LU/LA type of elevator is recommended with power operated side opening doors and fully automatic operation. A LU/LA lift must be installed to meet the latest B44 Safety Code Requirements.
- .3 The design requirements of Section 14 20 00 Elevators shall also apply to lifts where applicable. This includes an inspection and approval by [TSBC](#).

- .4 The use of inclined stair platform lifts is prohibited without specific approval [by the UBC Accessible Buildings Planner](#).
- .5 [Review](#) the location of all operator controls and communication initiation control with [the UBC Accessible Buildings Planner](#).

3.0 [MATERIALS \(Not Used\)](#)

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

- .1 Section 20 00 00 Mechanical (and all subsections)
- .2 Section 21 00 00 Fire Suppression (and all subsections)
- .3 Section 22 00 00 Plumbing (and all subsections)
- .4 Section 23 00 00 HVAC (and all subsections)
- .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.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.
- .5 This section of the Technical Guidelines is the parent of Division 21, 22 and 23. All requirements here, apply equally to those sections.

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 projects shall be subjected to UBC's design review process. Reviews will generally be conducted by representatives from UBC Facilities as well as other stakeholders. Requirements will vary depending on project. Consultants should work with UBC Project Managers to identify key steps.
- .2 All buildings shall utilize district energy
 - .1 This point and all sub-bullets for UBC Vancouver Only: All new and renewed buildings shall utilize district energy as the primary source of external heat opposed to boilers.
 - .1 When heatpump systems are utilized, district energy shall be used for supplemental heat.

- .2 Specifications and design details are to follow those described Section 33 61 00 District Hot Water Energy Distribution. Section 20, 22 and 23 of the UBC Technical Guidelines apply to secondary piping only. Refer to Section 33 for all information on primary side DES piping including installation and piping details.
- .3 Where the district hot water heating system is not yet available to tie into the building, space is to be allowed for the installation of a heat exchanger to provide heat transfer to the building heating system.
- .2 This point and all sub-bullets for UBC Okanagan Only: All new and renewed buildings shall utilize district energy as the primary source of heating and cooling
 - .1 Refer to Section 33 61 00 for all information on primary side DES piping including installation and piping details.
- .3 Wherever specialty systems are being installed (ex solar collectors), coordinate with UBC Facilities during the design stage to ensure that their service requirements can be met.
- .4 Designers shall implement redundant or partially redundant systems when practical. Many buildings may have specific requirements for N+1 redundancy. In less critical applications, such as teaching buildings provide core building infrastructure provide multiple pieces of equipment at 50% each. For example:
 - 2x District energy heat exchangers at 50% each
 - 2x Chillers at 50% each
 - Steam boilers per individual piece of equipment instead of one serving multiple
 - Air Handlers at 50% each

2.2 Access Requirements

- .1 Installing piping above ceilings, out of reach of any access panel shall be avoided. Installing valves such that they cannot be reached through an access panel is not acceptable.
- .2 Access panels shall be installed wherever required to access valves, equipment, sensors, etc.
- .3 Any equipment that requires regular access for maintenance shall not be located in a confined space.
- .4 Access to piping chases shall be granted
- .5 Consideration shall be given to accessing, servicing and replacing plumbing fixtures – particularly when they're mounted against tile.
- .6 All manufacturer recommended clearances and service requirements shall be met.
- .7 The designer shall include general notes pertaining to equipment access. If access is not adequate then projects will be responsible for granting adequate service access.
- .8 All rooftop equipment (including fans) shall be accessible for service without the use of ladders. Provide access platforms if required.

- .9 Designs shall consider any rigging requirements. For example, how rigging is to be installed to remove motors, chilled end bells, etc. Where needed, structural members shall be installed for this purpose.
- .10 Avoid placing equipment above communication rooms, freezer farms or other sensitive spaces where the floor will generally be consumed by large equipment which is hard to move. Consider floor mounted equipment in utilitarian spaces such as these as they are easy to access and service.
- .11 Where ladders exceed 16 feet in height or where there is a danger of a worker falling from the ladder to the ground level, roof or floor including an elevated access from a platform having less than 1.2 meters (48 inches) clearance between the ladder and any adjacent guardrail. The cage shall commence not more than 2.2 meters (7 ft.) above grade and continuing at least 90 centimeters (36 inches) above the top landing with openings to permit access by a worker to rest platforms or to the top landing.
- .12 Equipment (including exhaust fans) shall not be placed within 10' of the edge of a roof unless a 3'-6" high guardrail or parapet is in place.
 - .1 Note that TG 07 00 10 requires such full-height guardrails or parapets on all new buildings, so this should only be a common consideration on renovation projects.
- .13 Under no circumstances shall any utility piping extend under buildings as direct buried and in not readily accessible locations. Entire length of utility piping must be readily accessible after project completion. This includes steam, condensate, any gas piping, heating water, cooling water, domestic water, fire protection water, chilled water, and storm and sanitary drainage not related to the building.
- .14 No equipment with regularly scheduled maintenance (i.e. filter changes) shall be located above wood slat ceilings or other integrated ceiling systems (ceilings that feature proprietary panels, clips, etc.) Examples include:
 - .1 Although not preferred, a VAV box, reheat coil or similar may be located above a wood slat ceiling when necessary provided that access panels are provided.
 - .2 A horizontal fancoil or terminal heat pump shall be located in an open ceiling or above t-bar (preferred) or above drywall when absolutely necessary.
- .15 All regularly scheduled maintenance (i.e. filter changes) must be able to be done off a 12' ladder.
 - .1 Although not preferred, a VAV box, reheat coil or similar may be located higher than 12' provided that either:
 - .1 The space is accessible by a scissor lift. If scissor lifts are anticipated for maintenance then coordinate elevator capacity and ensure that a clear pathway to the work area is present without steps.
 - .2 Or there is space to setup a simple vertical scaffold on flat ground. Setting up scaffold above stairs or tiered seating is not acceptable access to mechanical equipment.

- .2 If fancoils or terminal heatpumps serve spaces with high ceilings then they shall be located outside the space in a location where they can be accessed from a ladder and ducted to the space they supply.

2.3 Equipment Requirements

- .1 All equipment shall have local support including proof of representation by the same local supplier for a minimum of three years.
- .2 Motors
 - .1 Requirements for variable frequency drives (VFDs):
 - .1 Refer to TG 26 29 23 -2.0.2 for electrical requirements for VFDs
 - .2 Refer to TG 25 00 00 – 7.21 for BMS requirement for VFDs
 - .3 Provide bypass only on critical applications where deemed appropriate by the designer. Avoid bypasses unless they're required.
 - .2 All motors over 1hp shall be MG1 Part 31 Inverter Duty.
 - .3 All motors over 20hp shall have shaft grounding rings.
 - .4 Requirements for electronically commutated motors (ECMs):
 - .1 Minimum BMS Connectivity

BMS Connectivity	Fractional HP ECMs (terminal units, small circulators, etc.)	ECMs > 1hp (air handlers, pumps, etc.)
Motor/drive enable (BO – input into drive from control device) (enables the drive to run, can be used to interlock for safety shut downs)	Required*	Required*
Motor/drive speed (AO – input into drive from control device) (this is a linear representation of the motor speed, 0-100% speed. "pressure or flow" control reset is not acceptable)	Required	Required
Motor/drive alarm (BI – output from drive into control device) (this is a dry contact that represents fault, as defined by the device manufacturer)		Required
Motor/drive status (BI – output from drive into control device) (represents drive is running)	** ***	Required ***
BACnet MS/TP master connection (slave connections are not acceptable) (modbus NOT acceptable) (Modbus to BACnet gateway NOT acceptable)		Preferred
* May be combined with the speed AO in some cases. ** Generally, a status is not required for fractional horsepower ECMs such as fancoils. However, DHW recirc pumps require status, even if they're fractional horsepower. *** CTs are not recommended for status of an ECM. Due to the high turn down, ECM's which can read their max current draw may not be able to read their minimum current draw accurately. Ensure that a suitable CT or CS is used if you're relying on a 3 rd party device for status.		

- .2 It is not acceptable to use any pre-programmed functions built into ECM controllers (e.g. constant flow, constant pressure, proportional control, etc.) The primary reasons for this is that trouble shooting this controls approach and controlling access is very challenging at a campus wide level and if the controller is ever reset or replaced, it is very likely those settings also will be lost.
 - .3 It is not acceptable to use pumps that require proprietary dongles or remote controls for setup. All settings must be available via local screen.
 - .4 It is not acceptable to use integrated ECM sensors as primary control devices (such as differential pressure sensors built into ECM pumps). However, where possible, these sensors should be available through BACnet for monitoring and optimization.
 - .5 ECMs 3hp or less must use 120/208V or 347/600V. It is preferred that ECMs larger than 3hp also use these voltages, however it is not a requirement at this time.
- .3 Heat exchangers
- .1 This point and all sub-bullets for UBC Vancouver Only: All DES Heat Exchangers
 - .1 Primary side temperatures: 70C EWT, rated for 150C.
 - .2 Brazed Plate Double Wall Heat Exchangers (for domestic hot water energy transfer stations)
 - .1 Rated for potable water service (NSF 372)
 - .2 Double wall design must include air vents and leak detection ports
 - .1 Leak detection via wetting anywhere over the entire exterior surface is not acceptable
 - .3 Plates shall be type 316L stainless steel and they shall be .4mm thick (minimum)
 - .4 Heat exchangers to be specified with removable insulation “blankets”
- .4 Equipment such as boilers, chillers, variable speed drives, air handling units with integral control panels, or unitary HVAC equipment with integral controllers shall be capable of interfacing with UBC’s Building Management System via BACnet protocol. All such equipment shall have IP set in the field (UBC to provide list of instance numbers). UBC is to be provided with all the tools to change the IP instance number in the future should it be required.
- .1 This does not preclude the fact that all central equipment (chillers, boilers, etc.) must have a hardwire BMS connection for enable, reset, alarm and status.
 - .2 See section 25 05 00 – Building Management System (BMS) Design Guidelines.
- .5 5th class plants as defined by the BC Boiler and Pressure Vessel act are not acceptable. This means that systems must be divided up to stay under BC Boiler and Pressure Vessel Act cutoffs for steam, refrigeration and hot water.
- .6 [Within the O&M Manual, provide an as-built equipment schedule prepared in spreadsheet format including:](#)

- .1 Equipment type
 - .2 Equipment Tag
 - .3 Manufacturer
 - .4 Model
 - .5 Description
 - .6 Location
 - .7 Other information as may be pertinent
 - .8 Detailed performance information (flows, capacity, etc) are not required in this table.
This information can be looked up in the shop drawings as needed.
- .7 Within the O&M, provide a filter schedule prepared in spreadsheet format including the below info for all equipment with filters
- .1 Tag
 - .2 Equipment type
 - .3 Location
 - .4 Filter type
 - .5 Filter size(s)
 - .6 Filter quantity

2.4 Mechanical Room & Roof Requirements

- .1 Mechanical rooms shall, at a minimum have painted drywall c/w waterproof cove base sealed or integrated into the floor.
- .2 Where mechanical rooms are adjacent to occupied spaces provide special attention to the acoustic concerns; avoid placing critical spaces like offices next to mechanical rooms and consider the use of concrete or block walls which are resistant to moisture and have substantial sound deadening effect.
- .3 Mechanical rooms shall be accessible from the outdoors via double doors.
- .4 Mechanical rooms and roofs shall have keycard access. Coordinate with other disciplines during design phase as needed.
- .5 Floor shall have an elastic membrane coating when mechanical rooms are built over occupied spaces. Refer to TG 09 67 00 Fluid Applied Flooring for more information.
- .6 Designs shall minimize the mechanical equipment, which is installed exposed on rooftops, and ensure that all equipment installed on rooftops is suitable for outdoor installation:
 - .1 All buildings with a high density of rooftop mechanical equipment shall have fully enclosed mechanical penthouses to contain all air handlers, pumps, tanks, boilers, chillers, etc. and where practical exhaust fans and mixing box's.
 - .2 Exposed piping on rooftops should only include low point drains, high point air vents and manual isolation valves with valve stem extensions. Where additional piping accessories are required, a heated valve house shall be constructed. All pipes and electrical connections shall rise into this room and penetrate to the roof horizontally. All pumps, control valves, temperature sensors, strainers, etc. shall be installed in this room.

- .3 The designer may determine how to execute this concept including putting it on the side of an elevator overrun, as a freestanding structure, built into custom air handling equipment or other concepts that maintain the same design intent.
- .4 In situations where a "valve house" is not deemed necessary, insulated heating and cooling pipes shall not penetrate rooftops vertically with just a sleeve installed. A proper "dog house" shall be installed. This "dog house" shall have an overhang.
 - .1 Isolation valves may be installed under the overhang of the "dog house" provided that they have valve stem extensions so that the insulation is only minimally compromised.
- .5 Small diameter pipes such as refrigerant pipes and gas pipes may penetrate the roof through a gooseneck provided that the gooseneck is counter flashed into the roof and that the gooseneck is sealed to prevent insects, rodents and birds from entering the building through these penetrations.
 - .1 Where applicable consideration must be given to oil return and/or airlocks forming in goosenecks.
- .6 Plumbing vents flashed into the roof with a spun aluminum cap that overlaps the roof penetration or similar flashing are acceptable.
- .7 Exposed duct runs shall be minimized. Where they are used, structural steel supports integrated into the roof are required, the ductwork shall be insulated and clad with appropriate waterproof cladding (plated sheet metal shall not be exposed) and ductwork layout shall not impede access to equipment. Use of numerous ships ladders to go over ductwork does not constitute reasonable access.
- .8 See link here for 2018 memo which includes more details on this item:
https://www.technicalguidelines.ubc.ca/files/Div20/Roof_Memo_Apr2018.pdf

2.5 Construction Requirements

- .1 Where pipes penetrate through floor slabs they must be sleeved with a pipe that protrudes a minimum of 2" (50 mm) proud of the floor or a small housekeeping pad installed to prevent flooding to the floor below.
 - .1 Where riser clamps are used, an appropriate detail must be used such that the riser clamps do not sit on the sleeves.
- .2 All exposed materials prone to rusting (equipment supports, cut ends of unistrut, fasteners, exposed pipe sleeves, etc.). Shall be coated with rust inhibiting paint.
- .3 Insulation on piping or equipment shall be installed such that all factory or field installed labels remain visible.
 - .1 All piping shall have computer generated labels. Preference is to stack the lettering and display the full word description of the piping (i.e. "Domestic Hot Water", not "DHW" or "District Hot Water", not "DHW" or "Domestic Cold Water", not "DCW")
 - .2 All pipes that are accessible must be labelled every 10m and where they enter and leave rooms.
- .4 Pipe all equipment drains to floor drains.
 - .1 See plumbing fixture section for additional requirements.

- .5 All base mounted equipment shall sit on housekeeping pads, minimum 2" high and 4" wider than the equipment.
- .6 Cleaning
 - .1 Refer to 01 77 00 for further information
 - .2 Specify cleaning of interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.
 - .3 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.
 - .4 Specify new filters at turn-over, clean switch gear and VSD serving mechanical equipment inside and out.
 - .5 Specify removal of construction debris from the mechanical/electrical rooms.
- .7 No mechanical equipment or services shall reside in or pass through an electrical room or communications room unless they directly serve that room.

2.6 Demolition Requirements

- .1 Decommissioned equipment shall be demolished and disposed of in accordance with applicable codes and standards. No equipment shall be abandoned.
- .2 Where pressure vessels are decommissioned or abandoned, the contractor shall supply UBC Facilities with a photo of all labels on the equipment including the TSBC (previously BCSCA) registration decal. The contractor shall also drill a hole in the equipment prior to disposal and shall confirm in writing to UBC Facilities that this has been done. This is so that we can cancel the operating permit for this equipment and stop paying the annual fees associated with it.
- .3 Decommissioned piping and ducts located within mechanical rooms shall be demolished and cut back to the edge of the mechanical space, capped and clearly tagged. No piping shall be abandoned within mechanical rooms.
- .4 Decommissioned piping may be abandoned outside of mechanical rooms to the designer's judgement. Pipes which are likely to be obtrusive to future use of the space or maintenance should be demolished. Abandoned pipes are to be clearly labelled as such – at least once per room and more regularly as required.
- .5 All dead legs shall be capped and disconnected as close as possible to the active pipe. Valves shall not be considered acceptable isolation from a dead leg. The dead leg piping/equipment shall be demolished as per the requirements above.

2.7 Water Feature Requirements

- .1 All ponds shall utilize standard building components that maintenance crews are familiar with servicing. Avoid the use of specialty pond manufacturers for components such as pumps.

- .2 All ponds shall be controlled by a standard BMS Controller by one of UBC's approved providers. A graphic shall be constructed for the pond that is remotely accessible through UBC's BMS system.

2.8 Miscellaneous Requirements

- .1 Provide one set of special tools including computer hardware and software required to service equipment as recommended by manufacturers and in accordance with Section 01 77 00 Closeout Procedures.
- .2 Connections into existing systems to be made at time approved by owner. Request written approval of time when connections can be made.

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 All pipe penetrations through fire rated walls must have appropriate firestop listing
 - .1 If the pipe is subject to movement (thermal expansion, vibration, etc.) then the listing must accommodate the pipe movement
 - .2 If the piping has the potential to condense on the outside then the listing must make accommodations to maintain the insulation and vapour barrier

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines & Documents**

- .1 [Section 26 16 00 – Metering](#)
- .2 [Section 33 10 00 – Water Utilities](#)
- .3 [Section 33 51 00 – Natural Gas Distribution](#)
- .4 [Section 33 61 00 – District Hot Water Energy Distribution](#)

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](#)

1.3 **Description**

- .1 These guidelines apply to all work completed within UBC owned buildings at UBC Vancouver – this includes core academic buildings, student housing, athletics.
 - 1. [For metering requirements for non-UBC owned buildings, coordinate with UBC Energy and Water Services](#)
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.
- .5 This section of the Technical Guidelines is the parent of Division 21, 22 and 23. All requirements here, apply equally to those sections.

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

- .1 The project shall bear all costs associated with installation of meters.
- .2 [All site-level meters, unless otherwise specified, shall be supplied by the project, from local distributors as per spec in this document. Coordinate with UBC Energy and Water Services for approval.](#)
- .3 All UBC owned and non UBC owned buildings and all irrigation systems constructed on UBC property shall have meters installed on all services, for example:
 - 1. Water
 - 2. District Energy System (DES)
 - 3. Gas
 - 4. Electricity
- .4 [Main building water and gas meters shall be compatible with remote monitoring and wired directly to the building automation system. The Division 26 contractor shall be responsible to install all pathways and wiring for remote monitoring of these meters. Refer to Section 26 16 00 and standard drawing E4-6 for wiring methods.](#)
- .5 Deleted.

- .6 DES meters shall be network connected for remote monitoring only. The Division 20 contractor shall provide all necessary communication equipment to ensure effective remote monitoring is achieved. [Refer to Section 33 61 00 0 5.3.1 and 5.3.5](#) and standard drawings E4-6c.
- .7 All UBC buildings shall have the following services metered:
 - 1. Water: All buildings
 - 2. Gas: All buildings
 - 3. Electricity: All buildings
 - 4. District Energy: All buildings
- .8 Standard of acceptance of mechanical meters shall be as follows:
 - 1. [Water: Badger M5000](#)
 - 2. [Gas: Dresser D800](#)
 - 3. [District Energy: Kamstrup Multical 603 with BACnet module](#)
- .9 Electrical Meters
 - 1. Refer to Division 26.

*****END OF SECTION*****

1.0 GENERAL

1.1 Coordination Requirements

- .1 UBC Facilities
- .2 University's Project Manager
- .3 UBC Energy and Water Services.

1.2 Description

- .1 Salvage of existing mechanical equipment or controls components on renovation or retrofit projects.

2.0 MATERIAL AND DESIGN REQUIREMENTS

- .1 The Mechanical Consultant shall prepare a list of those items that are potentially reusable by the Owner. Submit the list to the University's Project Manager before demolition commences.
- .2 The list will be reviewed with the UBC Operations Department, revised to reflect the University's needs and returned to the Consultant before demolition.
- .3 The Consultant shall list, in the specifications, all items that are to be salvaged.
- .4 The following wording shall be included in the specifications:
 - .1 The following items shall be carefully removed and handed over to the Owner.
 - .2 The Sub-Contractor shall inventory all items identifying their source, the location, date of removal and stating the Company's name.
- .5 Items for Disposal
 - .1 Remove all redundant material not required by the owner from the Campus and dispose of legally outside of UBC Property.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Standard Piping Signage Designation
- .2 ANSI 13.1 Scheme for Identification of Piping Systems.

1.2 Coordination Requirements

- .1 Coordinate with UBC Facilities
- .2 Coordinate with other design disciplines.
- .3 Refer to the University's standard designators for systems and components.

1.3 Description

- .1 Identification of mechanical systems and components in all University buildings, facilities and tunnels.
- .2 The identification system is composed primarily of nameplates, labels, tags and stenciled lettering.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 Identification Logic

- .1 Identify each system and system component according to the nomenclature used on the drawings and specifications. Identification to be consistent throughout the project.
- .2 When identifying systems and components in existing buildings, the new items shall be numbered sequentially with existing systems. Where possible include the zone or building area serviced by each system.
- .3 In new buildings (or full scale renewals), all mechanical equipment shall be tagged with a two or three letter equipment description, followed by the floor number (of the physical location of the equipment), followed by the indexed number. Examples:
 - .1 AHU-B2-03 is the third air handler located on level B2
 - .2 FC-04-16 is the sixteenth fancoil on level four
- .4 Special tagging requirements exist for fumehoods, associated fans and starters. [See TG 23 38 00.](#)
- .5 In existing buildings, equipment tagging shall be consistent with existing tagging in the building. Tags shall not be re-used.

2.2 General

- .1 Submit list of system and component labels to be Consultant for review prior to engraving.

2.3 Labels (Identification)

- .1 Provide lamicoid plastic labels with black face and white centre, 100 mm x 35 mm x 2.5 mm thickness for the following applications:
 - .1 Gauges and Panels engrave with 6 mm high lettering. Note for electrical switch gear, coordinate with Division 16.
 - .2 Systems engrave with 25 mm high lettering.

- .3 Fume Hoods engrave with 10 mm high lettering.
- .4 Apply labels to the following systems within the Mechanical Rooms and Penthouse:
 - .1 Water.
 - .2 Natural Gas.
 - .3 Steam.
 - .4 Fire Protection.
 - .5 Condensate.
 - .6 Compressed Air.
 - .7 One label to be affixed to the system and a second applied to the associated switch gear.
- .5 Gauges and Panels.
- .2 All fumes hood systems shall be identified with limacoid labels. Identical labels are to be affixed to each fume hood and associated fan and motor starter (note that three labels are required for each system). The wording which will identify the specific fume hood and associated fan will be supplied by the owner.
- .3 Limacoid labels shall be mechanically fastened to the identified system and components in a conspicuous location.

2.4 Labels for Perchloric Fume Hoods

- .1 Provide limacoid plastic labels with "fire red" face and white centre 135 mm x 65 mm x 2.5 mm thickness to act as a warning to Fume Hood users.
- .2 For label layout refer to Standard Detail in Division 20. This label is in addition to that required above.
- .3 Perchloric fume hood labels shall be secured to the upper front panel adjacent to the static pressure gauge.

2.5 Color Coded Dots

- .1 Color Coded Dots
 - .1 Provide self-adhesive color-coded dots 13 mm in diameter.
 - .2 Dots shall be Avery TR808 or an alternate approved by the Owner. Colors shall be yellow, black, red and green.
- .2 Doors and ceiling panels providing access to devices mounted in concealed locations shall be identified by color coded dots.
- .3 Color coding shall be to the following schedule:

.1 Mechanical equipment and cleaning access	Yellow.
.2 Control equipment, dampers, valves and sensors	Black.
.3 Fire, smoke and sprinkler equipment	Red.
.4 Pipe mounted equipment other than above	Green.
- .4 Where access is through a suspend T-Bar ceiling affix dot to exposed T-Bar frame closest to the concealed equipment.

2.6 Valve Tags

- .1 Tags shall be 40 mm diameter brass with 10 mm stamped alpha-numeric coding filled with black paint.

- .2 Tags shall be complete with non-ferrous chain or "S" hooks.
- .3 Tags shall be as supplied by W.H. Brady or an alternate approved by the Owner.
- .4 Consecutively number all valves and controllers installed by Division 15 on a system basis using tags. Coordinate between the various mechanical trades to prevent duplication.
- .5 Identification coding is to start with a utility description followed by a maximum of three numerals:
 - .1 Water WXXX
 - .2 Natural Gas GXXX
 - .3 Steam SXXX
 - .4 Fire Protection FPXXX
 - .5 Condensate CXXX
 - .6 Compressed Air
- .6 The first tag number in each series will be supplied by the Owner.
- .7 For installations in existing buildings the valve and controller numbers shall be numerically sequential with the existing series.
- .8 Provide six identification flow diagrams for each system incorporating the tag schedule stating the designation number, the service function and location of tagged items and normal operating position of valves. Flow diagram shall be on maximum size 11" x 17" sheets having a 3/4" border on the left side to permit insertion into a ring binder.
- .9 Mount one copy of the flow diagram in a glazed frame.
- .10 Provide copies of flow diagram for the Operating and Maintenance Manuals.

2.7 Stenciled Letters

- .1 Black stenciled letters and numbers 25 mm high, to sign painting standards.
- .2 Black stenciled direction arrows shall be 175 mm long by 56 mm wide.
- .3 Duct Work and Access Panels: Use the system designators stated on the drawing and specification.
- .4 Duct Identification and Direction Arrows shall be located on all duct runs in Mechanical Rooms and Penthouses.
 - .1 Maximum distance between markings shall be 8 meters.
 - .2 Where ducts pass through walls or partitions identify ducts on both sides of the section.
 - .3 Beside each access panel.
- .5 Perchloric Fume Exhaust
 - .1 Identify each duct "Danger-Perchloric" using 50 mm high black letters in the following locations as described above in "Duct Identification and Direction Arrows":
 - .1 Adjacent to all major changes in direction.
 - .2 At least once in each room. Where duct is concealed in a chase, shaft, gallery or other confined space, identify at points of entry and leaving and at each.
 - .3 At access openings.

.6 Access Panels

- .1 Panels shall be identified according to the following schedule of functions:

<u>Access Function</u>	<u>Symbol</u>
Cleaning and Service	C.A.
Controls including Sensors	C.
Dampers – Back draft, Balance and Control	D.
Fire Dampers	F.D.
Smoke Dampers	S.D.

- .7 Preference is for full words when labelling pipes or ductwork opposed to abbreviated versions. This is because abbreviations can often be misinterpreted. Some examples that have caused confusion in the past are:

- .1 CWS could be condenser water or chilled.
- .2 CHWS could be change over water supply or chilled water supply.
- .3 DHW could be domestic hot water or district heating water.

2.8 Manufacturer's Nameplates

- .1 Each piece of equipment shall have an original factory installed metal nameplate with raised or recessed characters.
- .2 The nameplate shall fully describe the component as to manufacturer, size, model, serial number, voltage, cycle, phase, power, pressures, volume, etc.
- .3 Locate nameplates so that they are easy to read. Do not insulate or paint over.
- .4 Provide standoffs where nameplates cannot be located on cool surfaces.
- .5 Ensure that regulatory registration plates are also attached to equipment - Pressure Vessel Rating, Underwriter's Laboratory Approval, CSA Approval, etc.
- .6 For all pressure vessels, order with two identification plates (each with the CRN) - one on either side of the pressure vessel so we're not at risk of the identification plate facing into the wall. Most manufacturers can accommodate this request when it is made at the time of ordering.

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

- .1 UBC Facilities Energy and Operations Policy I-B-53.
- .2 Section 23 00 00 HVAC (and all subsections)
- .3 BC Building Code and all references contained there within

1.2 Related Documents External to UBC

- .1 ASHRAE 55-2017: Thermal Environmental Conditions for Human Occupancy
- .2 ASHRAE 10-2011: Interaction Affecting the Achievement of Acceptable Indoor Environments
- .3 ASHRAE 62.1-2013: Ventilation for Acceptable Indoor Air Quality
- .4 BC Building Code and all references contained there within

1.3 Coordination Requirements

- .1 Coordinate with UBC Sustainability and Engineering and UBC Facilities.

1.4 Description

- .1 The Guidelines apply to all work completed within buildings on the UBC Vancouver campus unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

1.5 Purpose

- .1 This document is meant to provide guidance for the design of HVAC systems in new buildings and major renovations in order to provide a suitable thermal environment for the activities typical of UBC office, classroom, and laboratory spaces.
- .2 The basis for design and operation are the applicable ASHRAE standards. This standard clarifies how to interpret and apply these standards for the UBC Vancouver campus.

2.0 MATERIALS 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 Principles

- .1 Passive design:
 - .1 Designers shall adopt passive design approaches that use building architecture to improve indoor thermal comfort, minimize equipment sizing and run-time, and attempt to eliminate the requirement for active space conditioning and ventilation. Design

approaches such as the use of trees and architectural features for shading are recommended, as well as selection of glazing with a low solar heat gain coefficient for large window areas and operable windows.

.2 Passive cooling:

- .1 A passive cooling strategy is the preferred design approach where possible. Buildings with passive cooling shall be designed such that spaces served shall not overheat, as defined in ASHRAE 55-2017 and Section 2.3 of this guideline.
- .2 Operable windows shall be provided. Sensors shall interlock with space conditioning to prevent the mechanical system fighting the natural ventilation. See ASHRAE Handbook Fundamentals, Natural Ventilation and Infiltration, Chapter 22.
- .3 For buildings where passive cooling strategies are unable to meet either the thermal comfort requirements given in this guideline or the program requirements of the building, a mixed-mode ventilation strategy should be considered that uses a combination of natural ventilation and mechanical HVAC where necessary.

.3 Mixed-Mode Ventilation:

- .1 Designers are encouraged to use natural ventilation when available through passive design measures. When it is impracticable for the building to use natural ventilation (during cold winter months, for example), the building should have a ventilation system capable of supplying sufficient ventilation air to the building. In this case, passive cooling principles would be used as a first stage of cooling, and mechanical cooling would activate as a second stage. Designers are encouraged to use demand control ventilation strategies to reduce heating of outdoor air.

.4 Mechanical cooling:

- .1 Mechanical cooling shall only be used when spaces cannot comply with Section 2.3 using passive design principles. When it is required, mechanical cooling shall serve only the zones which will overheat.

.5 Process Cooling:

- .1 Mechanical cooling shall be provided where process or code requirements dictate.

.6 Ventilation

- .1 Select a ventilation strategy which is most suitable for the building design. Passive or natural ventilation should be used wherever appropriate, using buoyancy of warm air, building orientation, etc. to ventilate the building.
- .2 Refer to CIBSE – Natural Ventilation in Non-Domestic Building – Chapter 2 “Selecting a natural ventilation concept” as a source of reference.

.7 Adaptation:

- .1 Designers shall design with climate change adaptation in mind. Heating coils shall be selected such that they can be used as changeover coils in the future. Where this is not possible, space for future cooling coils shall be provided.
- .2 Refer to [Climate Ready Requirements for UBC Buildings](#) for information on potential climate adaptation strategies for new buildings.

.8 Humidity control:

- .1 Vancouver's temperate climate, with mild temperatures and moderate humidity levels year round, allows the humidity in a space to be uncontrolled and the space still be considered comfortable. Unless there is a specific reason for humidity control (animal care, etc), it shall not be provided.

.9 Modeling:

- .1 simulation shall be used to verify the need for mechanical cooling. Thermal modeling shall be conducted using the 2050s (2041-2070) weather files for YVR. Future shifted weather file can be obtained from the PCIC website (<https://www.pacificclimate.org/data/weather-files>). Note that this weather file should be used for summertime thermal comfort modeling only from May to September inclusive. This weather file is not be used for energy simulations.

2.2 Design Criteria

- .1 The following table summarizes the heating and cooling design requirements for new construction and major renovation projects at UBC:

Space Type	Heating Design Temp	Cooling Design Temp or Standard	Allowed Exceedance
Office	22°C	ASHRAE 55-2017 section 5.4 if passively cooled 25°C peak temperature if mechanically cooled	3% occupied hours of exceedance (between May-Sept inclusive).
Laboratory ¹ (general wet lab)	22°C	25°C or as required by lab processes.	As determined by laboratory manager.
Classroom ¹	22°C	25°C peak temperature	
Student Residences	22°C	25°C peak temperature	
Stairwells & Hallways	22°C	None – ventilation only	N/A
Assembly spaces ¹	22°C	25°C peak temperature	
Transient spaces	22°C	ASHRAE 55-2017 section 5.4 if passively cooled 25°C peak temperature if mechanically cooled	3% occupied hours of exceedance (between May-Sept inclusive).

¹ Note that these spaces are expected to utilize mechanical cooling, as they cannot rely on natural ventilation to maintain the 25°C temperature limit. Additionally, adaptive thermal comfort principles do not apply to these spaces as users typically don't have the ability to adjust clothing levels, open windows, get up for breaks when needed, etc.

2.3 Design Criteria of Passively Cooled Spaces

- .1 Spaces that are passively cooled shall be designed such that they comply with the table in section 2.2 when modeled from May to September inclusive.
- .2 Thermal comfort modeling shall be conducted using the 2050s weather file for YVR obtained from the PCIC website (<https://www.pacificclimate.org/data/weather-files>). Models shall simulate indoor thermal conditions for the months of May to September inclusive.

- .3 Where mechanical cooling is required to meet compliance as per sentence 2.3.1, for all space types other than classrooms, designers shall apply for a design variance (see Appendix A) to the UBC Energy & Operations Steering Committee indicating:
 - .1 which criteria were failed when attempting to use passive cooling,
 - .2 which zones shall be served by mechanical cooling, and
 - .3 which passive design features are being employed and why they can't meet the thermal comfort requirements of the zone.

2.4 Design Criteria of Mechanically Cooled Spaces

- .1 Systems shall be designed such that spaces served by mechanical cooling meet ASHRAE 55-2017, Section 5.3. Graphic Comfort Zone Method or Analytical Comfort Zone Method defined in 5.3.1 or 5.3.2 are acceptable for determining overheating in mechanically cooled zones.
- .2 Active cooling systems, where required, shall be sized to prevent overheating (see section 2.2 for thermal comfort criteria) based on 31°C DB / 23°C WB (the expected 2.5% summer design condition in the 2050s climate¹) and an indoor temperature of 25°C.
 - .1 2050s design condition is determined by: (BCBC 2018 2.5% July condition) + (2050s median change for YVR2) for both dry bulb and wet bulb. This works out to:
$$28\text{C} + 3.0 = 31.0\text{C (DB)}$$
$$20\text{C} + 2.9 = 22.9\text{C (WB)}$$

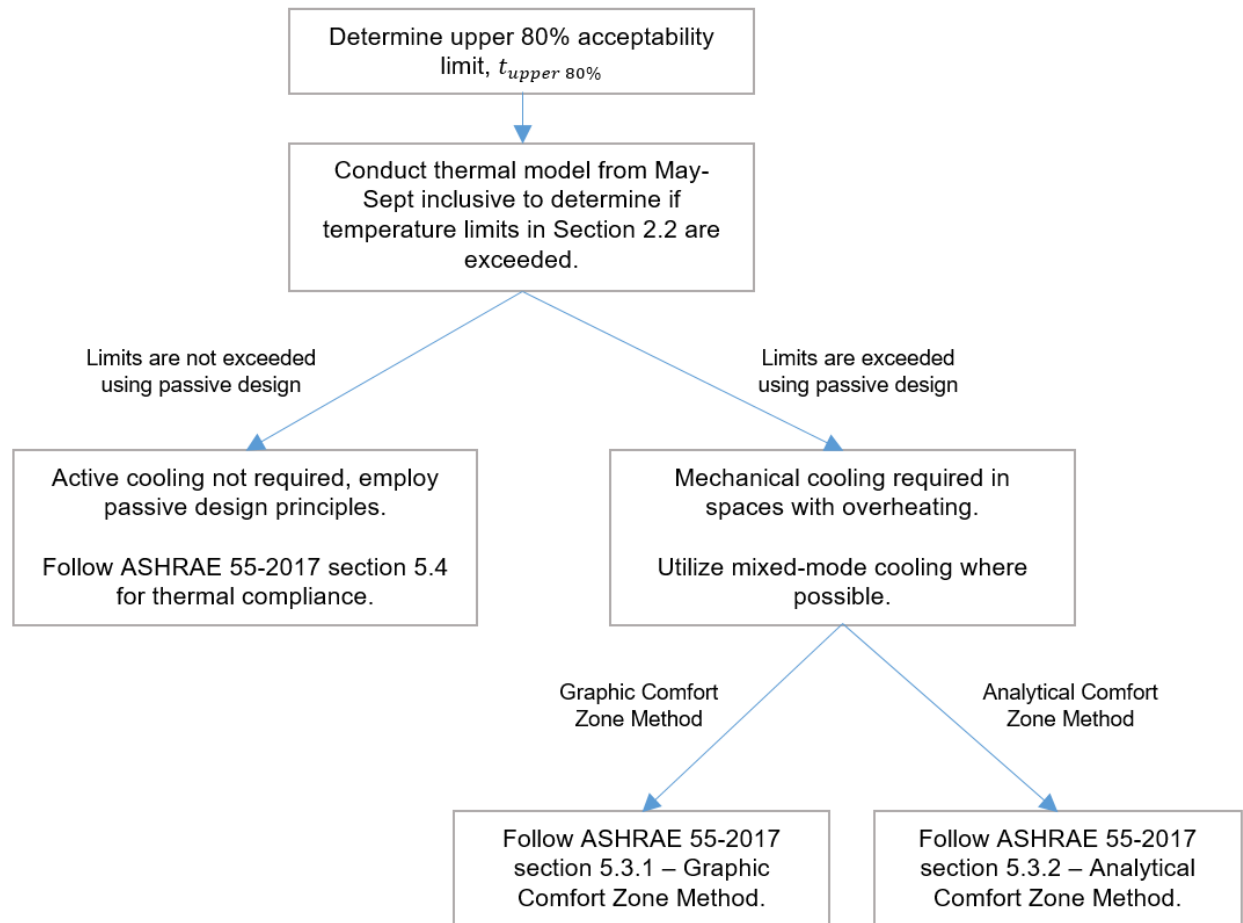
2.5 Design Criteria of Heating Systems

- .1 Heating systems shall be sized to maintain indoor temperature at 22°C when the outdoor temperature is equal to the BC Building Code January 1% design temperature.

2.6 Process

- .1 The adaptive model of thermal comfort has found that building occupants perceive thermal comfort inside buildings as it relates to the current and recent historical outdoor air temperatures. People tend to acclimatize to outdoor temperature conditions with recent outdoor thermal experiences being more influential in a person's perception of how hot or cold a space is.
- .2 For this reason, UBC has adopted the ASHRAE 55 approach for passive cooling designs to identify a daily maximum comfort temperature using a running mean approach where recent daily mean temperatures are weighted more heavily in the calculation. The 2050s model hourly dry bulb temperature is available on UBC's SkySpark platform and shall be used for this calculation.

Obtain the 2050s weather file (per section 2.1.9 above); and the prevailing mean outdoor temperature $\overline{t_{mda(out)}}$, and upper 80% acceptability limit $t_{upper\ 80\%}$ (calculated as per ASHRAE 55-2017) through UBC's SkySpark platform following the instructions here: <https://energy.ubc.ca/energy-and-water-data/skyspark/>
- .3 The process to determine whether a space overheats is given below. Mathematical definitions of variables discussed are included in section 2.7.



- .1 Determine daily running mean outdoor temperature ($\overline{t_{mda(out)}}$).

Using the 2050s weather file, designers shall determine the daily running mean outdoor temperature ($\overline{t_{mda(out)}}$) between May and September inclusive. The preferred method for determining $\overline{t_{mda(out)}}$ is given in ASHRAE 55-2017 Appendix J (note, this is *not* simply an average of the previous days' temperatures, but adds weight to recent days' temperatures).

- .2 Determine daily 80% upper acceptability limit ($t_{upper\ 80\%}$) for each day.

From the daily running mean temperature, designers shall determine the upper 80% acceptability limit for each day, using the formula given in ASHRAE 55-2017 section 5.4.2.2.

- .3 Determine whether overheating is an issue with your passively cooled space with reference to section 2.2. If a passive design will lead to overheating as per Section 2.2, mechanical cooling will be required.

2.7 Definitions:

- .1 Upper 80% acceptability limit (°C)

$$t_{upper\ 80\%} = 0.31 \times \overline{t_{mda(out)}} + 21.3$$

- .2 Prevailing mean outdoor air temperature

$$\overline{t_{mda(out)}}$$

(refer to ASHRAE 55-2017 Appendix J for calculation method)

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 "Passive design" or "passive cooling" does not mean simply omitting mechanical cooling from the project. Passive design is a holistic approach to building design, using building architecture and orientation to minimize heat gain in the summer, and using the buoyancy of warm air and strategically located building openings to catch wind to naturally force ventilation air through the building.
- .2 Some recent buildings that have not undertaken thermal comfort modeling and have simply omitted mechanical cooling in office spaces have had significant thermal comfort challenges in recent summers. Design teams should use the results of the thermal comfort model to inform design decisions early in project design stages.
- .3 Leaving room for cooling coils (per section 2.1.7) also means leaving sufficient space to install the coil. I.e. providing clearance in front of the AHU to add the coil. In terms of clearance requirements, a future cooling coil should be treated the same as an actual coil.

*** END OF SECTION ***

APPENDIX A – VARIANCE REQUEST

Variance Request Process

All permanent Variance requests shall be submitted to the UBC Energy & Operations Steering Committee in which the change is to take place. Requests should be submitted early in the building design stages to give the design team sufficient time to update the design.

The Steering Committee will consider multiple criteria when reviewing a variance request, including (but not limited to) effects on energy consumption; impacts on building systems such as electrical or plumbing systems; whether any additional equipment can reasonably be maintained; and impacts on UBC's overall goals of operational excellence. After a request has been reviewed, a written response will be provided to the design team.

VARIANCE REQUEST FORM

Please fill out as many fields as possible in the form below, and email to the building's Project Manager who will forward on to the UBC Energy & Operations Steering Committee.

Request Date:

Requestor Contact Information

Name:

Phone:

Email:

Variance Information

Building:

Passive measures employed in building design:
(attach additional sheets if required)

Proposed solution to achieve thermal comfort:
(attach additional sheets if required)

[illegible]

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

- .1 All other Tech Guidelines as may be applicable to a given project.

1.2 Related Documents External to UBC

- .1 BC Fire 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
- .4 Where the applicable regulatory codes do not reference applicable standards. The most relevant version of NFPA or other applicable standards shall be used as determined by the engineer. For example:
 - .1 NFPA 12 - Carbon Dioxide Fire Extinguishing Systems
 - .2 NFPA 45 - Design of Laboratories
 - .3 NFPA 2001 - Clean Agent Fire Extinguishing Systems

1.3 Description

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.

1.4 Design Review

- .1 All projects are expected to submit their designs for review through the UBC Design Review Portal. The milestones that are expected to be submitted will vary by project and discipline. Please coordinate with your UBC Project Manager for specific instructions.
 - .1 The review process does not relieve the designers of the requirement to follow the technical guidelines as well as other pertinent codes, standards and best engineering practice.

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. Please see the variance application process at <https://www.technicalguidelines.ubc.ca/>.

2.1 Design Requirements

- .1 New and renovated facilities at UBC are to be fully sprinkler protected regardless of code requirements. UBC is largely self-insured and has adopted this policy to manage risk and

enhance the safety of its facilities to the benefit of faculty, staff, students, and visitors. Fire sprinkler protection at the University is consistent to standard industry practice. Deviations are intended to increase system longevity and provide flexibility for subsequent renovation.

- .2 For water supply information:
 - .1 This bullet and all sub-bullets for UBC-Vancouver, only: Contact UBC Energy and Water Services for water supply information.
- .3 All flows shall be designed with a 10% safety factor to provide capacity for future renovations including the possibility that some light hazard spaces may be re-classified to ordinary hazard in the future.
- .4 Fire pumps:
 - .1 This bullet and all sub-bullets for UBC-Vancouver, only: UBC Vancouver has higher water pressure than most parts of the city. As a result, fire pumps are often not required. Review all required pressures and avoid booster pumps when possible.
 - .2 Size fire pumps with 10% safety factor for future expansion.
- .5 Each building shall have a separate water service. No building shall be fed from another building.
- .6 For systems subject to freezing, UBC order of preference is:
 - .1 Dry heads
 - .2 Dry systems
 - .3 Anti-freeze systems. (only if the above can be demonstrated to be impractical – variance required)
- .7 Deluge systems & fire curtains
 - .1 UBC has had false release events of deluge systems in performance theaters which has caused significant damage.
 - .2 Fire curtains are preferred, but there is a recognition that they are not appropriate for all applications. Please engage UBC Fire and Life Safety Maintenance group when specifying either deluge or fire curtain systems.
- .8 Oxygen displacement systems
 - .1 Shall be avoided and only considered when required by the specific application.
 - .2 Where oxygen displacement systems are used, gases with low global warming potential (GWP) and zero ozone depleting potential (ODP) shall be utilized. For example:
 - .1 FM200 is not acceptable
 - .2 Novec1230, Intergen, CO2 are acceptable
- .9 Wet chemical systems
 - .1 Provide one manual control ULC listed operating station to NFPA17A.
- .10 Fire Shutters
 - .1 Fire shutters require motor operators in both directions. Manual open fire shutters are not acceptable.

2.2 Construction & Material Requirements

- .1 Access Requirements
 - .1 Installing valves such that they cannot be reached through an access panel is not acceptable.
 - .2 Access panels shall be installed wherever required to access valves, equipment, sensors, etc.
 - .3 Any equipment that requires regular access for maintenance shall not be located in a confined space.
 - .4 Access to piping chases shall be granted
 - .5 All manufacturer recommended clearances and service requirements shall be met.
 - .6 Where ladders exceed 16 feet in height or where there is a danger of a worker falling from the ladder to the ground level, roof or floor including an elevated access from a platform having less than 1.2 meters (48 inches) clearance between the ladder and any adjacent guardrail. The cage shall commence not more than 2.2 meters (7 ft.) above grade and continuing at least 90 centimeters (36 inches) above the top landing with openings to permit access by a worker to rest platforms or to the top landing.
- .2 All equipment shall be installed such that it is readily accessible. This includes but is not limited to:
 - .1 Piping installed above drop ceilings shall be within reach of an access panel located on the ceiling. Installing piping out of reach of any access panel shall be avoided. Installing valves such that they cannot be reached through an access panel is not acceptable.
 - .2 Appropriate access panels shall be installed.
 - .3 Any equipment that requires regular access for maintenance shall not be located in a confined space wherever avoidable.
 - .4 Access to piping chases shall be granted
 - .5 Consideration shall be given to accessing, servicing and replacing plumbing fixtures – particularly when they're mounted against tile.
 - .6 All manufacturer recommended clearances and service requirements shall be met.
 - .7 The designer shall include general notes pertaining to equipment access. If access is not adequate then projects will be responsible for granting adequate service access.
- .3 Whenever fire protection may be temporarily suspended, in buildings/facilities with Occupancy Permit, a Fire Watch must be called for which conforms to the requirements of UBC Building Operations. For details click on the following link:
 - .1 Vancouver Fire & Rescue Services. https://buildingoperations.ubc.ca/files/2017/05/I-B-41_AW_and_MF_Fire_Watch.pdf
- .4 Building fire alarm panels shall provide one set of form C contacts for monitoring of fire alarm system status by the BMS System.
- .5 Drains
 - .1 System drains shall be piped to floor drains, minimum size of 4"
 - .2 All low point drain valves shall be mounted at maximum 2m AFF and the associated piping shall allow for discharge into a floor drain.

- .3 The inspector's test valves and drum drip shall be readily accessible and secured to prevent tampering.
- .6 Standpipes
 - .1 Where standpipes are required and provided in the stair enclosure, the control valves and drains shall be secured from tampering/vandalism.
- .7 Compressors
 - .1 All Pre-Action System and Dry System compressors shall be dedicated to Life Safety and shall not serve any other purpose.
 - .2 All Pre-Action System and Dry System compressors shall be mounted using suitable vibration isolation, using flexible air line that is rated to a minimum of 1.5 times the maximum psi rating of the compressor and with at least 1m clear space above and on one side to allow for maintenance.
- .8 All control, test and drain valves shall have tags / labelling:
 - .1 Shall identify the type of valve and the area (floor or portion of the building) affected by the valve
 - .2 Shall indicate normally open / normally closed position
- .9 Pressure gauges;
 - .1 Provide a 3 ½" diameter pressure gauge with the appropriate scale at the main incoming water. Also, at each valve station, base of every riser, above and below alarm valves, before and after check valves, at any compressors or pumps, and at any pressure switches.
- .10 Sprinkler heads
 - .1 In the following areas, exposed sprinkler heads are prone to damage and require guards:
 - .1 Mechanical rooms
 - .2 Electrical rooms
 - .3 Storage rooms
 - .4 Stairways
 - .2 The contractor shall work with UBC to assure a stock of spare sprinklers is available in conformance with code requirements.
- .11 Fire department connections
 - .1 Plastic caps on fire department connections are not acceptable due to concerns of durability.
- .12 Use Teflon pipe tape, pipe dope is not acceptable.
- .13 Manufacturer of all equipment and materials shall have local technical personnel available for testing, maintenance and repair,
- .14 All dry pipe valves must have an external reset feature actuated by a reset knob.

- .15 Exterior Fire Alarm Devices installation requirements:
 - .1 Bottom Entry.
 - .2 Weather Rated.
 - .3 Metal Shroud: Required to be mounted such that it does not interfere with operation or maintenance of FA device or adjacent equipment. Minimum of 6" vertical clearance from device and sized with a minimum 6" extension from the outermost edges of the FA device.

2.3 Testing & Commissioning Requirements

- .1 Operate all test connections to verify water flow switch operation per NFPA standards.
 - .1 For wet systems, it should exceed NFPA standards and operate in 30 seconds.
 - .2 For dry systems, it should meet NFPA standards.
- .2 UBC Facilities – Fire and Life Safety Crew shall be invited to witness and participate in the Integrated System Testing whenever it is required per BCBC and CAN/ULC S1001.

2.4 Demolition Requirements

- .1 Decommissioned equipment shall be demolished and disposed of in accordance with applicable codes and standards. No equipment shall be abandoned.
- .2 Decommissioned piping located within mechanical rooms shall be demolished and cut back to the edge of the mechanical space, capped and clearly tagged. No piping shall be abandoned within mechanical rooms.
- .3 Decommissioned piping may be abandoned outside of mechanical rooms to the designer's judgement. Pipes which are likely to be obtrusive to future use of the space or maintenance should be demolished. Abandoned pipes are to be clearly labelled as such – at least once per room and more regularly as required.
- .4 All dead legs shall be capped and disconnected as close as possible to the active pipe. Valves shall not be considered acceptable isolation from a dead leg. The dead leg piping/equipment shall be demolished as per the requirements above.

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 Space holder

END OF SECTION

1.0 GENERAL

1.1 Related UBC Technical Guidelines

- .1 10 00 01 Special Room Requirements
- .2 20 00 05 Mechanical - General Requirements
- .3 20 00 06 Meters
- .4 22 00 00 Plumbing (and all subsections)
- .5 23 21 05 District Hot Water Heating System
- .6 33 10 00 Water Utilities
- .7 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.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 Water entry station shall include, in this order:
 - .1 Wye-Strainer c/w blow off valve
 - .2 This bullet and all sub-bullets apply to UBC-Vancouver only: Neptune Water meter c/w turbine strainer as per 33 10 00 Water Utilities
 - .3 Backflow Preventers each sized at 50% flow for the building. Refer to 22 11 18 Backflow / Cross Connection Control for more details.
 - .4 Pressure reducing station after the backflow preventer
 - .1 Standard pressure PRV's such as a Watts 223LF have a max pressure of 75PSI but UBC Maintenance experience is that it can be hard to actually achieve that 75PSI especially when you have low flow and high flow PRV's (since the high flow needs to be set at a lower pressure than the low flow). The Watts 223LF-HP has a range of 50PSI – 145PSI (depending on size). The high-pressure model allows us to reliably run the systems at 80PSI (code maximum) when needed to address flow or pressure complaints which are common. High

- pressure PRVs should be used as the primary PRV for almost all UBC Buildings.
- .2 PRV Types
 - .1 If the flow can be achieved by a single PRV then a direct acting PRV that can go down to zero flow should be specified c/w a normally closed bypass.
 - .2 If the flow exceeds what can be achieved by a single direct acting PRV then two PRV's should be specified: low flow to be direct acting, high flow to be externally piloted type c/w normally closed bypass.
 - .2 This bullet and all sub-bullets apply to UBC-Vancouver only: All new and renewed buildings are to be connected to the district energy system. This system is to be the primary source of heat for hot water systems. Refer to section 23 21 05 for more details including energy transfer station piping arrangement.
 - .3 Drain valves c/w cap and chain shall be specified at all low system low points.
 - .4 This bullet and all sub-bullets apply to UBC-Vancouver only: All janitor rooms shall have detergent dispensing systems installed. These require ¾" RPBP's on DCW and DHW. Refer to 10 00 01 – Special Room Requirements for more information on janitor room requirements.
 - .5 For DHW recirculation systems, on all connection points specify, ¼ turn ball valves, check valves and balancing valves (or auto flow valves) (lead free for all).
 - .6 In no situation is it acceptable to use a balancing valve as an isolation point (even if it has a memory stop). The reason for this is that when they're used for isolation, they are frequently not returned to the same point and over time, system balancing is thrown off.
 - .7 Potable hot water tanks shall be maintained at no less than 50°C and no more than 60°C. Where potable water is stored in tanks, it cannot be stored at Legionella growth temperatures (25-45°C).
 - .8 The use of waste heat to preheat domestic hot water is encouraged where building mechanical designs are well suited to this. However, it's not acceptable to have a pre-heat storage tank due to legionella concerns so this must be done using instantaneous heat on the DCW supply line, using a double wall heat exchanger.
 - .9 "Alternate water source system" means a system to collect, treat, and use non-potable water from alternate water sources in lieu of potable water.
 - .1 Experience at UBC indicates that a robust maintenance plan with dedicated funding source be in place to operate and maintain these systems effectively to achieve the benefits and address performance outcomes.
 - .2 UBC is committed to water conservation and alternative water source systems however these will only be permitted at UBC through variance application to ensure that the necessary stakeholder engagement is in place.
 - .1 Acceptable alternate water sources and collection systems:
 - .1 Rainwater collected from roofs or similar above-grade surfaces free from use and storage of vehicles, hazardous materials, fuels and fertilizers.
 - .2 Clear-water waste such as cooling water or condensate drainage from refrigeration, not including wastewater (greywater or blackwater) or storm water.

- .2 Acceptable uses (subject to meeting applicable health and safety requirements and/or Canadian Water Quality Guidelines applicable to the specific use):
 - .1 Flushing of water closets, urinals and trap primers.
 - .2 Irrigation (non-food plants) using drip rather than spray systems.
 - .3 Equipment cooling water such as boiler make-up water or open-loop cooling of equipment.
- .3 Systems that are in line with the CSA-B128.1 – Design and Installation of Non-Potable Water Systems, ARCSA Rainwater Harvesting Manual, CoV Building By-law 10908 (note that this is elective compliance as CoV Building Bylaws do not apply at UBC)
- .4 As part of the variance process, additional conditions on design, regulatory requirements, testing and commissioning will be developed.

2.2 Construction and Material Requirements

- .1 Acceptable piping systems
 - .1 Domestic Cold Water
 - .1 Type K Copper (solder, grooved, pro-press or flanged) (pro-press acceptance is at the discretion of the Authority having Jurisdiction - it has been noted that pro-press is not currently accepted by the National Plumbing Code)
 - .2 Uponor (up to 3")
 - .3 Grooved or welded stainless steel (2-1/2" or larger) (pro-press acceptance is at the discretion of the Authority having Jurisdiction - it has been noted that pro-press is not currently accepted by the National Plumbing Code)
 - .2 Domestic Hot Water
 - .1 Type K Copper (solder, grooved, pro-press or flanged)
 - .2 Uponor (up to 3")
 - .1 Not acceptable within 20' of district energy heat exchangers.
 - .2 BMS to Close the DES primary side valve and throw a latching high temperature alarm if the water temperature leaving the DES heat exchanger exceeds setpoint by more than 10C. This high temperature alarm should be considered a critical alarm due to the damage that overheating water can do to plastic pipe. There must be substantial labelling (on BMS graphics and on site) stating the max temperature and implications of higher temps.
 - .3 Grooved or welded stainless steel (2-1/2" or larger)
 - .3 Domestic Hot Water Recirc
 - .1 Type K Copper (solder, grooved, pro-press or flanged)
 - .2 Uponor (up to 3")
 - .3 Grooved or welded stainless steel (2-1/2" or larger)
- .2 Insulation:
 - .1 Chilled water and condenser water piping shall have continuous vapour barrier complete with oversized hangers and 'h-block'
 - .2 Indoor piping
 - .1 Insulation shall have paper wrap (even in existing mech rooms which have canvas)
 - .2 Pre-formed PVC elbows
 - .3 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
 - .4 Chilled and condenser water pump bodies shall be insulated with pre-formed foam (preferred) or closed cell adhesive foam.

- .5 Thickness and additional specifications by consulting engineer
- .3 Wafer style valves are not acceptable. All valves shall be capable of end of line isolation.
- .4 Heat tracing is to be monitored by the BMS. Dedicated heat trace controller must include hardwired alarm contact to BMS or bacnet communication interface for monitoring. CT based alarm for BMS is not acceptable as it is considered unreliable for self-regulating heat trace.
- .5 Provide isolation valves on DCW, DHW and DHWR recirc lines that provide the ability to perform maintenance and renovation activities without shutting down the entire building. Including but not limited to:
 - .1 Takeoffs for each floor of a building
 - .2 Different wings of a building
 - .3 Different branches leaving a mechanical room
 - .4 Bathroom groups
 - .5 Other areas of high fixture volumes

2.3 Testing and Commissioning Requirements

- .1 This bullet and all sub-bullets apply to UBC-Vancouver only: UBC Building Official shall be invited to witness all tests that are required by code or the tech guidelines.
- .2 This bullet and all sub-bullets apply to UBC-Vancouver only: BCPC 2.3.7.2 requires water pressure tests at the maximum in service pressure. At UBC Vancouver this shall be deemed to be 125PSI (worst case if PRV fails). The system must maintain pressure without leaking for a minimum of 2 hours.
- .3 For renovation projects, all new lines shall be flushed and pressure tested prior to connecting to the base building system.

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 Non-potable water system requirements as per CSA B128.1-06 (referenced in BCBC)
 - .1 All piping shall be marked with warning labels and shall be purple in colour or have a continuous purple stripe.
 - .2 All water outlets on non-potable systems shall have signage as described in the standard
 - .3 This may include lab sinks where zone protection is being used

END OF SECTION

1.0 GENERAL

1.1 Related UBC Technical Guidelines

- .1 20 00 05 Mechanical - General Requirements
- .2 22 00 00 Plumbing (and all subsections)
- .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
- .4 CSA B64.10-.17 Selection and Installation of Backflow Preventers / Maintenance and Field Testing of Backflow Preventers

1.3 Description

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 There is a cross connection control program in effect at the University and all installations shall be in accordance with the recommendations contained in the latest edition of the BC Plumbing Code.
- .2 RPBP Special Requirements:
 - .1 Provide a drain standpipe or tank below RPBPs relief ports such that discharge does not go onto the floor. The drain must be sized to accommodate the max possible, continuous discharge of the RPBP.
 - .2 RPBPs larger than 1" shall not be installed below the sanitary gravity discharge from the building. RPBPs larger than 1" shall not discharge to sump pumps without receiving an approved variance.

- .3 RPBPs larger than 3" shall be installed above grade, in rooms that are on building exteriors and their discharge shall daylight.
- .3 Water service entry:
 - .1 Two Backflow Prevention Assemblies piped in parallel are required at the water service entry to all buildings, to allow for servicing without having to completely isolate the water supply to the building.
 - .2 Whether a Reduced Pressure Backflow Assembly (RPBA) or alternate type of assembly is required will depend on the hazard category of the building in question.
 - .3 The parallel Backflow Prevention Assemblies must be designed to allow for peak design flow during normal operation and for one unit to be taken off line for servicing while maintaining 50% or greater peak flow.
- .4 Fire Protection Service Connection:
 - .1 A double check valve assembly, (DCVA), is required at Fire Protection service connections per British Columbia Building Code-Plumbing Services (part 7). An additional parallel DCVA is not required.
- .5 Irrigation Systems:
 - .1 A DCVA at the service connection is to be provided in accordance with the usage. Note: where a higher hazard exists (due to chemical injection), additional area protection with an RP Assembly is required.
- .6 Potable Water Systems:
 - .1 Backflow protection is required to be installed in local areas to protect potable water systems in buildings from labs and other hazardous water uses within the building.
- .7 Water Filters:
 - .1 An RPBA shall be installed immediately upstream of all water filters equal to, or greater than 25mm (1").
 - .2 A DCVA shall be installed immediately upstream of all water filters less than 25mm (1").
- .8 Chemical or Detergent Mixing Stations:
 - .1 An RPBA shall be installed immediately upstream of any chemical or detergent mixing station.
 - .2 These are present in most janitor rooms on campus by UBC, post construction. All janitor rooms should have RPBAs (hot and cold piping) as well as other project specific locations.

2.2 Construction and Material Requirements

- .1 All backflow prevention assemblies shall comply with the requirements of CSA B64.10-17

2.3 Testing and Commissioning Requirements

- .1 Following installation, prior to building turnover - a test report completed by a certified tester shall be submitted to the Owner, indicating satisfactory operation of each device.
 - .1 This report shall be included in the O&M manual submitted at the end of each project.
 - .2 The report shall be on UBC's standard format, located at https://technicalguidelines.ubc.ca/Division_22/Ref_materials/Backflow_Test_Form.pdf.

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 RPBPs shall only be used where the building risk analysis deems they're required. Where possible use DCVAs as they are easier to maintain and pose less risk to the building (flooding).

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

- .1 Section 20 00 05 Mechanical - General Requirements
- .2 Section 22 00 00 Plumbing (and all subsections)
- .3 All other Tech Guidelines as may be applicable to a given project.
- .4 UBC Hazardous Waste Disposal Guide

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.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 UBC does not support the installation or use of acid neutralization tanks (small under counter, or large centralized) or acid waste piping. Researchers are to collect their acid waste in an appropriate container and follow the procedures outlined on UBC's Hazardous Waste Disposal Guide.
 - .1 In buildings with existing central acid waste piping and tank – the system shall be considered de-commissioned. New fixtures/appliances that enable users to put acids down the drains shall not be installed.
 - .2 This does not apply condensate neutralization tanks on gas fired HVAC/Plumbing equipment with condensing flue gases. However, care should be taken to ensure that these tanks are installed in a serviceable manner and that they have enough capacity that the lime chips don't have to be replenished very often. They should be the style where the top opens to put more lime chips in, opposed to closed tube style assemblies.
- .2 Refer to section 22 30 00 for requirements for sump pumps.
- .3 Specify floor drains in all public washrooms.

- .4 UBC requirements to avoid clogs in sanitary piping systems:
 - .1 All consultants should read and be familiar with the article “Dry Drains” by Ron George which was published on the PHCP website on Jan 18, 2019 and shall consider the design guidance provided therein. It is also available [here](#).
 - .2 Double Wye fittings are not acceptable on horizontal pipe runs. A disproportionate number of our clogs occur at these fittings. Instead, use regular wye fittings and “roll them up” to ensure that no backflow into the fitting occurs.
 - .1 The design of these fitting necessitate that they are installed flat. As a result, every time the flow passes one, the hydraulic depth is reduced, eventually leading to solids dropping out.
 - .2 Solids which enter these fittings from the sides have a tendency to hit and become lodged on the opposing corner which eventually leads to build up and forms a clog.
 - .3 See videos at [this link](#) for examples of the above.
 - .3 All toilets in ICI buildings shall be BCBC maximum flow, 6LPF (see Section 22 40 00 – Plumbing Fixtures for more info). Lower flow toilets are not acceptable except when they are required as a mandatory requirement for LEED.
 - .4 Avoid long horizontal runs which are common in academic buildings with long hallways and consider increasing pipe slopes (while being aware that too great a pipe slope can result in the liquid portion of waste passing the solid waste and dropping the solids into the pipe).
- .5 Grease interceptors – UBC sewage system connects to Metro Vancouver Sewage system. Grease interceptors must be installed to the requirements of Metro Vancouver.

2.2 Construction and Material Requirements

- .1 Acceptable piping systems
 - .1 Sanitary Above Grade
 - .1 Copper
 - .2 Cast Iron

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 None noted at this time.

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

- .1 Section 20 00 05 Mechanical - General Requirements
- .2 Section 22 00 00 Plumbing (and all subsections)
- .3 Section 33 49 00 Storm Drainage
- .4 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.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 Refer to section 33 49 00 for more information on parkade drainage
- .2 Refer to section 22 30 00 for requirements for sump pumps.

2.2 Construction and Material Requirements

- .1 Acceptable piping systems
 - .1 Storm Above Grade
 - .1 Cast Iron
 - .2 Copper
 - .2 Insulation:
 - .1 Storm piping shall be insulated where there is the potential for condensation or freezing to occur. Including:
 - .1 Underside of roof drain body

- .2 Rainwater piping for 5m from drain
- .3 Plumbing vents within 2m of roof/wall penetration
- .4 Traps subject to freezing
- .3 Perimeter drainage
 - .1 Perforated PVC Pipe (non-flexible)
- .4 *All roof drains shall have metal grates or leaf guards; plastic is not acceptable.*

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines & Documents**

- .1 Section 20 00 05 Mechanical - General Requirements
- .2 Section 22 00 00 Plumbing (and all subsections)
- .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.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 **Normal Compressed air systems (opposed to oil free, with desiccant dryers)** shall avoid the use of proprietary packaged compressors as these can have very high first costs and very high maintenance costs associated with them. If you have questions, please reach out to UBC Building Ops to coordinate. In general, compressors installed at UBC should include:
 - .1 Two receiver mounted, air cooled compressors
 - .2 Two air dryers piped in parallel c/w auto drain valves
 - .3 Two filter packages piped in parallel
 - .4 Factor installed controls including
 - .1 Adjustable pressure switches
 - .2 Low oil level alarm wired to BMS
 - .3 Low pressure alarm wired to BMS
 - .5 Provide the first service kit for all compressors. Place it beside the compressor in a clearly marked plastic container that includes re-ordering information.

2.2 Construction and Material Requirements

- .1 Acceptable Piping Systems
 - .1 Compressed Air
 - .1 Copper

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 When connecting new compressors to new systems, ensure that adequate provisions are included to purge old piping which may be contaminated with oil.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines & Documents**

- .1 Section 20 00 05 Mechanical - General Requirements
- .2 Section 22 00 00 Plumbing (and all subsections)
- .3 Section 23 21 05 District Hot Water Heating System
- .4 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.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 Sump Pumps
 - .1 All sump pumps are to be selected as duty/standby. Design is not to be for parallel operation in normal operating conditions.
 - .2 Controller is to rotate runtime between the two pumps.
 - .3 Pumps are to be controlled by three floats. The configuration of the floats at UBC is specific because we want to ensure that we receive an alarm to BMS when one pump has failed. A four-float configuration will not send an alarm until both pumps have failed and the water level overcomes the highest float.
 - .1 Stop pumps
 - .2 Start lead pump
 - .3 Start lag pump and sound alarm
 - .4 If a four-float configuration is supplied by accident then adjust the top two floats so that the alarm float is slightly below the lag pump start float.
 - .4 All floats are to be mounted near the lid of the sump such that a maintenance worker can reach in to test or replace the floats without their head having to enter the sump.
- .2 Water heaters

- .1 This bullet and all sub-bullets apply to UBC-Vancouver only: All new and renewed buildings are to be connected to the district energy system. This system is to be the primary source of heat for hot water systems. Refer to section 23 21 05 and 33 61 00 for more details including energy transfer station piping arrangement.
 - .1 If a project is not going to connect to DES, they must have a variance in place from UBC Energy and Water Services (Section 33 of the TGs)
 - .2 Water heaters with storage capacity of 120 L or less and heating capacities of 3.0 kW or less may be electric.
- .2 Where central thermostatic mixing valves are used (common in designs of instantaneous DHW from DES), they shall be purpose built thermostatic mixing valves which comply to ASSE 1017.
 - .1 A BMS controlled 3-way mixing valve shall not be acceptable.
 - .2 The TMV shall NOT be digital and shall not require a BMS or electrical connection of any kind.
 - .3 It shall be of the bi-metallic strip or wax element type at the discretion of the designer.
 - .4 Provide temperature sensors in the domestic hot water return and domestic hot water supply line and connect to BMS for monitoring and generating alarms.
- .3 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 domestic water heating.
 - .1 This bullet applies to UBC-Vancouver only: Natural gas shall also not be used as the backup heating source in domestic water heating.
- .4 Where on demand domestic hot water heaters are specified, make provisions for water expansion without relying on pressure relief valve for control of water pressure.
- .3 Expansion tanks shall be installed on all domestic hot water systems.
 - .1 Specify expansion tanks with the "bladder monitor" feature where available. This is offered by several major manufacturers and provides a pressure gauge and a bladder leak indicator which changes colour from white to red when a leak occurs.
 - .2 All expansion tanks shall have an isolation valve from the system. Between the isolation valve and the expansion tank there shall be a drain valve.
 - .1 This is necessary to accommodate maintenance of expansion tanks which requires to first isolate, then drain the expansion tank before proceeding with maintenance such as checking the bladder pre-charge.

2.2 Construction and Material Requirements

- .1 Housekeeping pads are to be installed under all equipment.
- .2 This bullet and all sub-bullets apply to UBC-Vancouver only: All tanks containing hazardous materials must be registered with UBC Risk Management Services. This includes but is not limited to chemical feed tanks, acid neutralization tanks, oil water separators, grease traps, etc. <https://srs.ubc.ca/environment/pollution-prevention/storage-tanks/>

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 All sanitary sumps shall be vented and have sealed lids as per BC Plumbing Code 2.4.6.3.2.

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

- .1 Section 10 21 13 Toilet Compartments
- .2 Section 20 00 05 Mechanical - General Requirements
- .3 Section 22 00 00 Plumbing (and all subsections)
- .4 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
- .4 BC Building Access Handbook
- .5 ANSI Z358.1 Eyewash Standard

1.3 Description

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 Locking Frost proof hose bibs shall be installed. At least one on each major building face.
- .2 Washroom fixtures:
 - .1 All urinals shall be wall-hung. (Refer also to Section 10 21 13 Toilet Compartments, Sentence 2.1.2.)
 - .2 If 'No-touch' motion detector-activated plumbing fixtures and accessories are used for faucets and urinals then they shall be hard-wired.
 - .3 Waterless urinals are not acceptable
 - .4 Dual flush toilets may be used for residential installations only, not for institutional or public buildings.

- .3 Emergency eye wash stations and showers:
 - .1 Emergency water at all emergency showers and eyewashes supply shall be tempered to comply with *WSBC* and *ANSI Z358.1*. Recirc lines shall be run as close as practically possible to the thermostatic mixing valve.
 - .2 Emergency showers/eye wash stations shall have 'stay open', hand controlled valves.
 - .3 If practical, provide floor drains under all emergency showers and eye wash stations that are prone to spilling on the floor. Alternatively, provide floor drains within the vicinity such that water is unable to build up to a depth which can damage the building and to assist with cleanup. Floor drains should have trap primer.
 - .4 Eye wash shall be specified as eye wash only not face and eye wash combination.
 - .5 Emergency shower/eye wash isolating valves shall not be readily accessible to the user.
 - .6 Shall be compliant with *ANSI Z358.1* Eyewash Standard.
 - .7 Label fixtures as per below abbreviations:
 - EEW Emergency Eye Wash Station
 - EFW Emergency Eye / Face Wash Station
 - ESH Emergency Shower Station
 - ESC Emergency Eye / Face Wash and Shower Combination
 - EDH Emergency Drench Hose Unit
 - .2 All eye wash stations and showers shall be tested by the projects which install them as part of the commissioning process such that they do not require an annual recertification until one year after project completion.
- .4 Drinking fountains
 - .1 All buildings over 600 gross square meters shall have at least one accessible drinking water fountain, located in a public area.
 - .2 For all new buildings, drinking water fountains shall be located inside buildings at level one entrance lobbies and should be visible from the exterior.
 - .3 Drinking water fountains to be installed on the shortest dead leg possible off of a line that is flowing regularly. This line would preferably be serving a washroom.
 - .4 The drinking water fountain shall NOT be cooled.
 - .5 Drinking water fountains shall NOT have filters and hence no backflow preventers will be required.
 - .6 Drinking water fountains shall feature a water bottle filler. One way to specify this is for a deck mounted one-hole spigot, installed onto the fountain. An appropriate fountain/spigot combination needs to be specified to avoid splashing.
 - .1 Touchless bottle filler stations that require electrical connections and have additional service requirements are NOT preferred.
 - .7 All water fountains must be barrier free and conform to the latest requirements of the Building Access Handbook
- .5 Domestic water dispensing and filtration equipment is not preferred by UBC Facilities. However, it is acceptable provided that the below requirements are met. It is the responsibility of designers to ensure that their clients are aware of their responsibilities for damage as per the below.

- .1 The installation of water dispensing/filtration equipment for office and kitchenette type areas is acceptable provided that a UBC Plumbing permit is obtained. An approved backflow device must be installed as per Section 22 11 18 Backflow/Cross Connection Control to prevent water from being drawn out of the filter system back into the water supply line.
- .2 The installation costs of a domestic water filtration/dispensing device and the associated recurring maintenance such as sanitization and filter changes are the sole responsibility of the client and should be managed with an outside service provider.
- .3 Property damage resulting from equipment failure and/or auxiliary supply lines installed by a vendor downstream of a UBC domestic cold water isolation valve will be the sole responsibility of the client and/or service provider.
- .4 All water filtration and dispensing devices must be CSA approved and meet all requirements of the BC plumbing Code.
- .5 Saddle style valves are not permitted to be installed on UBC water services by outside service providers. On a client funded basis, UBC Building Operations may install a domestic cold water tie in location and isolation valve for the purpose of supplying water to a filtration/dispensing device.
- .6 Canister style water filter units must be of metallic constructions and units that consist of multiple filter elements be either homogenous in their design or interconnected with brass NPT pipe nipples (e.g. EverPure). Interconnection of filter housings using plastic tubing and fittings is not acceptable.
- .7 Piping downstream of a UBC supplied shutoff valve to a filtration/dispensing device must be connected with FIP or MIP style fittings. Other flexible supply lines may be considered (see Auxiliary Supply Lines).
- .8 Auxiliary supply lines connecting a filtration/dispensing to a UBC shut off valve device are to be soldered copper, Uponor or flexible copper furnished with brass compression style fittings. Plastic tubing and plastic quick connect fittings are not acceptable. Auxiliary supply lines should NOT exceed 5 feet in length and routing is not permitted in wall cavities, ceiling spaces or areas susceptible to abrasion and or mechanical damage.
- .6 Roof drains
 - .1 Provide minimum of two (2) roof drains to all major roof areas (>800sqft) as insurance against clogging and flooding (e.g., 2 at 75 mm diameter preferred even if 1 at 100 mm diameter will do). This does not negate the BCBC requirement for scuppers.
- .7 Mechanical room floor drains
 - .1 Specify drains large enough to receive indirect equipment drains into their bodies such as "floor sinks" or "hub drains". In many cases on campus, indirect drains open-end above regular floor drains or simple funnel drains and as a result they splash or discharge over the floor leading to leaking floors and mechanical rooms which are in poor condition.

2.2 Construction and Material Requirements

- .1 New or replacement fixtures shall meet water efficiency performance requirements in Table 1.0. The table also shows comparative reference points in other standards and codes.
- .2 Flush tank toilets shall have an MaP score ≥ 350 as tested by IAPMO R&T (map-testing.com).

Table 1.0. Fixture Water Efficiency Requirements

The table below is based on the current National Plumbing Code. In some cases, these flow rates are more stringent than what is in the current BC Plumbing Code. These rates are minimums and higher performance fixtures are acceptable depending on project requirements (i.e. LEED).

Fixture	Requirement (Maximum Volume or Flow Rate)	Notes
Residential toilets	4.8 litres/flush or dual flush at 6.0/4.1 litres/flush	
ICI Toilets	6.0 litres/flush	Lower flush rates will be accepted when they are required by LEED as a mandatory requirement only.
Urinals	1.9 litres/flush	
Shower head	5.7 litres/minute	
Kitchen Faucet (except ICI)	6.8 litres/minute	
Lavatory Faucet – private	1.9 litres/minute	
Lavatory Faucet – public	1.9 litres/minute	Must have auto-shutoff

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines & Documents

- .1 Section 20 00 05 Mechanical - General Requirements
- .2 Section 22 00 00 Plumbing (and all subsections)
- .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
- .4 CSA Z -305.1. Non-Flammable Medical Gas Piping Systems.

1.3 Description

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- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 Where specialty piping systems serve specific labs or research groups they shall generally be the lab user's responsibility. It shall be the responsibility of the lab, faculty or department to setup a maintenance contract with the appropriate, qualified contractor or setup a maintenance contract with UBC Facilities. These systems do not fall within the standard scope of UBC Facilities of core building systems. It is the responsibility of the designer to inform their clients of this and coordinate the delineation of scope and demarcation points with UBC Facilities and the clients such that all parties' expectations are in line, prior to construction.
- .2 For specialty water systems, local generating systems shall be used. Large central sources shall only be used with an approved variance. This includes but is not limited to distilled water, reverse osmosis, filtered water, de-ionized water, salt water.

2.2 Construction and Material Requirements

- .1 Acceptable Piping Systems
 - .1 Piping systems shall be selected suitable to the specific application. Care shall be taken to avoid proprietary piping systems wherever possible.

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 Local process loops. Some labs have local process loops separated from the base building system by heat exchangers or chillers. These loops may not be chemically treated and as a result appropriate piping systems need to be selected. This needs to be coordinated with the lab users as this equipment is typically maintained by the users.
- .2 In lab buildings it has been observed that appliances such as humidifiers, glass washers and ice makers are commonly connected to RO or DI water. In some cases, this may be appropriate but challenges that have been observed are:
 - .1 Sometimes the water is too pure for the appliances connected which can cause damage since ultrapure water is corrosive.
 - .2 Connecting to the specialized water systems subjects this equipment to additional shutdowns – RO and DI systems typically will have bi-annual shutdowns that are a few days long for system sanitization.
 - .3 Appropriate model of humidifier needs to be selected to match the purity water provided (level control in some devices isn't compatible with pure water... or even Vancouver city water it too pure in some cases).

Please avoid connecting to RO/DI water unless it's required. Also note that 2.1.2 of this guideline prohibits the use of central RO/DI systems so these should not be installed without a variance/consultation with Building Operations.

*****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 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.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 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 46°C with a preference for lower temperatures whenever possible. Return water temperature on a design day should be 35°C. For UBC Vancouver, 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 requirements 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 spaces for the ease of service access. Alternatively, consider high wall fancoils (see discussion in bullet below about cooling for IT and electrical rooms).
- .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.
- .1 At UBC Okanagan, gas heating is acceptable for backup heating where critical spaces require redundancy. Reach out to UBCO Campus Operation for details.
 - .2 At UBC Vancouver, gas is not acceptable, even for backup.
- .11 Preferred approaches to cooling of electrical, IT, elevator machine rooms or similar utility spaces are below.
- .1 Preferred cooling strategies (from preferred to least desirable are):
 - .1 No HVAC if loads are small enough
 - .2 Exhaust fan and transfer air if loads are small enough
 - .3 Chilled water fancoils
 - .4 Terminal heatpumps
 - .5 VRF or split cooling
 - .2 When loads are moderate, a cost-effective and maintenance supported approach to installing fancoils is to install ductless high wall fancoils (HWFC).
 - .1 These are most commonly seen on VRF systems but are available by several manufacturers with chilled water.
 - .2 The electrical TG's specifically ask designers to leave space above the doors for the installation of HWFCs. This is an ideal location because:
 - .1 If it is possible to open the door then it is possible to erect a ladder at this location.
 - .2 It is unlikely that there will be equipment below this location and therefore drips are less of a concern.
 - .3 Electrical is unlikely to clutter this space with riser conduits.
 - .3 Coordinate electrical rooms to not have ceilings whenever possible. Install the HWFC at high level so that the condensate drain can be run by gravity. Drop to the floor below if necessary. Avoid condensate whenever possible.\
- .12 Demand controlled ventilation requirements
- .1 For spaces larger than 20m² - provide occupancy sensor(s) that adequately detect motion of entire space.

- .2 *When motion has not been detected for a minimum of 15 minutes, the system goes into standby mode. Refer to section 25 05 00 for specifications on sensors and sequences. Unoccupied nighttime setbacks in laboratories are required per Section 23 38 00.*
 - .3 *For UBCO only - for spaces with a design occupancy larger than 50 people, provide CO2 sensors*
 - .4 *Additional requirements may apply as dictated by external codes and standards such as LEED.*
- .13 All spaces with critical humidity requirements such as galleries or sensitive research spaces shall be specified with Vaisala HMT-120/130 sensors c/w display screen. Refer to the BMS TG 25 05 00 for more information.

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.
- .2 Condensation from cooling coils is a common source of leaks. Please make sure that designs include these best practices:
 - .1 Condensate pans for all cooling coils
 - .2 Condensate pans for all heat recovery coils including glycol run around loops and chilled water exhaust coils
 - .3 Appropriately designed p-traps for negatively or positively pressurized plenums
 - .4 Adequate ceiling space for p-trap drops and sloped condensate lines
 - .5 Only use condensate pumps where absolutely necessary. Drain by gravity whenever possible.

- .3 Elevator machine room drip pans under fancoils. Please be aware that the TSBC Elevator inspector expects that drain pans are installed under fancoils if they are installed in the elevator machinery room.
 - .1 If possible, provide cooling with an exhaust fan or locate the cooling device outside the room and duct in.
 - .2 If installing a fancoil in the room (for example high wall fancoil above the door) please coordinate a drain pan that does not encumber maintenance access.

*****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

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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 Glycol use in air handlers:
 - .1 This point and all sub-bullets for UBC Okanagan Only: All air handlers that are exposed to outdoor air (including mixed air units) are to use 30% uninhibited propylene glycol. Supplied glycol is to meet requirements of 23 25 00.
 - .2 This point and all sub-bullets for UBC Vancouver Only: 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 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.

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 Cooling towers/fluid coolers over 8 ft high shall have service platforms with permanent ladders.
 - .3 Multi-cell cooling towers with separate sumps shall have equalizing line of sufficient size to maintain water level in all sumps.
 - .1 Provide external equalizing lines c/w isolation valves. Do not provide internal equalizing flume as these are challenging to close off to drain and clean individual basins.
 - .4 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
 - .5 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)
 - .6 All closed loop fluid coolers or dry coolers that are not drained/winterized in the winter shall run a glycol mixture.
 - .1 In buildings that incorporate the fluid coolers into the heating water loop as part of a heat recovery setup, the fluid cooler shall be separate from the main loop with a heat exchanger.
- .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.
- .8 Chillers connected to open loop cooling towers shall be specified with marine water box's on the condenser. These attachments make it easier to clean and test the tubes as the condenser can be accessed without disconnecting the adjoining piping.
 - .1 Note that this is anticipated most frequently on retrofits to existing buildings as new buildings typically have closed loop systems and this is indicated by TG 23 21 00 - 2.2.2
- .9 Air source chillers / heatpumps shall be fed with glycol. This glycol loop shall typically be separated from the main hydronic loops with a heat exchanger.
 - .1 Replacement air source chillers in scenarios that don't already have glycol are exempt from this requirement. However, even in these replacement situations, glycol is still desired – please coordinate with UBC Facilities to discuss options.
- .4 Boilers or chillers with aluminum heat exchangers are not acceptable because they do not align with UBC's water treatment procedures.
- .5 Expansion tanks shall be installed on all hydronic systems.
 - .1 Specify expansion tanks with the "bladder monitor" feature where available. This is offered by several major manufacturers and provides a pressure gauge and a bladder leak indicator which changes colour from white to red when a leak occurs.
 - .2 All expansion tanks shall have an isolation valve from the system. Between the isolation valve and the expansion tank there shall be a drain valve.
 - .1 This is necessary to accommodate maintenance of expansion tanks which requires to first isolate, then drain the expansion tank before proceeding with maintenance such as checking the bladder pre-charge.
- .6 Avoid oversizing chillers/heatpumps and select equipment with enough stages that compressor cycling is minimized.
 - .1 Chillers/heatpumps shall operate with an average cycle time of greater than double the minimum cycling time recommended for the unit by the manufacturer. Average cycling time shall be calculated per equipment stage as the annual operating hours divided by the number of annual starts.
- .7 Heat tracing is to be monitored by the BMS. Dedicated heat trace controller must include hardwired alarm contact to BMS or bacnet communication interface for monitoring. CT based alarm for BMS is not acceptable as it is considered unreliable for self-regulating heat trace.

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 BMS to Close the DES primary side valve and throw a latching high temperature alarm if the water temperature leaving the DES heat exchanger exceeds setpoint by more than 10C. This high temperature alarm should be considered a critical alarm due to the damage that overheating water can do to plastic pipe. There must be substantial labelling (on BMS graphics and on site) stating the max temperature and implications of higher temps.
 - .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.
- .6 Where filters are required, the housings must either have:
 - .1 Twist off shells (ex. typical hydronic sidestream filter with ¾" connections)
 - .2 Swing-bolt lids (ex. large specialty water system filters, central side stream filters with 2" connections)
 - .1 Band-clamp closures are not acceptable.
- .7 Glycol system requirements
 - .1 Glycol feeders shall be provided with a low-level alarm. Connected to BMS where practical (eg new build), audible where not.
 - .2 Provide a receptacle near the glycol feeder
 - .3 Provide a hose bib protected by a backflow preventer near the glycol feeder
 - .4 All auto air vents and pressure relief valves on glycol systems should be piped back to the feeder
 - .1 Where not practical to pipe back to the feeder, use manual air vents

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 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.
 - .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**

- .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.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 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.

- .5 Ultrasonic and spray/adiabatic humidifiers are not acceptable because of the risk of bacteria growth / airstream contamination and because of the maintenance requirements of the upstream filtering and deionizing equipment.
 - .1 If there is a strong desire to pursue this technology and a large carbon impact (lab AHU>10,000CFM) then UBC Facilities is open to discussing the use of this technology and whether they are able to support it. A variance would be required.

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 (untreated)
 - .1 304 Stainless steel
 - .4 Condensate Return (untreated)
 - .1 304 Stainless steel
- .2 Insulation
 - .1 In mech rooms or other exposed installs
 - .1 Insulation shall have canvas jackets
 - .2 In ceiling spaces and other concealed indoor locations
 - .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. In some cases using chemically treated steam may be unacceptable for sterilizing processes as well. Please consider steam chemical treatment requirements in your design and 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.
- .2 This bullet and all sub-bullets for UBC-V only: Humidifier selections need to consider the water quality at UBC Vancouver. UBC-V has observed a high failure rate of stand-alone humidifiers.
 - .1 UBC water measures an average of ~50micro-siemens/cm (water is from Metro Vancouver so presumably this is typical for the region).
 - .2 Consult manufacturer specifications for acceptable water conductivity ranges.
 - .3 Electrode humidifiers are not acceptable at UBC-V as they typically require minimum water conductivity of 300 micro-siemens/cm so UBC-V water is too pure for them to operate properly.
 - .4 Some resistive humidifiers use water level probes which rely on conductivity and may not work with Vancouver water.
- .3 **Permits for boilers and pressure vessels:**
 - .1 Per the BC Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation – all steam boilers over 20kW (including steam generators integral to autoclaves) require a TSBC installation permit and need to comply with the requirements of CSA-B51.
 - .2 Per the BC Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation - most pressure vessels do not require a TSBC Installation Permit however they are regulated equipment and they do require a TSBC Operating Permit. While they will not be subject to the installation inspection process that comes with a TSBC Installation Permit, they will be subject to annual inspections that come with a TSBC Operating Permit.
 - .3 Refer to UBC Document, CPG-03 – Regulatory Requirements of Boilers, Pressure Vessels and Refrigeration Systems for more info.
- .4 Per CSA-B51, pressure relief valves off all regulated equipment (this includes steam boilers and pressure vessels) must discharge in a safe location. This is commonly interpreted by TSBC (and supported by UBC) as meaning:
 - .1 Relief valves off steam generators larger than 20kW shall be:
 - .1 Preferred - piped to the outdoors (all new builds should provide a pipe for this purpose)
 - .2 Or, if not practical to go to the outdoors, they may relieve in the room if a mechanism to collapse the steam is provided prior to discharging to drain (this is not necessarily a straight forward option) and the approach used is acceptable to the TSBC Safety Officer
 - .2 Relief valves off pressure vessels (ex. Autoclaves, autoclave jackets) may be either:
 - .1 Piped to the outdoors
 - .2 Relieve inside the room if it is safe to do so in the opinion of the Engineer of Record and the TSBC Safety Officer
 - .1 No risk of scalding room occupants
 - .2 Noise level of discharging PRV is not dangerous

- .3 Potential steam charge doesn't have any contaminants dangerous to human health
- .5 Per ASME CSD-1 (which is referenced in CSA-B51), all steam boilers (including steam generators integral to autoclaves) require an emergency shutoff button near the main exit door.

*****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
- .4 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.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 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.
- .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 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 (this includes air handlers where parallel fans are used).
 - .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.
- .5 VAV Diffusers are not acceptable at UBC. Small VAV's are similar in cost and a better fit for the institutional environment.
 - .1 This technology is, in our opinion not suitable for integration into large VAV air-handling systems. It hinders and limits system operation because they do not integrate well with BMS systems and they do not have reheat coils.
- .6 Provide heat trace & insulation on all exterior drain pipes including but not limited to:
 - .1 Cooling tower overflow drains
 - .2 Condensate drains (including air handling unit p-traps and heat recovery unit p-traps). The purpose of this is to ensure that equipment can drain during cold weather and to mitigate the risk of damage from a burst coil.

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 This bullet and all sub-bullets apply to UBC Vancouver only: 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.
 - .3 This bullet and all sub-bullets apply to UBC Okanagan only: Filters in primary air handling equipment shall filter to MERV 15
 - .1 Use micropleat filters with a frame depth of 12" (300mm)
 - .2 Filters shall not support microbial growth
 - .3 Filter frames shall be ABS construction with header complete with neoprene gasket seal to prevent any air bypass and allow filters to be incinerable.
 - .4 Air systems shall be designed to handle a final pressure drop across filters of at least 375Pa WC (1.5"WC) at a flow rate of 2.5m/s (500ft/min)
 - .5 Confirm with UBCO Operations that equipment is compatible with standard UBCO filter supply and operation.
- .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 wear. 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

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 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 On all manifolded fumehood exhaust systems, provide pressure relief doors (implosion doors) on the pressure exterior ductwork. Mechanical engineer to size the door to ensure that duct pressure cannot exceed duct pressure rating in any foreseeable operating circumstance (ie all upstream dampers closed or in min position with fan running).
- .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-ROOM-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 percloric 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.
- .12 All constant volume, bypass type fumehoods must run 24/7 including new installs and renovations of existing as per UBC Safety and Risk Services. This policy is in place to protect against possible improper use of the hood such as storing chemicals or running an experiment within a closed hood that is turned off.
 - .1 This approach simplifies the HVAC system as the supply and general exhaust does not need to account for changes in the hood operation.
 - .2 If there is a lab renovation where the hood previously had a on/off switch, then the project shall modify fumehoods that are within scope to run 24/7 including the associated room HVAC pressure controls sequence if necessary.
 - .3 In many cases there is no energy penalty to this approach as spaces with a low density of fumehoods are unlikely to dictate the room air change rate.
 - .4 See TG 11 53 13 for possible other scope on existing hoods.
- .13 Makerspaces, workshops, electronics laboratories with soldering and other similar spaces shall be appropriately ventilated to manage airborne contaminants. Air within these spaces shall be considered, at a minimum, Class 2 as defined by ASHRAE 62 and shall not be suitable for recirculation to most other spaces.
- .14 3D Printers are a source of airborne contaminants. Spaces that house 3D printers shall be designed with the below considerations in mind:
 - .1 Designers shall be familiar with the document "Approaches to Safe 3D Printing: A Guide for Makerspace Users, Schools, Libraries and Small Businesses" as published by the US National Institute of Occupational Safety and Health (NIOSH) especially 4.4 - Engineering Controls.
 - .2 Mechanical Engineers shall utilize a combination of local exhaust, ventilated enclosures, air change rate and filtration as recommended by the NIOSH article above.
 - .3 The air in spaces that contain more than two PLA 3D printers shall be considered Class 2 as defined by ASHRAE 62 and shall not be suitable for recirculation to other spaces
 - .4 The air in spaces that contain any number of resin or ABS 3D printers shall be considered, at a minimum Class 2 as defined by ASHRAE 62 and shall not be suitable for recirculation to most other spaces

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**

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 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).
 - .1 All manifolded exhaust systems need to run 24/7 as per ANSI Z9.5. Minimum airflow volumes for closed vav hoods shall be per ANSI Z9.5 (3.3.2).
- .2 WSBC regulations do not currently allow low flow fumehoods. Face velocities must be between 80-120fpm
 - .1 WSBC regulations do not currently allow fumehood occupancy sensors to reduce face velocity (when the area in front of the hood is vacant). However, a hood occupancy sensor may be used to prompt the researchers to close the sash.

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
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1.3 Description

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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 CSA B52 describes signage requirements for machinery rooms. At UBC these signage requirements shall be extended to all mechanical rooms with central chillers. In addition to the information required by CSA B52, the signage 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 systems are used, the expectation is that they will generally have a standalone control system. Provide a manufacturer supported bacnet gateway and integrate into the Building Automation System for monitoring and alarms.
 - .1 If VRF systems are providing cooling to a critical space then provide a temperature sensor connected to the BMS for alarms only.
- .4 VRF systems are not acceptable as a building wide solution for new buildings.

2.3 Construction and Material Requirements

- .1 Brazed joints are required for all field installed refrigeration joints. Compression couplings aren't acceptable.
- .2 All exterior refrigerant piping insulation shall have aluminum hard covers to protect the insulation from UV and birds.

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 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. These systems should only be used for targeted cooling or special applications such as retrofitting cooling on a relatively small scale.

END OF SECTION

Building Management Systems (BMS)

Design Guidelines

University of British Columbia Vancouver

Revised: November 2023

Contents

1	OVERVIEW	4
1.1.	General	4
1.2.	Application of these BMS Design Guidelines	4
1.3.	List of Abbreviations	5
1.4.	Existing BMS Facilities	7
1.5.	Existing BMS Communication Network Facilities at UBC	Error! Bookmark not defined.
2	BMS INSTALLATION GUIDELINES	10
2.1.	General BMS Installation Requirements	10
2.2.	BMS Electrical Installation Requirements	12
2.3.	BMS Communication Provisions	16
2.4.	BMS Pneumatic Control Installation Requirements	16
2.5.	BMS Installation Training Requirements	16
2.6.	BMS Documentation Requirements	17
2.7.	BMS Installation Commissioning and Testing	18
3	BMS DESIGN GUIDELINES.....	20
3.1.	General BMS Design Requirements	20
3.2.	BMS Subcontractor and System Qualifications.....	21
3.3.	BMS Network Architecture and Communications Requirements.....	22
4	BMS EQUIPMENT	25
4.1.	Management Level Network.....	25
4.2.	BMS Automation Level Network.....	25
4.3.	Communication Control Panels (CCP)	25
4.4.	Distributed Control Panels (DCP).....	26
4.5.	Unitary Controllers (UC)	28
4.6.	Valves and Dampers	30
4.7.	BMS Field Devices and Instrumentation	36
5	BMS SOFTWARE, DATABASE AND PROGRAMMING REQUIREMENTS	44
5.1.	General	44
5.2.	System Requirements	44
5.3.	SOFTWARE	46
6	CBMS SOFTWARE, DATABASE AND PROGRAMMING REQUIREMENTS.....	48

6.1.	Integration of Standalone Building BMS into the Campus BMS	48
6.2.	CBMS Dynamic System Requirements	48
6.3.	CBMS Dynamic System Graphical Interface Requirements	49
6.4.	Alarm Management and Annunciation	51
6.5.	CBMS/BMS Alarm Handling Archiving Requirements	52
6.6.	Testing and Commissioning Requirements	54
6.7.	UBC BMS Point Naming Conventions Requirements	54
6.8.	UBC BMS Controller and Device Addressing and Naming Convention Requirements	55
7	GUIDELINES FOR APPLICATION OF BMS TO TYPICAL HVAC SYSTEMS	56
7.1.	BMS Sequences of Operation, Field Termination Schedules, and System Schematic Diagrams	56
7.2.	BMS Component and Building Equipment Failure Requirements	56
7.3.	BMS Automatic Sequenced Control of AHU Mixing Dampers and Valves	57
7.4.	General BMS Monitoring and Control Requirements	57
7.5.	Post Fire Alarm Equipment Restart	57
7.6.	Post Building Power Failure Equipment Restart	58
7.7.	Air Handling Unit Optimum Start and Stop Programs	58
7.8.	After-hours Equipment Operation	58
7.9.	Air Handling Unit Supply Air Temperature Reset Schedules	58
7.10.	Dynamic Mixed Air Calculations and Mixing Damper Minimum Outside Air Positioning	59
7.11.	Typical Sequence of Operation - Variable Volume Air Handling Unit	59
7.12.	Typical Sequence of Operation - VAV	59
7.13.	Chilled Water (CW) and Condenser Water (CSR) Systems	59
7.14.	Supply Hot Water System (SHW)	59
7.15.	Domestic Hot Water System	59

1 OVERVIEW

1.1. General

- A. The University of British Columbia is a large campus with numerous buildings of various ages. A significant number of these buildings are of a vintage that predates modern microprocessor based HVAC control systems and these older building control systems are continuously being upgraded. New buildings are also being constructed at the UBC Campus on an on-going basis.
- To assist in the operation and maintenance of campus buildings, UBC Building Operations provide centralized monitoring and control of UBC buildings from a central location via microprocessor based DDC controls. To facilitate the centralized BMS monitoring and control standards have been applied to the selection of BMS equipment and for the application of BMS installations in buildings. The UBC BMS Design Guidelines serve to identify typical standards for the application of BMS's in UBC buildings. These Design Guidelines have also been developed to assist UBC in ensuring that UBC buildings are provided with high quality BMS installations that fully meet their requirements.

1.2. Application of these BMS Design Guidelines

- A. This document is intended to serve as a guideline for the Design of Building Management System (BMS) installations in buildings at the University of British Columbia (UBC). The guideline serves to generally identify the existing UBC Campus BMS infrastructure and installed components and to record BMS design requirements specific to UBC installations. The UBC Design Guidelines may be used by BMS Designers for guidance in the design of UBC BMS installations but shall not be reproduced, in whole, or part, for inclusion in BMS Design Specifications, or Tender or Contract Documents. The UBC BMS Design Guidelines are not Design Specifications and do not include sufficient detail to be used as such. BMS Designers will be required to include additional detailed information in BMS Design Specifications to clearly identify all aspects of the BMS installation.
- B. BMS Designs shall be based on sound industry standard practices. BMS Designers shall provide BMS Designs that have been specifically engineered for the application and shall exercise discretion in the application of these guidelines. All new building construction at UBC will utilize DDC BMS monitoring and control of building equipment and systems to some degree. Existing buildings are also being upgraded with retrofits to mechanical and electrical systems as well as to the building control and monitoring facilities. BMS Design Documents shall clearly identify the nature of the BMS installation work and shall include the contractual documentation and requirements where applicable.
- C. All new BMS installations shall comprise equipment, data and data communications that are fully compliant with ANSI/ASHRAE Standard 135-2001 "BACnet" and Division 27 Section 27 05 08 – 1.4.8.
1. Legacy equipment manufactured by JCI and SBT that are not compliant with ANSI/ASHRAE Standard 135-2001 shall NOT be used for NEW BMS installations.
 2. Equipment installed on extensions of a BMS using non-BACnet legacy equipment, manufactured by JCI and SBT, and shall have the capability of directly communicating to the legacy equipment in the proprietary communications protocol as well as communicating with BACnet devices. New equipment that does not have the capability to communicate in both the proprietary protocol and BACnet is placed onto a legacy system; the device shall use the BACnet communications protocol. When equipment capable of communicating only with BACnet is placed onto an

existing legacy system, a communication gateway device shall be placed on to the proprietary network. The gateway shall bridge the two disparate communication protocols and act as a translator that allows bilateral communication between the BACnet compliant devices and devices communicating using proprietary communication protocols.

1.3. List of Abbreviations

- A. The following are a list of abbreviations used throughout these design guidelines and are also abbreviations used by the University of British Columbia relating to Building Management Systems.

ANSI -	American National Standards Institute
ASC -	Application Specific Controller
ASHRAE -	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM -	American Society for Testing Materials
AWG -	American Wire Gauge
B-AWS -	BACnet Advanced Operator Workstation: The B-AWS is the advanced operator's window into a BACnet system. It is primarily used to monitor the performance of a system and to modify parameters that affect the operation of a system. It may also be used for configuration activities that are beyond the scope of this standard.
B-OWS -	BACnet Operator Workstation: The B-OWS is used for monitoring and basic control of a system, but differs from a B-AWS in that it does not support configuration activities, nor does it provide advanced troubleshooting capabilities.
B-OD -	BACnet Operator Display: The B-OD is a basic operator interface with limited capabilities relative to a B-OWS. It is not intended to perform direct digital control. The B-OD profile could be used for wall-mounted LCD devices, displays affixed to BACnet devices; handheld terminals or other very simple user interfaces.
B-BC -	BACnet Building Controller: A B-BC is a general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks.
B-AAC -	BACnet Advanced Application Controller: A B-AAC is a control device with limited resources relative to a B-BC. It may be intended for specific applications and supports some degree of programmability.
B-ASC -	BACnet Application Specific Controller: A B-ASC is a controller with limited resources relative to a B-AAC. It is intended for use in a specific application and supports limited programmability.
B-SA -	BACnet Smart Actuator: A B-SA is a simple control device with limited resources; it is intended for specific applications.
B-SS -	BACnet Smart Sensor: A B-SS is a simple sensing device with very limited resources.
BMS -	Building Management and Control System
BACnet -	Building Automation and Controls Network - ANSI/ASHRAE Standard 135-2012

BTL -	BACnet Testing Laboratory: A recognized, independent third party laboratory certified to test product for compliance to BACnet standards.
BTL Mark -	A seal affixed to product certifying that it has been tested by a recognized BACnet Testing Laboratory and found to conform to BACnet standards.
CBMS -	Campus Building Management System
CCF -	BMS Central Computer Facility
CCP -	Communications Control Panel
CPU -	Central Processing Unit
DAU	Data Archival Unit. A device that sits on the Automation Network Level and automatically collects data to be sent up to the central data archive server that resides on the Management Level network and is located in the MACC.
DCP -	Distributed Control Panel
DDC -	Direct Digital Control
DELTA	Delta Controls Inc.
ESC	ESC Automation Inc. is the installing contractor and local representative for DELTA Controls.
FAS -	Fire Detection, Alarm and Communication System
FTS -	Field Termination Schedule
H/O/A -	Hand/Off/Auto Motor Control Switch/Circuit
HDAS	Historical Data Archiving Server
HVAC -	Heating, Ventilating and Air Conditioning
IEEE -	Institute of Electrical and Electronics Engineers
I/O	Input/Output
JCI	Johnson Controls, Inc.
LAN -	Local Area Network
LCD -	Liquid Crystal Display
LED -	Light Emitting Diode
LON -	Local Operating Network
LonTalk -	The open control networking protocol developed by Echelon Corporation
LONWORKS	Echelon's family of hardware and software products
MACC-	BMS Master Alarm and Control Centre
NDS -	Network Data Server
NEC -	National Electrical Code
NEMA -	National Electrical Manufacturers Association
OIW -	Operator Interface Workstation
PC	Personal Computer
PICS	Protocol implementation conformance statement: All devices conforming to the BACnet protocol shall have a documented statement (PICS) that identifies all of the portions of BACnet that are implemented in the device.
POT -	Portable Operator Workstation
PIM	Process Interface Module
RAM -	Random Access Memory
RFI	Radio Frequency Interference

RH	Relative Humidity
ROW -	Remote Operator Workstation
RTD -	Resistance Temperature Device
SBT -	Siemens Building Technologies Ltd.
SVGA -	Super Video Graphics Adapter
UBC -	University of British Columbia
UC	Unitary Controller
cUL	Underwriters Laboratory Canada
UPS -	Uninterruptible Power Supply Unit
VDU -	Video Display Unit

1.4. Existing BMS Facilities

- A. There are three separate and autonomous BMS's installed and operating on the UBC Campus, all with individual central alarm monitoring and control facilities, interconnecting network communications facilities and BMS monitoring and control facilities installed within campus buildings. BMS installations within individual buildings are configured as stand-alone BMS installations capable of real-time monitoring and control. Each of the stand-alone building BMS installations communicates with central computer equipment. The existing BMS facilities are Delta Controls Ltd. (DELTA), installed by Ainsworth, Johnson Controls (JCI) Metasys as installed by the factory branch, and Siemens Building Technologies, Ltd. (SBT) as installed by the Siemens factory branch. The three different BMS's utilize separate communication network facilities.
- B. The following is a list of existing Delta Controls Ltd. BMS facilities and equipment at UBC:
1. Delta EnteliWEB software running on a Virtual Server.
 2. The EnteliWEB server is running on a virtual server segment, provided and maintained by UBC-BIS group.
 3. Delta DCP's and ASC's installed in distributed standalone building BMS installations.
 4. Delta Entelivault is provided for long term historical trending (copper cubes are no longer required).
- C. The following is a list of existing Siemens Building Technologies, Ltd. BMS facilities and equipment at UBC:
1. Insight server running revision 3.14 client.
 2. Desigo server running v6.0
 3. The Insight server and Desigo server is running on a virtual server segment provide by and maintained by the UBC-BIS group.
- D. The following is a list of JCI BMS Facilities and equipment at UBC.
1. Metasys Application Data Extended Server (ADX) (10 user) server running MEA version 12.0 / UI version 6.1
 2. The ADX server is running on a virtual server segment, provided by and maintained by UBC-BIS group.
 3. Metasys Network Engines installed in distributed standalone building BMS installations.
 4. New building installations can choose to forgo a physical building NAE and provide a network based NAE, on a server provided by UBC. The NAE software will still be provided by Johnson Controls.

1.5. *Existing BMS Communication Network Facilities at UBC*

- A. All controls additions or modifications involved in a building renovation and/or addition shall be an extension of the existing BMS located in the building being renovated. An exception to this clause may be made if a vendor, other than the vendor of the existing BMS, makes an acceptable bid to replace the entire existing BMS system as well as satisfying the requirements of the building renovation or addition specifications.
 - 1. UBC retains the right to define what an acceptable bid is.
 - 2. UBC retains the right to define the extent of work required to be completed before an existing BMS can be deemed to be replaced.
 - 3. The vendor seeking to replace an existing BMS shall submit a comprehensive engineering proposal to UBC Energy, Planning & Innovation department detailing the proposed replacement BMS. The UBC Energy, Planning & Innovation department must approve of the replacement BMS system design and scope before the system can be approved as an acceptable replacement.
- B. The Delta Controls BMS, JCI Metasys BMS, and the SBT Desigo BMS at UBC utilize separate network communication facilities. Existing BMS Network Communications facilities are generally as follows:
 - 1. All vendors:
 - a. All core systems shall be BACnet IP controllers, using one controller per system. Examples of core systems are Air handling units, boiler systems, central heating systems, chiller plants, etc.
 - b. Core systems shall be provided IP addresses by UBC-BMS / UBC-BIS group.
 - c. Terminal units and lower level systems can be connected via BACnet MS/TP networks or IP networks, using vendor provided routers.
 - d. If routers are being provided by the vendor, they must be approved by UBC-BMS and UBC-BIS before install on site. Any non-compliant routers will be rejected out of hand, at vendor expense. Routers must be approved before install.
 - e. Single IP connection per building shall be provided by UBC, if more than one IP connection is required, this can be provided by exception, but shall not be the basis of design.
 - f. For discussion: UBC - BMS is investigating the implementation of a layer 2 network inside critical buildings that will include some newer IP architecture, including ring networks and LLDP monitoring. To this end we are investigating products from Wieland and Cisco that are designed for industrial installation. If any of the vendors would like to provide feedback or comment on this investigation, please get in touch with Zach Danyluk at UBC – BMS.
 - 2. Delta Controls BMS Data Communication within Building
 - a. Automation Level communication LAN (native BACnet) for data communication between CCP's/DCP's within building installations utilizes either BACnet/IP or MS/TP communications. The BMS automation level communication networks within buildings are dedicated BMS network segments and are not shared with other building data communications.
 - b. Each building shall be a separate site and a separate subnet in the Delta system.
 - 3. Delta Controls Campus BMS Data Communications
 - a. Management Level communication LAN (native BACnet) utilizes UBC campus enterprise IP Network for communication between remote building BMS installations and the central monitoring and control equipment. The dedicated standalone BMS network is interconnected to the UBC Campus Enterprise Network at a location within the building.

4. JCI BMS Facilities BMS Data Communication within Building
 - a. All systems shall be BACnet IP or MS/TP
 - b. N2 network is not approved in any case.
5. JCI Campus BMS Data Communications
 - a. There are a number of JCI building installations that utilize TCP/IP Ethernet data communications over the UBC campus enterprise Ethernet Network for communication between the remote building BMS installations and the central monitoring and control equipment. The dedicated standalone BMS network is interconnected to the UBC Campus Enterprise Network at a single location within the buildings.
6. SBT Apogee BMS Data Communications within Building
 - a. All systems shall be BACnet IP or MS/TP
 - b. New P2 bus connections are not approved in any cases.
 - c. New P1 or any other proprietary buses are not approved in any cases.
 - d. Non BACnet network connections are only permitted by exception, approved by the UBC-BMS group.
7. SBT Apogee BMS Campus Data Communications
 - a. All SBT Apogee building installations that utilize TCP/IP Ethernet data communications over the UBC campus enterprise Ethernet Network for communication between the remote building BMS installations and the central monitoring and control equipment. The dedicated standalone BMS network is interconnected to the UBC Campus Enterprise Network at a location within the building.

2 BMS INSTALLATION GUIDELINES

2.1. General BMS Installation Requirements

- A. This section of the UBC Design Guidelines identifies minimum requirements for BMS field installations. BMS designs shall include these requirements and BMS designers shall ensure that design specifications include these requirements.
- B. All DDC connected devices shall be provided in SI units from the factory. Local conversions or unit conversion integrators are not acceptable. This applied to all devices connected to the BMS system as well. No imperial units are acceptable. This applies to integration devices as well as first party devices.
- C. BMS installations shall be fully BACnet, and be based on sound industry standard practices that are in compliance with all applicable codes, statutes and ordinances.
- D. All building controls shall be by the base building contractor (existing buildings) or one of the three approved controls vendors (new construction, or if the competing controls contractor wants to replace all of the existing building controls with their system).
- E. Integrations that provide control that is not completely controlled by the base building controls contractor is not acceptable
 - 1. The following items are not acceptable:
 - a. Air handling unit package controls
 - b. VAV box packaged controls
 - c. Damper packaged controls
 - d. Fan coil packaged controls
 - e. HRV packaged controls
 - f. Split air conditioning unit package controls.
 - g. High plume exhaust air systems.
- F. Acceptable third party controls
 - 1. Devices that serve as a safety device that would have special requirements that cannot normally be executed by a controls contractor.
 - 2. Devices that meet these requirements:
 - a. Variable speed drives.
 - b. Kitchen ecology units
 - c. Chiller controllers for modular chillers
 - d. Boiler controllers for modular boilers
 - 3. These devices still have the requirement to integrate via BACnet, as will all other BMS requirements outline in this document.
 - 4. Exceptions are acceptable. But must be approved by UBC - BMS.
- G. All BACnet equipment and software supplied for the projects shall be supported by manufacturer supplied PICS (Protocol Implementation Conformance Statement) certifying that the device complies with the specified BACnet requirements.
 - 1. All products shall have a BTL Mark certifying that the product was independently tested by a third party testing facility and complied with BACnet conformance requirements.
- H. Design Specifications for BMS Installations shall provide detailed specifications for the all components of the BMS including equipment, field devices, wire/cable,

conduit, pneumatic tubing, mounts, terminations, etc.

- I. The BMS Designer shall fully coordinate BMS design requirements with the other project design team parties (where applicable). The BMS Designer shall coordinate field panel mounting locations, intended DCP/ASC locations, power supply requirements, communications outlet requirements, etc.
- J. All new BMS Installations shall be integrated into the CBMS through either the SBT Designo, JCI Metasys or Delta Enteliweb.
- K. The following are general installation guidelines for BMS installations:
 1. All equipment and materials furnished shall be new.
 2. All equipment and materials shall be cUL and/or UL listed and/or CSA approved where applicable. Equipment and components shall be labelled accordingly.
 3. Wherever possible all similar components (e.g. temperature sensors, differential pressure transducers, current transformer/relay combinations, signal transmitters, etc.) in a BMS installation shall be by the same manufacturer.
 4. Components shall be provided which are suitable for the intended application. Components shall be capable of maintained operation in the applicable environmental conditions and operation in contact with the controlled/monitored medium.
 5. With the exception of field mounted instrumentation and devices, all BMS components shall be installed in field panels. Panels and enclosures shall meet, at minimum, the following requirements:
 - a. Painted steel panels with hinged locking door. All panels shall be keyed to the controls vendors' standard key, or provided with non-keyed twist locks.
 - b. Ventilated to prevent excessive heat build-up, where required.
 - c. Cable within enclosures shall be installed in cable *ducts* with snap on covers.
 - d. Internal components shall be installed to allow easy access for diagnostics, maintenance, removal or replacement.
 - e. Panel or enclosure shall be suitable rated for the environment for which it is to be installed.
 - f. Exterior enclosures shall be, at minimum, NEMA 1 for indoor applications and NEMA 3R for outdoor applications.
 6. Panels and enclosures shall only be located within mechanical rooms or at approved locations. Panel locations shall be coordinated during design by the BMS Consultant and shall be identified on project design drawings. For new construction projects the BMS panel locations shall be identified in the project mechanical design drawings, and coordinated on site. For retrofit applications the BMS panel locations shall be identified on building floor plan drawings and in the graphics package to be included in the project BMS Specifications/Contract Documents.
 7. All components of the BMS shall be Identification tagged. Identification tags shall be *resistant to mechanical damage and* securely fastened to the device. Identification tags shall be provided for, at minimum, the following:
 - a. Sensors.
 - b. Transmitters.
 - c. BMS controlled valve and damper actuators.
 - d. End-Devices (other).
 - e. Field panels.
 8. All BMS wire and cable and pneumatic control tubing shall be identification tagged.

Wire/cable shall be identification tagged at every termination location. Wire/cable and tubing terminating at DCP's and ASC's shall be tagged with the point name (full point name, using the UBC standard {buildingnumber.system.device.point}). At any splices or terminal strips between the field device and DCP/ASC, the wiring shall be tagged on both sides of the termination point the same as for a field device termination.

9. 120 VAC power supply sources shall be provided to all BMS field panel and DCP mounting locations. As built documentation shall detail power supply circuit source panels and termination locations.
 10. DDC panels that require guaranteed up time, shall be connected to the building emergency power system, or the building UPS system. DDC provided UPS devices are not acceptable, except by exception.
 11. All installations shall be provided to readily allow access for maintenance.
- L. The BMS specifications shall identify requirements for all work to be provided by the BMS Contractor including all boring, saw cutting, fire stopping, sleeves, equipment mounting and supporting, etc.

2.2. BMS Electrical Installation Requirements

- A. All BMS wiring, conduit, junction boxes, pull boxes, cable tray, etc. shall be provided by the BMS Subcontractor as required for a complete installation. The BMS Contractor shall provide all required access panels, coring, saw cutting, fire stopping, mounting, etc. as defined by the specific job contract documents.
- B. The BMS Contractor shall coordinate installation of conduit with building structure and other trades. Conduit installation above accessible ceilings shall be such that there will be no interference with the installation of lighting fixtures, fire protection, air outlets or other devices. Color code *or place identifying stickers* at all conduit and fittings with a unique color at every junction box and at least every 3 m along the conduit. BMS conduit shall be identified by a blue colour code.
- C. BMS wire/cable shall not share conduit with other building wiring. Low voltage cable shall not be installed in conduit with line voltage or higher voltage carrying cable.
- D. The following are minimum requirements related to BMS electrical installations:
1. All installations shall be in accordance with the National Electric Code, the British Columbia (BC) electrical code, and all governing codes, statutes and ordinances.
 - a. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.
 - b. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused.
 2. With the specific exception identified within this document, all BMS wire and cable shall be installed in conduit.
 3. In new construction projects exposed conduit installations are not permitted in normally occupied building spaces. In retro-fit applications exposed conduit shall only be allowed in specific applications as approved by the BMS Consultant and UBC.
- E. Conduit:
1. Conduit shall be run in all areas *exposed to mechanical damage*.

2. Conduit must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.
 3. Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes shall not be hung on flexible duct strap or tie rods. Conduit, junction boxes, pull boxes, and control panels shall not be run on or attached to ductwork.
 4. Conduit fill:
 - a. Shall meet the requirements of the Electrical Specifications for line voltage or AC power runs.
 - b. Shall not exceed 80% of the cross sectional area of the conduit for low voltage signal carrying conductors.
 5. Junction or pull boxes shall be installed:
 - a. Every 25 meters for 12mm conduit runs,
 - b. Every 30 meters for conduit greater than 12mm,
 - c. After the equivalent of four (4) 90° bends have been made. Every offset counts as ½ of a 90°, and each saddle counts as one 90° bend,
 - d. All junction boxes shall be installed in accessible locations.
 6. Use of flexible or BX (or equivalent) shall be limited to a maximum length of one (1) meter, and shall be supported on each end, *which connects to an end device*.
 7. Exposed conduit ends shall have bushings installed to protect wiring running through the end of the conduit.
 8. Flexible conduit shall have anti-short inters installed at each end to protect the wire or cable running through the end,
 9. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
 10. Wire/cable for space temperature sensors, VAV terminal unit damper actuator, zone coil control valve actuator, VAV terminal unit ASC automation LAN and (where applicable) 24VAC power supply distribution wiring may be installed in ceiling spaces without conduit where code permits.
 - a. Wire/cable installed in ceiling spaces without conduit shall be suitably rated and labelled.
 - b. Wire/cable shall be securely supported and installed in a neat and workmanlike manner following building lines.
 - c. Sleeves shall be provided for all wire/cable that penetrates wall partitions, concrete slabs, or rated partitions.
- F. BMS low voltage monitoring and control wiring shall meet the following minimum requirements:
1. Minimum #22 AWG stranded copper conductors (larger gauge wire/cable shall be provided where required by BMS equipment and where applications warrant (e.g. long runs, etc.).
 2. All BMS input/output point wire/cable and communication cable shall be shielded.
 - a. Non-shielded cables may be approved for BMS input and output field point wiring following certification from the BMS manufacturer that non-shielded cables will function satisfactorily for the life of the building and that the use of non-shielded cables will not negatively affect other building systems/cabling.
 - b. The manufacturers certification shall guarantee to UBC that should it be determined that BMS system performance is negatively affected or another building system or equipment is negatively affected due to the non-shielded cable, the BMS manufacturer shall replace the cable at no cost to UBC.

3. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
 4. Free air cabling installed in non-combustible rated buildings shall be fire rated cable with a minimum rating of FT-6.
 5. Wiring located in combustible rated buildings above T-bar ceiling shall be run in free air using fire rated cable with a minimum rating of FT-6.
 - a. Note: all free air cabling used in combustible rated buildings to interface to security or fire alarm systems shall be FT-6 rated.
 - b. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
 6. Cables shall follow building lines and be installed in bundles resting in a cabling support system (J-hooks, Bridal Rings, eye wraps can be used.) Where possible have wires installed to ceiling or highest possible elevation.
 7. Cable supports shall be attached to the wall or ceiling of the area they are running through. Cable supports **shall not be attached to**:
 - a. Electrical raceways,
 - b. Duct work,
 - c. Ceiling suspension systems,
 - d. Piping,
 - e. Wilson joists.
 8. Cabling bundles inside controls enclosures shall be held in the cable support system using Velcro straps, "zap straps" are not acceptable.
 9. Cable straps (Zap straps) are acceptable outside of control enclosures.
- G. Data Communication Cabling shall meet the following minimum requirements:
1. Unless otherwise specifically called for in the specifications, uniformity of manufacture to be maintained throughout the building for any particular item or type of equipment. All data cabling shall use stranded conductors. Solid core conductors are not accepted.
 2. Data cabling shall be run as per the vendors best practice guidelines. Communication runs be one continuous run from end to end without splices or connections, Cabling shall be colour coded with different colours for each conductor.
BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135, and the appropriate vendor standards. This includes but is not limited to:
 3. The maximum length of an MS/TP segment is 900 meters (with AWG 22 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485
The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters. Exceptions can be approved by the UBC-BMS group.
 4. An MS/TP EIA-485 network shall have no T connections.
- H. BACnet Ethernet communications cabling shall meet the following minimum requirements:
1. Data cable shall Category 6 Ethernet cable.
 2. The maximum cable length for each run shall be limited to 90 meters.
 3. All Category 5 cables must be Power Sum accepted and recognized by the manufacturer.
 4. Cables must display the manufacturer's stamp stating that the cable is included in the latest UL verified publication for Category 6 standards.
 5. All cables must be included in the System / Applications Certification Warranty.
 6. All cabling installed inaccessible areas, (above drywall ceilings, and crawl spaces), must be installed in conduit or cable tray. Conduit fill must not exceed 40%.

7. Cable colour shall be purple for BMS IP cable.
8. Ethernet Cable Testing:
 - a. The Controls Contractor is to use a Level III tester that is capable of testing the specified cable to the performance level(s) indicated in this document. The tester is to use the latest version of firmware and software to test the unshielded twisted pair (UTP) cabling system.
 - b. The nominal velocity of propagation (NVP) must be set specific to each cable manufacturer before testing. Portable tester is to be calibrated on a minimum annual basis.
 - c. The Consultant before the commencement of all field-testing may perform a visual inspection. The installation will be validated for compliance with the Industry Standards with particular attention given to the following criteria:
 - I. Cable jacket removal and connector termination.
 - II. Routing and pathway supports.
 - III. Cable bend radius and cable tie slack.
 - IV. Neatness, clamping, and harnessing of cabling and wiring.
 - V. Wire and cable identification and labeling.
 - VI. Nameplates, identification, plates, and markings.
 - d. Provide two copies of testing and commissioning documentation for all items and their related components to the Project Manager and Owner's Designated Representative before the designation of substantial completion for the project. Include maintenance manuals and operating instructions for Customer's staff use. Substantial completion will not be granted until all documentation has been submitted and accepted by the Consultant.
 - e. The permanent link performance of the installed cabling Data system must comply with EIA / TIA 568B-1 specifications for testing Category 5e systems. All horizontal channel testing shall be performed end to end for each port, (Dual NEXT). No conditional passes will be accepted.
 - f. Testing of all 4 pairs of the horizontal cable (as specified in this document) is to include but not be limited to the following:
 - I. Wire Map including; end to end continuity, open and shorts, pair polarity
 - II. Cable length
 - III. Attenuation
 - IV. NEXT/FEXT
 - V. ACR
 - VI. Return Loss
 - VII. ELFEXT, PSELFEXT
 - VIII. Propagation Delay, Delay skew
 - IX. PSNEXT, PSACR.
 - g. All of the above parameters must be recorded and included in the test results.
 - h. Correct all cable faults. Splicing of any cables will not be permitted, for any reason, unless prior authorization is received in writing from the Consultant.
 - i. The Controls Contractor shall supply the Consultant with test results for approval and system acceptance. An additional copy of the test results is to be included for the maintenance manuals.
9. The colour of BMS Ethernet cable shall be purple.
 - I. Wiring runs shall be continuous runs without splices.
 - J. All BMS equipment and components shall be grounded to building ground facilities.

- K. BMS shall only be capable of controlling electric motors when the associated hand/off/auto (HOA) motor control switches are in the "auto" position. BMS control shall be wired into the auto circuit of the hand/off/auto motor control circuit only. Where hand/off/auto switches do not exist they shall be provided by the *electrical* contractor.
- L. Life safety and equipment protection interlocks shall be wired to override equipment whenever it is in operation.
- M. Existing interlocks and override control facilities should typically not be removed or overridden by the application of new BMS control facilities without the specific instruction of the BMS Design Consultant and the approval of UBC Building Operations.

2.3. BMS Communication Provisions

- A. The following minimum requirements shall be provided *by UBC IT group / Construction team*:
 - 1. One female data connection per building will be provided near a DDC panel. This location to be coordinated with the construction team/UBC-CI/UBC-BMS

2.4. BMS Pneumatic Control Installation Requirements

- A. Pneumatic are only approved by exception, as approved by UBC-BMS in buildings with existing pneumatic systems. Pneumatic specifications are available upon request.

2.5. BMS Installation Training Requirements

- A. The *project* BMS Specifications shall specify requirements for CBMS/BMS training to be provided as part of the work of all CBMS/BMS projects. CBMS/BMS Contractor shall submit an outline of the training courses to be given.
- B. Training sessions shall include classroom type instruction and "hands on" instruction and shall be given by the BMS Subcontractor on site using the completed installations. Arrange for additional meeting room space with the Owner.
- C. Provide training tailored to the various Owner operations personnel requirements. Duration and number of training sessions to be determined by the BMS Consultant and shall be specified to accommodate the installation requirements.
- D. The BMS Contractor shall provide initial basic monitoring and control training to the Owners personnel to provide them with sufficient knowledge of the BMS installations such that they can use the BMS for the day-by-day monitoring and control of the BMS.
- E. The advanced BMS training shall, at minimum, cover the following topics:
 - 1. Site review (equipment and device locations)
 - 2. Sequence of operations and programming review.
 - 3. Graphic package review.
 - 4. System interaction review.
 - 5. Sharing of special case situations that have occurred during construction.
- F. Training sessions shall be designed on the basis of experience and knowledge of the attendees scheduled to participate and shall differentiate between the requirements of supervisory, operations and maintenance personnel.

- G. The BMS Subcontractor may provide computer based, self-directed training accomplish the portions of the UBC training requirements. Provide onsite training for details specific to the particular BMS installation project (i.e. device locations, sequences of operation, safety devices, life safety system interlocks, maintenance procedures, etc.). Provide site training for any new products, equipment, devices, and software.

2.6. BMS Documentation Requirements

- A. The BMS Specifications shall specify requirements for CBMS and BMS documentation to be provided as part of the work of all CBMS/BMS projects.
- B. A Graphics package shall match the vendor specific requirements for each system.
 - 1. Delta:
 - a. Graphics shall be HTML5 (enteliviz), using the standard that has been developed in conjunction with ESC.
 - b. Old graphics are acceptable by exception, on existing buildings only
 - 2. Johnson Controls:
 - a. Graphics shall be MUI (Metasys User Interface, web development) graphics, using the standard that has been developed in conjunction with Johnson Controls.
 - b. Additionally GGT graphics shall not generated, unless an exception is required by UBC-BMS.
 - 3. Siemens Building Technology:
 - a. Graphics shall be Desigo graphics, using the standard developed by UBC-BMS.
 - b. Additionally Insight graphics shall be generated, unless an exception is provided by UBC-BMS.
- C. Shop drawings shall be generated *in a digital format*. Drawings shall include diagrams, mounting instructions, installation procedures, equipment details and software descriptions for all aspects of the system to be installed. At minimum, the shop drawings shall include:
 - 1. BMS topology/network architecture schematic(s).
 - 2. Installation drawings and schedules.
 - 3. Protocol Implementation Conformance Statements (PICS),
 - 4. CCP, DCP, UC and other panel layouts, including floor plan location and interconnection drawings.
 - 5. Field instrumentation locations on floor plan drawings.
 - 6. Schematic of systems indicating instrumentation locations.
 - 7. Installation details.
 - 8. Schedule of cabling including details of proposed cable types.
 - 9. *Wiring details drawings*
- D. Equipment submittals shall include design, performance and installation details for all aspects of the system to be installed. Equipment submittals shall be in hardcover binders with a table of contents and indexing tabs. At minimum, the equipment documentation submittals shall include:
 - 1. Equipment technical data sheets with mounting and installation details.
 - 2. The documentation shall include comprehensive and complete details of the Automation Level data communications, data objects, and devices including address, associated controller type, etc. as required and for the interface to the CBMS. Provide Protocol Implementation Statements (PICS) for all devices.
 - 3. Details of networks/communications equipment, cabling and protocols proposed.
 - 4. Software specifications and descriptions including operating sequences.

5. Field sensor and instrumentation specification sheets.
 6. Damper and actuator specification sheets.
 7. Valves and valve actuator specification sheets.
- E. Provide record documentation in manuals as indicated below (*digital copies* are required):
1. Specifications, maintenance requirements and installation requirements for all hardware components.
 2. *As build package of submission package*
 3. Field Instrumentation and End Device Hardware Manuals
 4. Software Documentation Manuals.
 5. Maintenance Manuals.
 6. Control Drawings.
 7. Other supporting documentation.
- F. Manuals shall be updated whenever the Subcontractor makes changes to the work. A unified package for each building shall be provided as part of each upgrade to a modified building.
- G. Provide a complete set of all record in .pdf electronic computer data file format, and modifiable shop drawings in Visio or CAD format.
- H. All BMS and CBMS Record Documentation shall be provided in electronic .pdf file format.

2.7. BMS Installation Commissioning and Testing

- A. BMS specifications shall clearly specify the requirements for Contractor testing and commissioning of the BMS including test documentation and requirements for testing and demonstration with other project commissioning personnel and the BMS design consultant.
- B. All commissioning shall be completed using the graphics generated for the user interface, and the graphics shall be verified at the same time that point end-to-end checks and programmed sequences of operation verifications are completed.
1. Hardware and graphics commissioning shall take place simultaneously.
 2. Should the initial end-to-end checks be completed without the use of the graphics, the end-to-end checks must be completed again to confirm the point layout indicated on the graphics is consistent with the point locations in the field.
- C. The BMS Subcontractor shall conduct full end-to-end testing and commissioning of the BMS installations and the overall monitoring and control of the building systems. , BMS Contractor testing shall include the monitoring and supervisory control and data communications with the associated campus NDS.
- D. The BMS Subcontractor shall work with the UBC BMS Group to ensure all controllers are visible on the network, and verify BMS integration.
- E. Point to point checks shall verify (at minimum) the following:
1. Correct location of the field device for the application.
 2. Correct installation of the control device/interface with reference to the manufacturer's literature and check that sufficient access has been provided for maintenance.
 3. That the control device has the correct range for the application, that the range is correctly entered in the controller and is correctly engineered on the operator's terminal.
 4. Correct operation of the controls device/interface, including any associated

- alarm and alarm text.
- 5. Correct installation of each valve and damper actuator, and ensure that each valve and damper actuator is stroked correctly when checked against the BMS output.
- 6. Calibration of the control device.
- 7. Labels provided on the control devices and mechanical equipment is correct.
- F. Systems testing shall commence once all component testing has been successfully undertaken and approved by the Consultant.
- G. The Consultant's verification tests shall be performed by the BMS Subcontractor and shall be witnessed by the Consultant or Commissioning Agent who shall complete the Consultant's portion of the system performance verification test sheets as each test is successfully undertaken. The BMS Subcontractor shall remedy any deficiencies that are observed during the system performance verification tests and shall be re-tested as required to demonstrate satisfactory performance and compliance with the specifications.
- H. Integrated BMS/CBMS joint systems tests shall be undertaken to demonstrate that the interaction between the individual building BMS and the CBMS meets the UBC requirements. The BMS Subcontractor shall participate in joint verification of the integrated systems and cooperate with the Owner in the demonstration of the integrated systems.
- I. The BMS Specifications shall specify the requirements for the BMS/CBMS integration joint systems verification. The BMS/CBMS Integrated System Verification shall include the following minimum requirements:
 - 1. Test all BMS monitored and controlled field devices, BMS data points and all BMS input and output points. CBMS monitored data point values shall be verified against actual field device position/state and compared to BMS values to ensure both BMS and CBMS values are the same.
 - 2. CBMS override control of all BMS output points and control data points shall be verified.
 - 3. BMS network and controller device status and data communications status are accurately monitored at the CBMS. Alarms for failed controllers and failed data communications are annunciated.
 - 4. BMS data values displayed on dynamic system graphics or in tabular data format at the CBMS are functional and accurate.
 - 5. CBMS operator control of BMS control output points and control data points are functional via the dynamic graphic interface.
 - 6. CBMS facilities for operator adjustment of alarm definition parameters and thresholds, set point adjustment, control parameter adjustments, point trend initiation and modification to trends, etc. are fully functional.
 - 7. The CBMS performance requirements for the monitoring and control of BMS data and field devices meet the UBC requirements.
 - 8. BMS device addressing and identification definitions are compatible and identical and the addressing scheme meets with UBC requirements.
 - 9. All BACnet controllers addressing shall conform to the UBC schedule for BACnet device addressing.
 - 10. Point naming used is compatible and conformal with the UBC requirements.
- J. All test documentation shall be maintained in electronic format.

3 BMS DESIGN GUIDELINES

3.1. General BMS Design Requirements

- A. BMS installations at UBC buildings shall be turnkey installations operating fully standalone.
- B. All BMS shall conform to the most recent revision of the ANSI/ASHRAE Standard 135 including all issued addenda, at minimum, at the Management data communication network level as defined within these guidelines. All BMS devices shall implement the functionality detailed in the BACnet Standard "Device Profiles". The BMS shall also be native BACnet compliant at the Automation data communication network level.
- C. The CBMS shall be compliant with the requirements defined for a BACnet Operator Workstation Device (B-OWS). The CBMS shall provide centralized operator interface for monitoring and supervisory control of the individual building BMS.
 - 1. Each BMS manufacturer has a virtualized CBMS installed.
 - a. New and renovated BMS installations shall interface to the CBMS supplied by the *UBC-BS group with software provided by UBC from the associated manufacture*:
 - I. SBT BMS will interface with the Apogee/Desigo CBMS,
 - II. JCI BMS will interface with the Metasys CBMS,
 - III. Delta BMS will interface with the *Enteliweb* CMBS.
- D. The BMS Specifications for each building BMS project shall specify the requirement for the BMS Contractor/Manufacturer to provide all hardware and software required for the CBMS to communicate with the BMS via BACnet IP on the UBC campus WAN. Facilities to be provided shall include any manufacturer specific software tools required for programming, point mapping, configuration, etc. of building BMS data points.
- E. UBC building BMS installations shall be specified to include all project design, documentation, training, installation work, software, database and logic programming, WAN interconnection, testing, commissioning, warranty, project management and trade coordination work as required for a fully functional, standalone, turnkey BMS. The individual building BMS installation

Contractor work shall include coordination and documentation work for the integration of the BMS into the CBMS via BACnet data interface by other contract. Installations shall in no way negatively affect existing BMS installations and existing campus BMS performance.
- F. BMS installations shall be provided which incorporate BMS equipment and network facilities in compliance with the requirements identified in these guidelines. The BMS designer shall specify detailed BMS equipment requirements and BMS network architecture requirements in the BMS Design Specifications. BMS equipment and data communication network specifications shall incorporate good BMS engineering, design, and application practices and shall incorporate the UBC BMS Design Guideline requirements.
- G. BMS online editing is necessary for all controllers that serve critical equipment (to be determined by project team) which cannot be shut down without a maintenance shutdown notice.
- H. BMS installations in UBC buildings shall incorporate the following minimum requirements:
 - 1. Equipment shall be approved components as manufactured by one of the UBC

- approved BMS Manufacturers and shall be in compliance with the UBC BMS Design Guidelines.
2. Management and Automation Level communication LAN's shall be provided to ensure the following:
 3. The failure of a DCP shall not affect the operation of other operating DCP. UC's supervised by the failed DCP shall continue to function and shall control associated equipment according to specified failure routines. Where information in the failed DCP is used by other DCP's, UC's, buildings, routines, etc. the non-availability of the information shall be alarmed and alternate control strategies shall be automatically initiated.
 4. The failure of an UC shall not affect the operation of other operating UC or DCP.
 5. All BMS monitored and controlled points associated with an individual HVAC System or equipment shall be terminated in the same UC or DCP. It is not acceptable for BMS monitored and controlled points associated with an individual system to be terminated at separate distributed DCP's or UC's. All required logic programming and point database facilities associated with an individual building system shall reside in the same UC or DCP to which the system input/output points are terminated. It is not acceptable for logic programming and database facilities required for BMS monitoring and control of a building system to reside in a DCP or UC other than to which the system input/output points are terminated in.
 6. UC's controlling space terminal units (e.g. VAV terminal units, fan powered terminal units, etc.) shall reside on the same automation LAN as the UC that is controlling the associated air handling unit. If an AHU is controlled directly by a DCP, the UC's controlling space terminal units shall be supervised by that DCP.

3.2. **BMS Subcontractor and System Qualifications**

- A. BMS's to be provided for any UBC building installations shall be products as manufactured by one of the following manufacturers:
 1. Siemens Building Technologies as *installed by the factory branch*.
 2. Delta Controls as *installed by ESC*.
 3. Johnson Controls, Inc. *Metasys product, as installed by the factory branch*.
- B. BMS standalone building installations shall be provided by one of the following UBC approved BMS installation contractors who shall install products of one of the above approved manufacturers:
 1. Siemens Building Technologies as installed by the factory branch.
 2. Delta Controls as installed by Ainsworth.
 3. Johnson Controls Inc. Metasys product, as installed by the factory branch.
- C. BMS installations shall be provided by BMS Contractors who meet the following requirements:
 1. Must have been in operation in the BMS industry in the City of Vancouver area for a minimum of 10 years.
 2. Employ qualified staff in the Vancouver area capable of undertaking a complete BMS installation project and to provide routine and emergency maintenance on all elements of the BMS.
 3. Have successful project experience on similar projects for a minimum period of five (5) years.
 4. Have local service and support facilities for the total BMS. BMS Contractor shall have service and support facilities available to UBC 24 hours per day, 7 days per week.

5. Have local, or access to, supplies of BMS components with a maximum delivery period of 24 hours.
- D. BMS facilities to be provided for UBC building installations shall be fully compatible with the existing installed central monitoring and control facilities, network communications facilities, and with other UBC building BMS installations.
- E. All BMS DCP's, UC's, OIW's where applicable, and other BMS Manufacturer specific equipment within a building shall be manufactured by the same manufacturer. All HVAC and building services monitoring and control shall be provided by BMS facilities from one of the approved UBC BMS manufacturers. In applications where HVAC system controls within an existing building are being retrofitted and BMS facilities of any of the approved BMS manufacturers exist within the building, BMS facilities shall be provided by the manufacturer of the BMS equipment already installed. The retrofitted BMS installation shall be provided to interconnect the new renovation work into the existing building and campus BMS facilities.
- F. BMS DDC controllers shall be products manufactured by a company that is an active Corporate Member of the BACnet Manufacturers Association (BMA).
- G. All BMS products proposed for installation on a UBC project shall have been previously demonstrated to UBC Building Operations satisfaction and approved by UBC Building Operations prior to being listed as an approved bidder. Any BMS product/equipment for which there is not a significant existing installation on campus of products from the same manufacturer that is successfully integrated with the CBMS shall be fully demonstrated to UBC's satisfaction and approved by UBC Building Operations prior to being considered as an approved product.

3.3. BMS Network Architecture and Communications Requirements

- A. The CBMS and the individual building BMS systems shall be based on multiple tier/level data communication networks utilizing different network communications technologies. The CBMS and the individual building BMS system architecture shall comprise of three layers as defined within these documents.
- B. BMS design specifications shall detail the data communications network facilities to be provided and the contracting party responsible for providing the work.
- C. The CBMS/BMS architecture shall comprise the following network layers:
 1. Management Level (by CBMS and BMS Contracts):
 - a. A Wide Area Network (the UBC Campus WAN) shall provide a means of interoperable communication between the CBMS and the individual building BMS using BACnet/IP. This WAN is hereafter referred to as the Management Level Network. The Management Level Network shall provide a means by which the building systems throughout the UBC facilities can exchange data in the form of BACnet data objects. The Management Level Network shall be BACnet/IP over Ethernet and shall be such that an operator with the required access level shall be able to undertake monitoring and control functions for any of the integrated BMS buildings.
 - b. It shall be the responsibility of each BMS building contractor, to ensure that all BMS system data is available at the Management Level Network. The intent is that the CBMS shall be able to automatically read this data from the network using the BACnet automatic "find new objects" features. Each BMS building system contractor shall provide comprehensive and complete documentation

- regarding the installed BACnet devices, device address, controller type, databases and other pertinent information to the Owner and to the CBMS contractor. BMS Specifications shall specify the inform
- c. Each BMS system shall have a dedicated NDS installed at the UBC MACC. The NDS shall be dedicated to campus building BMS's of the same manufacturer product. The NDS shall have terminal service capabilities with "Thin Client" operator interface or shall employ "web services" technology such as Microsoft .Net technology with web browser based operator interface. The NDS shall communicate with the individual building BMS's over the BMS Management Level via BACnet/IP. The NDS shall have manufacturer specific application software for operator interface. The NDS shall be configured for archiving and data storage of all associated BMS controllers and devices and for manufacturer specific controller programming, trouble shooting, data entry, configuration software tools, etc. It is not intended that the NDS be configured as the central operator monitoring and control workstation.
 - d. The CBMS shall be in conformance with the requirements and functionality detailed in ANSI/ASHRAE Standard 135 (BACnet) for a BACnet Operator Workstation (B-AWS). The CBMS shall have terminal service capabilities with "Thin Client" operator interface. The CBMS shall communicate with the individual building BMS's over the BMS Management Level via BACnet/IP. CBMS applications software shall run on the existing SBT Apogee NDS server computer installed at the UBC MACC. The CBMS workstations, including the Portable Operator Workstations (POT), shall be Thin Clients operating through a Virtual Private Network (VPN). It shall be possible to add access from a remote location by modem and/or via the Web.
 - e. The Management Level Network communications, without exception, shall be BACnet/IP. It is intended that there be a single point of interface between a building BMS and the Management Level Network (UBC WAN). If multiple CCP are required in a building due to Automation Level node quantities or limitations of CCP capabilities, the BMS Contractor shall add the additional CCP as an extension of the Management Level Network within the *building*. The BMS Contractor shall provide Management Level network facilities within individual buildings.
 - f. The demarcation point between the CBMS and the building BMS shall be the BMS CCP connection to the WAN data outlet within the building. The BMS Contactor shall make the final terminations with supervision from UBC.
2. Automation Level (by the BMS Contract):
- a. The Communication Control Panels (CCP) shall be part of the BMS. CCP shall be software programmable and shall incorporate BACnet/IP to BACnet/MS/TP routers between the Management Level Network and the BACnet controllers on the Automation Level Network.
 - b. The Automation Level shall primarily include the DDC controllers that interface with the field sensors and final control elements. It is anticipated that there will be two types of DDC controller within the CBMS architecture:
 - I. Distributed Control panels (DCP).
 - II. Unitary Controllers (UC).
 - c. DCP controllers shall be fully programmable controllers and shall have an I/O capability to handle major types of equipment such as air handling units, roof top units, chiller plants, heating plants, etc. The DCP shall be BACnet Building Controller (B-BC) type controllers and shall be interfaced with the Management Level Network via the CCP. DCP may incorporate CCP functionality and reside at the Management network level.
 - d. UC shall be application specific or fully programmable controllers and shall be suitable for the monitoring and control of specific types of smaller equipment

- such as VAV terminal units and Fan Coil Units. UC shall be BACnet Advanced Application Controller (B-AAC) and/or BACnet Application Specific Controller (B-ASC) type controllers at the Automation Level. These UC shall operate on the same network as the BACnet DCP.
- e. All controllers shall be BACnet compliant. Where testing protocols and certification requirements are developed for standardized BACnet device types, devices must be tested and certified compliant by the BACnet Testing Laboratory (BTL). For BMS standardized devices where testing protocols and certification requirements are not yet finalized, the BMS product manufacturer must demonstrate committed efforts to comply with BACnet Standard requirements for the device and an ongoing commitment to undertake the future testing and certification process. All BMS controllers shall be tested and certified within a reasonable period of time of the testing and certification process being available.
 - f. The BMS Automation Level Networks shall be BACnet MS/TP protocol *or* BACnet IP. No other protocols or network architecture shall be used.
 - g. Where interface to a third party controller is not BACnet compatible, the interface shall be accomplished through a point-for-point, hardwired interface (*VFD shall have BI - DRIVE-S, BI – DRIVE-ALARM, AO – DRIVE-O, BO – DRIVE-ENABLE*), *Heat/cool devices shall have (BO – DEVICE-ENABLE, BI – DEVICE-STATUS, BI-DEVICE-ALARM AO – DEVICE-RESET (Typically temperature) etc.*
3. Field Level (by BMS Contract):
- a. The Field Level shall include the instrumentation interfaced to the Automation Level DDC controllers such as the temperature, humidity, level, pressure sensors and switches. It shall also include the final control elements such as the valve and damper actuators and the control relays.

4 BMS EQUIPMENT

4.1. Management Level Network

- A. Extension of the Management Level Network shall meet, at minimum, the following requirements:
 - 1. Ethernet TCP/IP network. The CCP, OIW, NDS, POT and CBMS shall communicate at 100Mbps or higher communication rates.
 - 2. All data communications shall be BACnet/IP
 - 3. Cabling shall be Category 5e or higher quality and shall be tested and certified for 1 Gbps data transfer rate.
 - 4. Network equipment, configurations, and data communications shall be fully compatible with the UBC Campus WAN.
 - 5. Cable colour shall be purple for BMS network cable.
- B. For discussion:
 - 1. Provision of layer 2 network facilities for buildings with IP networks that do, or are likely to exceed 200 ip devices (exceeding IP address designations)
- C. OPERATOR INTERFACE WORKSTATION (OIW)
 - 1. Not used on campus.
- D. WEB SERVER OPERATOR INTERFACE (WOI)
 - 1. Servers are determined by the vendors and are approved by EWS-BMS. All servers are in place and shall be connected to by the end users via thin or fat clients.

4.2. BMS Automation Level Network

- A. BMS Automation Level LAN shall meet, at minimum, the following requirements:
 - 1. BACnet IP and/or BACnet MS/TP protocol implemented via EIA-485.
 - a. Data transfer rate and data throughput as required to meet the alarm annunciation requirements.
 - 2. BACnet IP protocol
 - a. Data transfer rate and data throughput as required to meet the alarm annunciation requirements.
- B. The failure of any node on the Automation Level LAN shall in no way affect the operation of the BMS except to inhibit monitoring and control functions at the OIW for that node or any devices served by the failed node.
- C. The failure of any node shall not inhibit the communication between remaining nodes.

4.3. Communication Control Panels (CCP)

- A. CCP shall be BACnet compliant. CCP shall be software programmable controllers on the Management Level Network and shall be a router between the BACnet/IP Management Level Network and the BACnet/MSTP Automation Level Network.
- B. Provide, at minimum, one CCP per building. Additional CCP may be required to accommodate the number of Management and Field Level Controller nodes and network segments.

- C. The CCP shall incorporate software as necessary to provide communications on the Management Level Network.
- D. The failure of any CCP shall be annunciated as an alarm at the CBMS.
- E. Provide a real-time hardware clock at each CCP. The hardware real-time clock shall be used to synchronize all other hardware and software clocks in the local building BMS.
- F. CCP shall record and store device change of state data, BMS event/transaction and alarm data, and trend data in memory within the CCP and shall automatically upload the data to the CBMS and NDS. In the event that the CBMS and/or NDS is not available, the CCP shall store the data in memory within the controller and automatically upload the data once the CBMS/NDS resume communications. CCP shall have memory facilities to hold 4 days of historic data of normal typical transactions and for 4 days of historic trend data for monitored point values at 300 second samples. An exception can be made for storage devices residing on the local network
- G. CCP panels shall comply with the BACnet Building Control (B-BC) device profile. A B-BC is a general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks. The panel shall have the following capabilities:
 - 1. Data Sharing
 - a. Ability to provide the values of any of its BACnet objects,
 - b. Ability to retrieve the values of BACnet objects from other devices,
 - c. Ability to allow modification of some or all of its BACnet objects by another device,
 - d. Ability to modify some BACnet objects in other devices.
 - 2. Alarm and Event Management
 - a. Generation of alarm / event notifications and the ability to direct them to recipients,
 - b. Maintain a list of unacknowledged alarms / events,
 - c. Notifying other recipients that the acknowledgment has been received,
 - d. Adjustment of alarm / event parameters.
 - 3. Scheduling
 - a. Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.
 - 4. Trending
 - a. Collection and delivery of (time, value) pairs.
 - 5. Device and Network Management
 - a. Ability to respond to queries about its status,
 - b. Ability to respond to requests for information about any of its objects,
 - c. Ability to respond to communication control messages,
 - d. Ability to synchronize its internal clock upon request,
 - e. Ability to perform re-initialization upon request,
 - f. Ability to upload its configuration and allow it to be subsequently restored,
 - g. Ability to command half-routers to establish and terminate connections.

4.4. Distributed Control Panels (DCP)

- A. The BMS Contractor shall provide all DCP. DCP shall be software programmable controllers that reside/communicate via BACnet/IP on the Management Level and/or via the BACnet MS/TP Automation Level Network and shall provide an interface via Point Interface Modules (PIM) to the field instrumentation and final control elements.
- B. DCP may be used for any equipment monitored and controlled by the BMS. Dedicated DCP

shall be used to monitor and control the following equipment:

1. Chilled water system.
 2. Cooling towers.
 3. Heating water system.
 4. Air handling units.
- C. The DCP shall control its own communications so that the failure of any one node, including any associated PC workstation or server computer, shall not inhibit communications on the network between the remaining nodes. Provide integral network communication connections.
- D. DCP shall be BACnet compliant. DCP shall be BACnet Building Controller (B-BC) type controllers and shall be interfaced with the Management Level Network via the CCP. DCP may be equipped with integral CCP functionality. All controllers shall be BACnet compliant and shall have been tested and certified compliant by the BACnet Testing Laboratory (BTL).
- E. DCP panels shall comply with the BACnet Building Control (B-BC) device profile. A B-BC is a general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks. The panel shall have the following capabilities:
1. Data Sharing
 - a. Ability to provide the values of any of its BACnet objects,
 - b. Ability to retrieve the values of BACnet objects from other devices,
 - c. Ability to allow modification of some or all of its BACnet objects by another device,
 - d. Ability to modify some BACnet objects in other devices.
 2. Alarm and Event Management
 - a. Generation of alarm / event notifications and the ability to direct them to recipients,
 - b. Maintain a list of unacknowledged alarms / events,
 - c. Notifying other recipients that the acknowledgment has been received,
 - d. Adjustment of alarm / event parameters.
 3. Scheduling
 - a. Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.
 4. Trending
 - a. Collection and delivery of (time, value) pairs.
 5. Device and Network Management
 - a. Ability to respond to queries about its status,
 - b. Ability to respond to requests for information about any of its objects,
 - c. Ability to respond to communication control messages,
 - d. Ability to synchronize its internal clock upon request,
 - e. Ability to perform re-initialization upon request,
 - f. Ability to upload its configuration and allow it to be subsequently restored,
 - g. Ability to command half-routers to establish and terminate connections.
 6. Data Sharing
 - a. Ability to provide the values of any of its BACnet objects,
 - b. Ability to retrieve the values of BACnet objects from other devices,
 - c. Ability to allow modification of some or all of its BACnet objects by another device,
 - d. Ability to modify some BACnet objects in other devices.
 7. Alarm and Event Management
 - a. Generation of alarm / event notifications and the ability to direct them to recipients,

- b. Maintain a list of unacknowledged alarms / events,
 - c. Notifying other recipients that the acknowledgment has been received,
 - d. Adjustment of alarm / event parameters.
- 8. Scheduling
 - a. Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.
- 9. Trending
 - a. Collection and delivery of (time, value) pairs.
- 10. Device and Network Management
 - a. Ability to respond to queries about its status,
 - b. Ability to respond to requests for information about any of its objects,
 - c. Ability to respond to communication control messages,
 - d. Ability to synchronize its internal clock upon request,
 - e. Ability to perform re-initialization upon request,
 - f. Ability to upload its configuration and allow it to be subsequently restored,
 - g. Ability to command half-routers to establish and terminate connections.
- F. All applications programs and associated operating sequences shall reside at the DCP (this refers to control logic, not the written sequence of operations).
- G. Volatile memory for logic storage is not acceptable.
- H. Analog I/O PIM shall have a minimum 12 bit analog-to-digital conversion and shall interface to the entire signal types listed in the Point Schedules.
- I. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.
- J. Provide with each controller the BACnet configuration information including BIBB, address, controller configuration type, etc. to integrate the controller into the CBMS.
- K. The failure of a DCP shall not affect the operation of other operating DCP. UC's supervised by the failed DCP shall continue to function and shall control associated equipment according to specified failure routines. Where information in the failed DCP is used by other DCP's, UC's, buildings, routines, etc. the non-availability of the information shall be alarmed and alternate control strategies shall be automatically initiated.

4.5. Unitary Controllers (UC)

- A. The BMS Contractor shall provide all Unitary Controllers (UC). UC shall be fully programmable or applications specific controllers with pre-packaged operating sequences maintained in EEPROM or flash RAM.
- B. The UC shall be a node on one of the Automation Level LANs and shall control its own communications so that the failure of any one node shall not inhibit communications on the network between the remaining nodes.
- C. UC shall be BACnet Advanced Application Controller (B-AAC) and/or BACnet Application Specific Controller (B-ASC) type controllers incorporated at the Automation Level. These UC shall operate on the same network as the BACnet DCP. All controllers shall be BACnet compliant and shall have been tested and certified compliant by the BACnet Testing Laboratory (BTL).
- D. UC shall be totally independent of other LAN nodes for their monitoring and control

functions.

- E. All associated applications programs shall reside at the UC. UC shall not require communication to any other panel for normal operating sequences other than time scheduled base commands.
- F. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.
- G. Provide with each controller the BACnet configuration information including BIBB, address, controller configuration type, etc. to integrate the controller into the CBMS.
- H. UC's that serve equipment, (such as a unit ventilator), that requires a degree of custom programming to achieve the specified sequence of operation shall be a BACnet Advanced Application Controller (B-AAC). The B-AAC shall have the following capabilities:
 - 1. Data Sharing
 - a. Ability to provide values for any of its BACnet objects upon request,
 - b. Ability to allow modification of some or all of its BACnet objects by another BACnet device.
 - 2. Alarm and Event Management
 - a. Generation of limited alarm and event notifications and the ability to direct them to recipients,
 - b. Tracking acknowledgments of alarms from human operators,
 - c. Adjustment of alarm parameters.
 - 3. Scheduling
 - a. Ability to schedule actions in the local device based on date and time.
 - 4. Trending
 - a. No requirement.
 - 5. Device and Network Management
 - a. Ability to respond to queries about its status,
 - b. Ability to respond to requests for information about any of its objects,
 - c. Ability to respond to communication control messages.

4.6. *Electrical secondary meters*

- A. This section details the minimum requirements for the electrical secondary meters (not the main building billing meter, these devices are to remain in division 26). For all projects that are required to comply with the 2023 UBC technical guidelines. Electrical secondary meters shall be provided, installed and commissioned by the BMS trade.
- B. The BMS vendor shall provide an approved electrical sub meter assembly as required for the building design. The electrical secondary meters shall be integrated into the appropriate BMS system and also into the UBC Sky Sparks system.
- C. All electrical sub meters shall meet all required local and national certification requirements.
- D. All current transducers shall be provided by the electrical trade, and shall be Rogowski coils. See section 26 27 13 for more info.
- E. BACnet network requirements:
 - 1. BACnet IP requirements
 - a. BACnet IP is the only acceptable communication protocol.
 - b. BACnet gateways are not acceptable.
 - c. UDP port configuration is required (47800 – 47820)
 - d. Devices must comply with all other BMS requirements.
 - 2. Sub point naming must be available, and adjustable. Default names are not acceptable meters shall be ANSI X12.20-2015 class0.2 revenue grade meters.
- F. All electrical secondary meters shall comply with section 8.4.3 (electrical energy monitoring) of the most current LEED standard, and any other code requirements.

- G. Electrical sub meters shall be provided and integrated by the controls trade.
 - 1. All network integration shall comply with all other TG requirements outline in this document.
 - 2. All wire from the demark enclosure shall be provided by controls trade.
 - 3. BMS must provide direction to the electrical trade for current transducers to meet the requirements for the BMS provided sub meter.
- H. Demark enclosure shall be provided by the electrical trade including, please see section 26 27 13 for more details:
- I. This drawing indicates a general outline of the scope for each trade (Please see the electrical section 26 27 13.2.4).
- J. Please reference electrical specification section 1.1 for additional information.
- K. Metering is required at the locations as defined in section 26 27 13
- L. Basis of design is Setra and Dent is also approved. Other vendors can be approved through EWS BMS approval.

4.7. Valves and Dampers

- A. DES Valves (valves located on the primary side of the DES system)
 - 1. Shall be ANSI 250 rated.
 - 2. Basis of design is Belimo ball valves
 - a. Belimo PN B215 (up to 2")
 - b. Belimo PN B215 (above 2")
- B. Automatic Control Valve General Requirements:
 - 1. The BMS Subcontractor shall furnish all valves controlled by the BMS as detailed in the mechanical trade documents and as indicated on control drawings. The BMS Subcontractor shall furnish all shut-off valves for instrumentation. The Mechanical Subcontractor shall install valves (3 valve manifolds for DP cells, for example), except those for instrumentation. All other valves such as check valves, relief valves, pressure reducing valves, self-regulating valves, manually operated valves, etc. shall be furnished and installed by the Mechanical Subcontractor. The BMS Subcontractor shall provide details of the manufacturer's installation requirements to the Mechanical Subcontractor. The BMS Subcontractor shall coordinate the valve body type and pipe connections with the mechanical trade.
- C. The BMS Subcontractor shall refer to the Mechanical plans and drawings and to the control drawings for the design conditions on which to base sizing and ratings of the valves and their actuators.
- D. All valves shall be rated appropriately for the fluid, temperature and pressure.
- E. Valves of similar types shall be by the same manufacturer.
- F. Valves shall have the manufacturer's name and the pressure rating clearly marked on the outside of the body. Where this is not possible manufacturer's name and valve pressure rating shall be engraved on a minimum 50mm (2 inch) diameter stainless steel tag that shall be attached to the valve by a chain in such a manner that it cannot be unintentionally removed.
- G. Valves 13mm to 50mm (0.5 inch to 2 inches) shall have NPT ends. Valves 63mm (2.5 inches) and larger shall have flanged ends. Flanged valves shall be furnished complete with companion flanges, gaskets and bolting materials. Flanges, gaskets and bolting materials shall meet the appropriate ANSI requirements.

- H. Valves shall be suitable for continuous throttling.
- I. Valve schedules shall be submitted for review and shall clearly show the following for each valve:
 - 1. Associated system.
 - 2. Manufacturer and model number.
 - 3. Valve size and line size.
 - a. Flowrate, flow coefficient (cV) - and pressure drop at design conditions
 - b. Or valve authority, flowrate and pressure drop across the valve at design conditions and pressure drop across the associated mechanical equipment, e.g., coil, heat exchanger, etc., at design conditions.
 - 4. Valve configuration (e.g. two way, three way, butterfly).
 - 5. Maximum pressure shut-off capability.
 - 6. Actuator manufacturer and model number.
 - 7. Valve body pressure and temperature rating.
 - 8. Normally open/closed and failure positions.
- J. Where necessary to achieve the required performance and pressure drop a control valve may be sized up to a maximum of two nominal sizes below line size.
- K. Valve bodies shall be cast iron, carbon steel, stainless steel or bronze subject to requirements for valve body pressure and temperature rating and suitability of material for application. Valve trim for steam service shall be stainless steel.
- L. The BMS subcontractor shall certify that the materials of construction are appropriate for the application. In particular, valves used for the control of glycol solutions shall have a trim that is suitable for a glycol solution.
- M. Two-Way Control Valves
 - 1. The BMS Subcontractor shall provide two-way ball valves as indicated on the mechanical trade documents.
 - 2. Pressure drop shall not exceed 35 kPa and shall conform to the following requirements:
 - a. Valves shall be selected such that the valve authority (N) shall not be less than 0.5 as defined by the relationship:
$$N=P1/(P1+P2)$$
 - b. where P1= pressure drop across the fully open valve, and
P2= pressure drop across the remainder of the circuit (e.g. a coil, isolation valves, strainers, etc.)
 - 3. Valve shall be capable of tight shut-off when operating at system pressure with the system pump operating at shut-off head. Leakage rate shall not exceed 0.01% of the rated valve capacity.
 - 4. Two-port valves when used to control heating or cooling coil water flow shall have an equal percentage or modified parabolic characteristic. Two-port valves when used in liquid applications systems not detailed above shall have a linear / linear characteristic.
- N. Three-way Control Valves
 - 1. The BMS Subcontractor shall provide three-way control valves as indicated on the

- mechanical trade documents.
2. Pressure drop shall not exceed 35 kPa and shall conform to the following requirements:
 - a. Valves shall be selected such that the valve authority (N) shall not be less than 0.5 for diverting valves and 0.3 for mixing valves as defined by the relationship: $N = P1 / (P1 + P2)$
 - b. where P1= pressure drop across the fully open valve
 - c. P2= pressure drop across the remainder of the circuit (e.g. a coil)
 3. Mixing valves shall be capable of tight shut-off between each inlet port and the outlet port and diverting valves shall be capable of tight shut-off between each outlet port and the inlet port when operating at system pressure.

O. Valves for Instrumentation

1. Instrumentation, such as pressure sensors and flow rate monitors, which is provided for the monitoring of parameters associated with liquid in pipes or tanks, shall be removable and replaceable without the requirement to shut down a pump and without the requirement to drain the pipe or tank and without causing liquid to leak from the pipe or tank. To facilitate this, the BMS subcontractor shall furnish valves for installation by the mechanical trade.
2. Instrumentation that is mounted external to the pipe or tank and which is connected to the pipe or tank by one or more sampling lines shall have a manual two-way on/off valve in each sampling line meeting the following requirements:
 - a. Ball type valve
 - b. Valve body shall be 316 stainless steel
 - c. Ball and stem shall be 316 stainless steel
 - d. Zero leakage.
 - e. Rated for 7000 kPa or for a pressure 50% greater than the system working pressure; whichever is the greater.
 - f. Rated for a minimum of 50 ° C (90 ° F.) greater than the highest fluid temperature.
 - g. Stainless steel trim.
 - h. Valve seats shall be metal, reinforced TFE or equivalent and must assure tight seating.
 - i. Valve shall be Whitey 40 Series or 80 Series or approved equal it meets the requirements detailed above.
3. Valves for insertion flow meters shall be full port *ball* valves sized for the flow meter in accordance with the flow meter manufacturer's instructions. If the flow meter manufacturer offers the valve as an accessory then it shall be purchased by the BMS subcontractor from the insertion flow meter manufacturer and shall be installed by the mechanical trade in accordance with the insertion flow meter manufacturer's instructions. The valve shall meet the pressure and temperature requirements detailed for the control valves and shall have zero leakage at the system maximum pressure.

P. Valve Actuators - Electric

1. The BMS subcontractor shall provide electric actuators for valves that are furnished by the BMS subcontractor.
2. Actuator shall be motor driven type. Valve stem position shall be adjustable in increments of one (1) percent or less of full stem travel.
3. Actuator shall have an integral self-locking gear train, mechanical travel stops and adjustable travel limit switches with electrically isolated contacts.
4. Actuator gear assembly shall be made of hard-anodized aluminum or steel or material of equivalent durability. Disassembly of the gears shall not be required to remove the motor.

5. Actuator shall be rated for continuous duty and have an input voltage of 120 vac/60 Hz, or 24 VAC.
6. Actuators on valves located in mechanical rooms or outdoors shall have covers of aluminum or a material of equivalent strength and shall have captive bolts to eliminate loss of bolts when removing the cover from the base. Housings for valves located in a plenum and used for terminal unit or fan coil unit heating/cooling coils, may be constructed of reinforced plastic. Materials of construction for all actuator components shall be non-corroding.
7. Actuator motor shall be fully accessible for ease of maintenance.
8. Actuator shall be sized to meet the shut-off requirements when operating at the maximum system differential pressure and with the installed system pump operating at shut-off head.
9. Actuator shall control against system maximum working pressures.
10. Actuator shall fail as indicated on the control drawings that form part of these contract documents. Provide spring return to de-energized position on loss of power or loss of control signal if so required by the sequences of operation.
11. Actuator shall accept control signals compatible with the BMS analogue or digital output subsystem as appropriate. The valve stem position shall be linearly related to the control signal.
12. Actuator shall have visual mechanical position indication, showing output shaft and valve position.
13. Actuator shall operate the valve from the fully closed to the fully open position and vice versa in less than two minutes.
14. Actuator shall be constructed to withstand high shock and vibration without operations failure. Materials of construction shall be non-corroding.
15. Actuator shall be equipped with an integral position potentiometer to indicate the stem position of the valve where required by the control sequences. All valve actuators shall have integral end position indicators.
16. Actuator and valve shall be mounted and installed only in the location/orientation approved by the manufacturer. Installation drawings shall clearly indicate the valve location.
17. Actuator shall have a manual declutch lever to enable manual operation of the valve. It shall be possible for an operator to manually modulate valves located in mechanical rooms in the event of loss of power. The operator shall be able to manually modulate the valves without having to climb a ladder or other non- permanent structure. It shall be ensured that the valve installation is such that the valve cannot declutch under the influence of gravity and/or vibration.

Q. Steam Control Valves

1. The BMS Subcontractor shall provide two way control valves at all steam service locations as indicated on the Field Termination Schedules. Steam control valves shall meet, at minimum, the following requirements:
 - a. Capable of tight shut-off against full system pressure.
 - b. Low pressure applications with an inlet steam pressure less than 15 psig shall be sized with a differential pressure equal to 80 percent of the inlet gauge pressure (psig).
 - c. High pressure applications with an inlet steam pressure greater than 15 psig shall be sized using a pressure drop equal to 42 percent of the absolute pressure (psia).
 - d. Rated for the operating pressure of the system as appropriate for the location.
 - e. Straight pattern single seat globe or double seated plug type suitable for steam service.
 - f. Suitable for continuous throttling.
 - g. Valve body material shall be steel, brass, stainless steel or cast iron, with

- stainless steel trim.
- h. Valve packing PTFE, graphite, or equivalent and must assure tight seating.
- i. Valve seats shall be metal, ceramic filled PTFE or equivalent and must assure tight seating.

R. Valve Actuators - Pneumatic

1. Pneumatic valve are no longer approved on campus without special approval from UBC-BMS.

S. DAMPERS - GENERAL

1. The BMS Subcontractor shall furnish automatic dampers (CD) as indicated in the Mechanical trade documents and in the Field Termination Schedules for installation by the Division 23 Mechanical subcontractor.
2. The BMS Subcontractor shall provide actuators for all automatic dampers furnished as part of the BMS contract and for all dampers provided by the air handling unit manufacturers, unless otherwise specified. The BMS Subcontractor shall provide all required actuator mountings, installation, drive arms, linkages and damper end switches. The BMS Subcontractor shall provide electric damper actuators as specified within the BMS specifications, in the Mechanical trade documents and as detailed in the field termination schedules.
3. Multiple section two position dampers shall be controlled by one BMS output unless indicated otherwise within the Field Termination Schedules or Sequences of Operation.
4. Multiple section modulating dampers shall be controlled in sequence unless indicated otherwise within the Field Termination Schedules or Sequences of Operation.
5. Individual sections shall not be larger than 1.67 sq. m (18 square feet). Each section shall have a separate actuator. Wherever possible the use of Jackshaft extensions shall be avoided for controlling multiple damper sections. Jackshaft connection of damper sections may be permissible where required to mount damper actuators outside of the duct for applications with hazardous exhaust air flow, etc.
6. Actuators shall be mounted to allow complete access for maintenance and removal. Wherever possible provide damper actuators mounted on the exterior of the duct/damper section. The installation of actuators within air streams will be permitted only where damper configurations and site conditions require. Obtain approval for proposed installations of actuators within ductwork, plenums, airstreams, etc. Furnish access doors where required to allow access to the actuators.
7. Dampers and actuators shall be configured for normal and failure positions as indicated in the operating sequences and as indicated in the Division 23 Mechanical Drawings and Specifications.
8. The BMS Subcontractor shall provide actuators sized in accordance with manufacturers recommendations and industry standards for accurate and stable control of airflow in each application.
9. The BMS Subcontractor shall provide damper and actuator installations to comply with the acoustical requirements for the project. Noise generated from dampers and actuators in air streams shall not be detectable in occupied building spaces.
10. The BMS Subcontractor shall furnish manufacturers' installation details to the Division 23 Mechanical subcontractor. Provide details of all multiple section damper installations. Provide schematic diagrams for all multiple section damper installations indicating damper section dimensions, mounting configurations, linkages, actuator mounting locations, structural bracing/reinforcement, etc.
11. The BMS Subcontractor shall submit damper schedules that include, at minimum, the following for each damper:

- a. Associated mechanical system.
- b. Damper manufacturer and model number.
- c. Actuator manufacturer and model number.
- d. Mechanical drawing reference.
- e. Damper size for each section.
- f. Parallel or opposed blade configuration.
- g. Ratio of anticipated air stream velocity to the manufacturer's maximum recommended velocity rating.

T. CONTROL DAMPERS (CD)

1. The BMS Subcontractor shall furnish CD as detailed in the mechanical drawings. Damper blade type shall be as per required function (for mixing, parallel blade, for isolation opposed blade, depending on function). Provide dampers tested and certified for leakage performance in accordance with AMCA Standard 500.
2. The BMS Subcontractor shall provide integral damper position indicator switches as required by the operating sequences and where required for interlocking to motors. Damper position switches shall be provided to indicate actual damper blade position.
3. Damper position indication based on damper linkage position or damper drive shaft position is acceptable.
4. Insulated dampers shall be provided in situations where the damper is exposed to outdoor air.
5. Dampers shall be Ruskin, Tamco, Siemens Building Technologies, Johnson Controls, Inc. or approved equal.

U. DAMPER ACTUATORS FOR CONTROL DAMPERS (CD)

1. Unless otherwise specified the BMS Subcontractor shall provide electric damper actuators for all control dampers. Electric actuators shall meet, at minimum, the following requirements:
 - a. Stroke by the rotating motion of a reversible, overload-protected synchronous motor. Actuators shall be directly coupled to damper drive blades with no intermediate linkages or shall be rotary type actuators directly coupled to the damper drive shaft.
 - b. Protected against overload by an integral magnetic clutch or stall protection by non-overloading impedance protected motor.
 - c. 120 Vac + or - 10% 60 Hz or 24 Vac power supply.
 - d. One actuator for each damper section. Provide additional actuators to ensure sufficient torque to meet the specified close off leakage requirements. Damper actuators shall not be stacked. Multiple actuators "stacked" on a single damper drive shaft will not be accepted.
 - e. Actuators shall be motorized/driven in both the open and closed directions. Where required by the sequences of operation, actuators shall have a spring return to the de-energized position upon loss of power. Damper normal and failure positions shall be as identified within the sequences of operation.
 - f. BMS controlled actuators for modulating automatic dampers shall be controlled by a 0-10 Vdc, or 4-20mA signal. Provide actuators that are fully compatible with the BMS analog output subsystem. BMS controlled actuators for two position dampers shall be controlled by 24Vac, 24Vdc or single-phase 120 Vac power switched by the BMS.
 - g. Complete with mounting brackets suitable for extended shaft mounting or direct damper drive shaft mounting.
 - h. Stroke dampers from fully closed to fully open in accordance with the following:

Service	Timing Requirement
Two position normal service	75 seconds
Modulating normal service	120 seconds
Emergency service (stair pressurization, smoke containment, etc.)	15 seconds

- i. Rated for operation at ambient temperatures of minus 40°C. to 50°C.
 - j. Complete with damper/actuator stroke position indicator.
 - k. Manual drive release mechanism and manual positioning mechanism.
2. Actuators shall be quiet in operation such that noise from actuator operation is not detectable in any occupied spaces.
 3. Actuators shall be Belimo, Siemens Building Technologies, Johnson Controls Inc. or approved equal.

V. DAMPER HARDWIRED INTERLOCKS

1. The BMS Subcontractor shall provide all required hardwired interlocks between fans, intake and discharge dampers, emergency generators, *VFD*, etc. and any motor actuated damper as identified within the BMS specifications or the mechanical drawings, whether or not furnished under this section unless the fan is furnished with interlock by fan manufacturer.
2. The BMS Subcontractor shall provide all wiring as required for the control and interlocking of automatic dampers. The BMS Subcontractor shall provide control signal and power supply wiring between any damper monitored and/or controlled by the BMS regardless of whether the BMS Subcontractor has furnished the damper/actuator assembly. The BMS Subcontractor shall also provide power supply and control signal wiring between damper actuators and interlocked motor control circuits, thermostats, duct pressure limit switches, safeties, etc.
3. Power for air handling unit automatic control dampers shall be obtained from the associated air handling unit supply fan motor control circuit. The BMS Subcontractor shall coordinate actuator power supply wiring and fire alarm system override control of dampers with the Electrical Trade.
4. Where dampers are specified to be hard wire interlocked with electric fan motors the BMS subcontractor shall provide the damper position switches and all required wiring and interconnection. Provide the damper end switch(s) hard wire interlocked to achieve the operational requirements as specified in the Field Termination Schedules and the sequences of operation in the BMS specifications, and as indicated in the Division 23 Drawings and Specifications. Provide damper end switches hard wire interlocked to prevent fan motor operation in both the hand and auto position of hand/off/auto motor control circuit.

4.8. BMS Field Devices and Instrumentation

- A. This section details the minimum requirements for BMS field devices and instrumentation to be provided for UBC BMS projects. Specifications for UBC BMS projects shall detail BMS

field device hardware and installation requirements.

- B. The BMS specifications shall instruct the BMS Contractor to provide the field devices and all wiring, installations, interconnections, power supplies, signal conditioning equipment, field point interface equipment, etc. as required for accurate and fully functional BMS monitoring and control of the device.
- C. BMS field device requirements shall be identified in the BMS project specifications. The BMS Consultant shall identify BMS monitoring and control requirements in the specifications via BMS Field Termination Schedules and BMS Systems Schematics. Individual BMS points identified in the Field Termination Schedules shall cross reference corresponding devices indicated on the associated BMS System Schematic. The BMS System Schematic and Field Termination Schedules shall be clearly titled and numbered. All required control requirements, interfaces and hard wire interlock requirements shall be identified in the Field Termination Schedules and in the BMS System Schematics.
- D. All BMS components, including equipment, instrumentation, field devices, etc., shall be cUL, UL, listed, or CSA certified where applicable and shall bear the appropriate labelling. No BMS component shall be provided which contains asbestos, PBC's, or other hazardous materials.
- E. BMS Field Devices and Instrumentation shall be provided in compliance with the following minimum requirements.
 - 1. Temperature Sensors
 - a. The end-to-end accuracy for all BMS monitored temperature sensors shall be ± 0.5 deg C (minimum)
 - b. Device accuracy range shall be acceptable for the installed location.
 - 2. Provide outside air temperature sensors in compliance with the following additional requirements:
 - a. Ventilated white PVC sun shield.
 - b. Wall mount weather proof enclosure with conduit fitting.
 - c. In compliance with requirements listed above.
 - d. Operating temperature range of -40 °C. to +50 °C.
 - 3. Provide duct temperature sensors in compliance with the following additional requirements:
 - a. In compliance with requirements listed above.
 - b. Single point type sensor probe. Sensor probe length shall be no less than 1/3 of duct width or diameter.
 - c. Complete with duct mounting facilities and conduit fittings.
 - d. Operating temperature range of -40 °C. to 80 °C.
 - 4. Provide duct averaging type temperature sensors in compliance with the following additional requirements:
 - a. In compliance with requirements listed above. Duct averaging probe materials may be stainless steel, copper or aluminum.
 - b. Probe length as required to provide 3.25m per square meter of duct cross-sectional area.
 - c. Duct mounted moisture/waterproof housing with conduit fitting.
 - d. Suitable supports at all bends and at intermediate points to prevent movement in the air stream.
 - e. Operating temperature range of -40 °C. to +50 °C.

5. Provide space temperature sensors in compliance with the following additional requirements:
 - a. In compliance with the accuracy requirements listed above.
 - b. Suitably finished wall mounted enclosure with discrete manufacturer logos and markings only. Space temperature sensor shall also have an occupancy button which will allow the room to be placed in occupied mode for an adjustable time period.
 - c. Mounted at locations approved by UBC and the BMS Design Consultant. For new construction projects the space temperature sensor locations shall be identified in the mechanical plans.
 - d. Provide protected sensors for all sensors mounted in mechanical and electrical rooms, janitor closets, and common spaces (non-secure public spaces) etc. Sensor shall not have a display and shall be resistant to tampering and physical damage. No display or occupancy override is required for these sensors.
 - e. Operating temperature range of 0 °C. to 50 °C.
 - f. Button or plate type sensors where required to suit the architectural finish is public areas.
 - g. Sensors associated with UC's for control of Terminal Units shall comply with the following:
 - I. Provide limited space temperature set point adjustment facilities on room sensors when the sensor serves a single office or personal space.
 - II. No set point adjustment facilities on sensors mounted in areas accessible to the public, in common office or shared areas, and for sensors that serve more than one occupied office or space.
 - III. Display is not required or preferred for zone sensors.
6. Provide thermowell temperature sensors in compliance with the following additional requirements:
 - a. In compliance with the accuracy requirements listed above.
 - b. Stainless steel thermowells for all applications
 - c. Probe length shall be at minimum 20% of the pipe width.
 - d. Provide housing with conduit fitting, waterproof enclosures for sensors in locations exposed to water.
 - e. Provide complete with thermal transfer compound inside thermal well.
 - f. Sensors required for the determination of temperature differential shall be matched with a maximum variation over the entire temperature range of 0.2°C.
 - g. Operating temperature range to suit application.
7. Low Temperature Detection Device (AHU Air Service)
 - a. Vapor tension single point alarm element, which shall serpentine the inlet face on all coils. Provide additional sensors, wired in series, to provide 3.25 m per square meter of coil surface area.
 - b. Hardwire interlock device to shut down fans and position mixing dampers to the full recirculation position. Refer to sequences of operation. Provide device hardwire interlocked such that the fan will shut down when HOA or VFD switch is in Hand or Auto position.
 - c. Manual reset.
 - d. Set point shall be adjustable in the range of, at minimum, 0 ° C. to 7 ° C. Provide a scale with temperature setting clearly displayed.
 - e. SPDT switch contacts. Switch contacts shall be rated for duty.
 - f. Provide suitable supports.
 - g. Provide complete with auxiliary contacts for monitoring by the BMS.
8. Relative Humidity Sensors (normal installation)

- a. Overall accuracy of +/- 3 % reading from 0 to 95 % RH unless the individual application requires higher accuracy.
 - b. Operating temperature range of - 20 °C to 80 °C.
 - c. Long term stability with less than 1 % drift per year.
 - d. Sensitivity of 0.5 % RH.
 - e. Complete with built in output proportional to RH to the BMS. Sensor to be fully compatible with BMS.
 - f. Suitably finished wall mounted enclosure with discrete manufacturer logos markings only. Enclosure shall not have temperature or RH indication devices.
9. Relative Humidity Sensors (high accuracy installation)
 - a. For locations that require high humidity accuracy (rare artifact storage, lab spaces etc. or spaces that require regular sensor calibration)
 - b. Part shall be HMT-120 or HMT-130 depending on required BMS signal requirements.
 - c. Displays are required for all high accuracy humidity sensors.
10. Provide outdoor air relative humidity sensors in compliance with the following additional requirements:
 - a. Non-corroding outdoor shield to minimize wind effects and solar heating.
 - b. Wall mount weather proof enclosure with conduit fitting.
11. Combination Relative Humidity and Temperature Sensors
 - a. Where there is a requirement for the monitoring of both relative humidity and temperature at the same location, the BMS contractor may provide a combination relative humidity sensor and temperature sensor. The individual sensors must each meet the specifications detailed above.
12. Combination Dew point and Dry Bulb Temperature Transmitter
 - a. Complete with mounting accessories and enclosures for interior or exterior wall or duct mounting.
 - b. Stainless steel probe with NEMA 4 transmitter housing. Outside air sensor shall have a solar shield.
 - c. Two wire, 4-20 mA output proportional to minimum dew point temperature range of -40 °C. to +63 °C.
 - d. Two wire, 4-20 mA output proportional to minimum dry bulb temperature range of -23 °C. to +79 °C.
 - e. Probe shall be a minimum of 200mm for duct application.
 - f. BMS shall report the monitored dry bulb temperature with an accuracy of ± 0.5 °C.
13. BMS shall report the monitored dew point temperature with an accuracy of ± 1 °C. at 50% RH and dry bulb temperature of -25 °C. to +65 °C.
14. Momentary Type Control Relays
 - a. Coil ratings as suitable for the application.
 - b. Provide complete isolation between the control circuit and the BMS digital output.
 - c. Contact rating shall match installation requirements.
 - d. LED status indication.
15. Duct Static Pressure Transmitter
 - a. Input pressure range to suit each individual application.
 - b. 4-20 mA or 0-10 vdc output signal proportional to pressure input range.

- c. $\pm 1\%$ accuracy.
 - d. Operating temperature range of -7°C . to 49°C .
 - e. Easily accessible, integral non-interacting zero and span adjustment.
 - f. Minimum over pressure input protection of five times rated input.
16. Space Static Pressure Transmitter
- a. Input range to suit application.
 - b. 4-20 mA or 0-10 vdc output proportional to pressure input range.
 - c. $\pm 1\%$ accuracy of range.
 - d. Easily accessible, integral non-interacting zero and span adjustment.
 - e. Over pressure input protection of five times rated input.
 - f. Exterior static pressure references shall be monitored via a static pressure sensor dampening pot. Coordinate exact mounting locations of exterior static pressure reference points.
17. Air Flowrate Sensor - Duct Mounted
- a. Multipoint flow cross or grid measuring device.
 - b. Complete with transducer. Input pressure range of pressure transducer shall be appropriate for application. Coordinate with Division 23 contractor.
 - c. Bulkhead fittings to allow sensor tubing to be connected or removed without removing ductwork.
 - d. Internal materials of the transducer suitable for continuous contact with air.
 - e. Sensing grid shall be constructed of stainless steel.
 - f. Integral signal integrator to minimize primary signal noise from the output signal.
 - g. Output signal of 4-20 mA proportional to input pressure.
 - h. Temperature range of -18°C . to 60°C .
 - i. $\pm 5\%$ accuracy of measured value.
 - j. Transducer to be provided complete with easily accessible, integral non-interacting zero and span adjustment.
18. Air Flowrate Sensor - Fan Inlet
- a. Multipoint flow cross or grid measuring device mounted at the inlet of the fan.
 - b. Complete with transducer. Input range appropriate to application. Coordinate with Division 23 subcontractor.
 - c. Bulkhead fittings to allow sensor tubing to be connected or removed without removing the device from the fan.
 - d. Internal materials of the transducer suitable for continuous contact with air.
 - e. Sensing grid shall be constructed of stainless steel.
 - f. Integral signal integrator to minimize primary signal noise from the output signal.
 - g. Output signal of 4-20 mA proportional to input pressure.
 - h. Temperature range of -18°C . to 60°C .
 - i. Combined sensor and transducer accuracy of $\pm 5\%$ of measured value.
 - j. Transducer to be provided complete with easily accessible, integral non-interacting zero and span adjustment.
19. Current Sensing Transducer and Relay Combination - Electric Motor Status Monitoring Service
- a. Rated for the applicable load.
 - b. Long term drift shall not exceed 5% of full range per 6 months.
 - c. 4-20 mA or 0-5 vdc or 0-10 vdc signals are acceptable.
 - d. Current transformer and relay shall have over current and over voltage protection. Transformer and relay may be combined into a single unit or can be separate units.
 - e. Transformer core shall be sized for the application.

- f. Accuracy- $\pm 2\%$ of reading from 10% to 100% of full scale range, $\pm 2\%$ full scale from 0 to 10% of full scale range.
 - g. Temperature range of -15°C . to 60°C .
- 20. Water Differential Pressure Sensor
 - a. Cast aluminum NEMA 1 enclosure.
 - b. Complete with transducer with output of 4-20 mA proportional to the pressure sensed.
 - c. Over pressure protection of five times the rated input.
 - d. Easily accessible, integral non-interacting zero and span adjustment.
 - e. Operating range to suit application.
 - f. Accuracy of $\pm 2\%$ of full scale reading.
 - g. Valved tapings shall be installed by the Division 23 subcontractor. Furnish the valves to the Division 23 subcontractor. Provide differential pressure transducer installation complete with a 3-valve manifold mounted within a suitable enclosure. Installation shall allow the transducer to be isolated for service.
- 21. Differential Pressure Switch - Air Service - Duct Static Pressure Limit Devices
 - a. SPDT or two SPST switches rated for 10 amps minimum at 120 Vac.
 - b. Adjustable set point with a set point range to suit the application.
 - c. 1/4 inch compression fittings suitable for copper sensing tubing.
 - d. Temperature range of -18°C . to 71°C .
 - e. Manual reset or automatic reset as required by application.
 - f. Provide sensing inputs complete with signal dampening facilities to prevent nuisance tripping where required.
- 22. Differential Pressure Switch - Air Service - Filter Status Indication
 - a. UL, cUL, CSA listed and approved.
 - b. SPDT or two SPST switches rated for 10 amps minimum at 120 Vac.
 - c. Adjustable set point with a set point range to suit the application.
 - d. 1/4 inch compression fittings suitable for copper sensing tubing.
 - e. Operating range to suit application.
 - f. Automatic reset
- 23. Differential Pressure Switch - Water Service
 - a. UL, cUL, CSA listed and approved.
 - b. SPDT or two SPST switches rated for 10 amps minimum at 120 Vac.
 - c. Adjustable set point with a set point range to suit the application.
 - d. 1/4 inch compression fittings suitable for copper sensing tubing.
 - e. Operating temperature and pressure range to suit application.
 - f. Durable Nema 4 rated enclosure.
 - g. Provide sensing inputs complete with signal dampening facilities to prevent nuisance tripping where required.
 - h. Suitable for continuous contact with the sensed fluid and rated for operating temperature.
 - i. Repeatability of $\pm 1\%$ of span.
 - j. Over pressure input protection to a minimum of five (5) times rated input.
- 24. Water Pressure Sensor
 - a. Input range as required per installation.
 - b. Complete with transducer with 4-20 mA or 0-10 vdc output signal proportional to water pressure.
 - c. 0.25% accuracy over entire sensing range.
 - d. Temperature range of -10°C . to 50°C .
 - e. Transducer with easily accessible, integral non-interacting zero and span

- adjustment.
 - f. Over pressure input protection of two times rated input.
 - g. NEMA-4 rated fittings.
 - h. Stainless steel wetted parts.
 - i. Burst pressure of 5 times rated input
 - j. Long-term stability of .25 percent of full scale.
 - k. Stainless Steel wetted parts suitable for continuous contact with the sensed medium.
 - l. Three valve manifold to be provided.
25. Liquid Level Float Switch
- a. Polypropylene float, PVC cable, hermetically sealed mercury switch.
 - b. 13 amp running current @ 120 VAC, 11 amp current @ 240 VAC.
 - c. SPDT switch contacts. Switch contacts shall be selected to suit required sensing/control action.
 - d. Operating temperature of 0 ° C. to 71 ° C.
 - e. Operating pressure of 26 psi.
26. Liquid level sensor
- a. Sensors shall be submersible pressure level transmitters sized as required for installation location.
 - b. Transducer shall be 4-20 mA or 0-10 vdc.
 - c. Accuracy shall be +/- 0.25% of full range.
27. Air Quality Sensor
- a. Measurement of volatile organic compounds (VOC) containing, at minimum, the following gases:
 - I. Methane
 - II. Ethylene
 - III. Hydrogen
 - IV. Carbon Monoxide
 - V. Carbon Dioxide
 - VI. Ammonia
 - b. Ventilated cover, Circuit board covered by a polycarbonate housing.
 - c. 135 mA max current, 4 K OHMS min. load resistance, 24 VAC + 10%-50% or 24DC. (Min. 12V, Max 24V) power supply.
 - d. Rate or rise circuit to filter out short term disturbances and provide a stable output.
 - e. Temperature range of 0 ° C. to 60 ° C.
 - f. Mounting and enclosure suitable for duct air or space air monitoring as specified.
28. Carbon Dioxide Sensor
- a. Negligible temperature and humidity effect on accuracy.
 - b. Complete with transducer with selectable 4-20 mA or 0-10VDC output signal proportional to carbon dioxide concentration.
 - c. 0 - 2000 ppm CO₂ sensing range.
 - d. Manufacturer 5 year or longer calibration interval guarantee.
 - e. Accuracy- ± 3% of reading or ± 50 ppm, whichever is the more stringent requirement over 15 °C. to 32 °C temperature range. Accuracy of +/- 5 % or 100ppm of reading whichever is the more stringent requirement over 0 °C to 50 °C temperature range.
 - f. Annual Drift not to exceed +/- 10 ppm.
 - g. Operating temperature of 0°C to 50°C.

- h. Complete with auxiliary relay contacts for alarm indication.
 - i. For space monitoring applications provide with a white enclosure with no manufacturer Logo or LED indication. Provide complete with blank display cover.
 - j. For duct sensing applications provide sensor complete with aspiration box and air stream sensor.
 - k. Nondispersive Infrared technology based sensor.
- 29. Damper Position Switch
 - a. Mechanically actuated electrical switch.
 - b. Provide damper end switch which indicates actual damper blade position. Damper position switches which are actuated by damper crankshaft or actuator position will not be accepted.
 - c. Contacts shall be rated for the electrical load to be switched. Provide auxiliary contacts as required.
- 30. Electronic to Pneumatic Transducers
 - a. Are no longer approved on site without exception provided by UBC-BMS
- F. Install sensors in accordance with the manufacturers' recommendations to sense the variables specified.
- G. Mount sensors securely. Mountings shall be suitable for the environment within which the sensor operates.
- H. Install sensors as required to properly sense the controlled medium. Sensor locations shall be such that access to the instruments can be obtained for service and removal.
- I. Sensors mounted on water lines shall have isolation valves that shall enable the sensor to be easily removed without the need to drain any lines or portions of lines.

5 BMS SOFTWARE, DATABASE AND PROGRAMMING REQUIREMENTS

5.1. General

- A. The BMS NDS shall be provided complete with fully functional, advanced, BMS application software and database facilities in compliance with the UBC requirements. The building BMS Contractor shall provide all required programming, database development, and data communication configuration work required to incorporate new campus building BMS installations.

5.2. System Requirements

- A. The NDS computer shall provide the capabilities for automatically archiving controller programming and database, receiving and archiving all operator transactions, trending and archiving of defined BMS data, etc.
- B. The NDS and associated application specific BMS Software shall be provided with programming and configuration facilities to allow BMS operators to undertake BMS administration functions including the following:
 - 1. Add/delete/modify data points and input/output points.
 - 2. Configure controller data communications.
 - 3. Add or modify automatic sequence of operations programs, database, etc.
 - 4. Change control system data parameters.
 - 5. Modify set points, etc.
 - 6. Restore/download programming and database parameters to BMS controllers.
- C. BMS installations shall be provided in a completed state fully ready for integration to the CBMS including all data point definition, addressing, naming, network configuration/connection, documentation, commissioning and training.
- D. The BMS Contractor shall work with the UBC-BMS group to bring the building network online to the UBC-UTILNET and the associated application server.
- E. BMS installations shall be in compliance with the following requirements and shall provide the following functionality:
 - 1. All BMS and CBMS controllers and operator interface workstations shall be devices that are conformal with the BACnet standardized device types described in Annex L of the ASHRAE Standard 135. BMS devices shall, at minimum, support the BIBB's (defined in Annex K of ASHRAE Standard 135) and the associated functionality that are defined as a functional requirement for the device in Annex L of the ASHRAE Standard 135.
 - 2. All BMS controllers, regardless of their device type, shall communicate on the BMS and CBMS networks and shall be "visible" to the CBMS and BMS networks.
 - 3. BMS data shall comply with the BACnet data object property requirements and, at minimum, shall support the properties defined in ASHRAE Standard 135 as "required".
 - 4. All physical BMS monitored input points (binary and analog type) shall be readable and available for monitoring at the CBMS and by other BMS controllers.
 - 5. All physical BMS controlled output points (binary and analog type) shall be readable and available for monitoring at the CBMS and by other BMS controllers and shall be writeable and shall be capable of being controlled/positioned by the CBMS and by other BMS controllers.

6. All software data points and control system parameters critical to the supervisory monitoring and control of the building systems shall be available for monitoring at the CBMS and by other BMS controllers and/or shall be writeable and shall be capable of being controlled/positioned by the CBMS and by other BMS controllers. Provide the following typical software data points and control parameters with the defined functionality, at minimum.
- F. The BMS Specifications shall identify additional points and functionality where required.
1. System enable virtual points.
 2. Virtual or “logical” software points.
 3. Equipment and System operation Calendar/Time Schedule points and parameters.
 4. Post Fire Alarm System Enable/Disable points.
 5. Post Power Failure System Enable/Disable points.
 6. Control loop set points and PID loop values.
 7. Alarm set points and alarm limit parameters.
 8. Define and modify alarm states and alarm limit threshold values for any monitored analog and digital input points and for analog output values.
- G. BMS data shall be presented in both tabular “report” format and in dynamic graphical display format at the CBMS. Provide the CBMS with the capabilities for the operator to select between report and graphical data display mode.
- H. Modification of the controlled output points shall be via operator interface at the CBMS dynamic report and graphical interface facilities and shall not require BMS manufacturer proprietary software or special configuration software files.
- I. All BMS standard and proprietary data objects from any BMS connected device shall be available for monitoring on the BMS and CBMS. Values for all BACnet defined required property values, supported optional properties and proprietary properties shall be available to the BMS and CBMS for monitoring and display and control where applicable.
- J. The BMS Specifications for each building BMS project shall specify the requirement for the BMS Contractor/Manufacturer to provide all hardware and software required for the CBMS to communicate with the BMS via BACnet IP on the UBC campus WAN. Facilities to be provided shall include any manufacturer specific software tools required for programming, point mapping, configuration, etc. of building BMS data points.
- K. Trending: The BMS contractor shall setup and configure system trending as follows:
1. In general, all DDC system points shall be trended and each trend log point shall be minimum 200 samples. Trend logs shall be set up to meet the following requirements:
 - a. Storage:
 - I. All panels that store trends must be able to store 3 days of 300 second sample rates for all attached physical points.
 - II. All long term storage devices shall be able to store 5 years of trend data.
 - III. The devices shall also be attached to the UBC-SKYSPARKS server. This connection is provided by UBC-BMS, no contractor intervention is required.
 - b. Sample Frequency:
 - I. Sample frequencies shall be configured to gather meaningful data required to analyze system performance, confirm loop tuning, and aid system troubleshooting.

- II. AI, AO and AV default trend sample rate shall be 300 seconds.
 - III. BI, BO and BV items shall be trended on COV trends to capture changes.
 - IV. MV shall be trended on COV trends to capture changes.
- 2. Trended Points:
 - a. All physical input and out points.
 - b. All set point values (this is to include loop set points, high and low limit set points, and all room set points, which can be trended at a relaxed rate).
- L. Data Archiving: The BMS contractor shall install, configure and program the DAU. The DAU shall be configured as follows:
 - 1. Every physical point shall be archived,
 - 2. Every software variable that is used for day to day operations shall be archived,
 - 3. The archival time period shall be set for five (5) years.
 - a. The DAU device or system shall automatically prune all data that has aged beyond the five year time limit.
 - 4. All alarms shall be archived. Alarms shall be archived to include the following information:
 - a. All alarms shall include the following identification; DCC Network Descriptor acronym
 - b. Expanded DDC Network Descriptor,
 - c. Date
 - d. Time
 - e. Point Name
 - f. Expanded Point Descriptor
 - g. Alarm Type (e.g.: Operating, Maintenance, Critical, Emergency, etc.)
 - h. Alarm Status
 - i. Automatic Control Priority (Overridden Value, Automatic Control, Disabled, failed, etc.)
 - j. Actual point monitored input / controlled output value.
 - k. Alarm Set point
 - l. Alarm Message.

5.3. SOFTWARE

- A. An operator with BMS configuration software shall be able to define a minimum time delay between successive starts of equipment so that disturbances created on the building electrical system are minimized in frequency and amplitude.
- B. An operator with BMS configuration software shall be able to define the minimum time delay between the stopping of a piece of equipment and its subsequent restart. This time delay shall be in effect for motors in the BMS software control mode and for motors in the BMS manual control mode.
- C. The BMS shall not override any hardwired interlocks such as those provided at motor starters for overload protection, damper interlock, pressure interlock, etc. and those provided to facilitate control by the Fire Alarm System regardless of the BMS output control mode.
- D. Unless stated to the contrary, the modulation of final control elements by the BMS in the BMS software control mode shall be based on a Proportional-Integral (PI) or Proportional-Integral-Derivative (PID) control algorithm. The control constants for the PID algorithm shall be definable by the operator. If self-tuning algorithms are provided, it shall still be possible for the operator to manually tune the control loops. The software shall incorporate facilities to enable the bump less transfer of a modulating output from BMS manual control to BMS

software control and vice versa and the prevention of integral wind-up. PID algorithms shall maintain the system operation within the desired tolerance around the set point.

- E. Provide run time totalizing software facilities at both the CBMS and BMS NDS that will accumulate the operating times for motors and unitary equipment as selected by the operator using an interactive procedure. Any piece of equipment that has its status monitored by the BMS shall be selectable for inclusion in this feature. It shall be possible to concurrently monitor the accumulated operating time for every item of equipment monitored and/or controlled by the BMS. Historical trend data shall be stored in a non-proprietary database such as Microsoft SQL Server in the BMS NDS.
- F. Provide demand limiting and duty cycle programs that will duty cycle equipment usage in a manner that conserves energy. The cycling of equipment shall be initiated by one of the following means:
 - 1. Operator defined schedule.
 - 2. Peak electric demand control software program.
 - 3. Operator manual command.
- G. The proportion of ON time to OFF time in a single cycle shall either be assigned by the operator using an interactive procedure or the operator may elect to have a variable ON/OFF ratio based on other criteria.
- H. Provide a scheduling program that will enable the BMS to automatically schedule an item of equipment on and off (occupied) and on and off (unoccupied) based on time to allow, for example, the AHU to operate with the outside air dampers closed during non-occupied time periods, etc. The operator shall be able to assign a minimum of four start and four stop times to each piece of equipment for each day of the week and for holidays. These schedules shall only be in effect for a piece of equipment when it is in the BMS software control mode. Equipment and space time occupancy time schedules shall be available for display and operator adjustable via the CBMS. The scheduling feature shall conform to the CBMS scheduling interface.
- I. Provide equipment fail restart software that will restart equipment shut down as the result of a fire alarm system following the return to normal conditions or a power fail condition.
- J. Provide a night setback software program that shall match ASHRAE 36.1 standard, with the following set points (Zone)
 - 1. Occupied heating – 21 deg C
 - 2. Occupied cooling – 23 deg C
 - 3. Standby heating – 20 deg C
 - 4. Standby cooling - 24 deg C
 - 5. Unoccupied heating – 17 deg C
 - 6. Unoccupied cooling - 28 deg C
- K. Provide facilities for alarm notification via both the building BMS NDS and the CBMS via e-mail messaging, wireless text messaging and SNMP.

6 CBMS SOFTWARE, DATABASE AND PROGRAMMING REQUIREMENTS

6.1. *Integration of Standalone Building BMS into the Campus BMS*

- A. The CBMS Contractor shall provide the mapping, storage, and reporting of the building BMS monitoring and control objects into the CBMS and the preparation of data presentation for the CBMS Management Level Network. The BMS Contractor shall provide to the Owner and to the CBMS Contractor, all necessary documentation, BIBB information, device addressing, etc. as required for the integration of the BMS monitoring and control functions into the CBMS.
- B. The CBMS Contractor shall integrate all trend logging and trend log archiving set up in the building BMS into the CBMS.
- C. The CBMS Contractor shall set up, configure, and prepare the HDAS to import all integrate all trend logging and trend log archiving set up in the building BMS DAU(s) into the HDAS. This shall include creating the capability to setup, configure, and review historical data obtained from the BMS in a graphical trend log format.

6.2. *CBMS Dynamic System Requirements*

- A. CBMS installations shall be in compliance with the following requirements and shall provide the following functionality:
 - 1. All BMS and CBMS controllers and operator interface workstations shall be devices that are conformal with the BACnet standardized device types described in Annex L of the ASHRAE Standard 135. BMS devices shall, at minimum, support the BIBB's (defined in Annex K of ASHRAE Standard 135) and the associated functionality that are defined as a functional requirement for the device in Annex L of the ASHRAE Standard 135.
 - 2. All BMS controllers, regardless of their device type, shall communicate on the BMS and CBMS networks and shall be "visible" to the CBMS and BMS networks.
 - 3. BMS data shall comply with the BACnet data object property requirements and, at minimum, shall support the properties defined as "required" in ASHRAE Standard 135.
 - 4. All physical BMS monitored input points (binary and analog type) shall be readable and available for monitoring at the CBMS and by other BMS controllers.
 - 5. All physical BMS controlled output points (binary and analog type) shall be readable and available for monitoring at the CBMS and by other BMS controllers and shall be writeable and shall be capable of being controlled/positioned by the CBMS and by other BMS controllers.
 - 6. All software data points and control system parameters critical to the supervisory monitoring and control of the building systems shall be available for monitoring at the CBMS and by other BMS controllers and/or shall be writeable and shall be capable of being controlled/positioned by the CBMS and by other BMS controllers. Provide the following typical software data points and control parameters with the defined functionality, at minimum. The BMS Specifications shall identify additional points and functionality where required.
 - a. System enable virtual points.
 - b. Virtual or "logical" software points.
 - c. Equipment and System operation Calendar/Time Schedule points and parameters.
 - d. Post Fire Alarm System Enable/Disable points.
 - e. Post Power Failure System Enable/Disable points.
 - f. Control loop set points and PID loop values.

- g. Alarm set points and alarm limit parameters.
 - h. Define and modify alarm states and alarm limit threshold values for any monitored analog and digital input points and for analog output values.
- 7. BMS data shall be presented in both tabular “report” format and in dynamic graphical display format at the CBMS. Provide the CBMS with the capabilities for the operator to select between report and graphical data display mode.
- 8. Modification of the controlled output points shall be via operator interface at the CBMS dynamic report and graphical interface facilities and shall not require BMS manufacturer proprietary software or special configuration software files.
- 9. Performance times shall be as follows:
 - a. Data values updated in dynamic report or graphical display reports within maximum interval of 5 seconds.
 - b. Defined high priority or critical alarms annunciated within 3 seconds of its sensed occurrence.
 - c. CBMS Operator command outputs and data point modifications shall be executed within 5 seconds of the command initiation at the CBMS workstation or other remote BMS device.
 - d. Failed BMS/CBMS data communications or controller device on the Management Data Communications Level or the Automation Data Communications Level within ten (10) seconds.
- B. All BMS standard and proprietary data objects from any BMS connected device shall be available for monitoring on the BMS and CBMS. Values for all BACnet defined required property values, supported optional properties and proprietary properties shall be available to the BMS and CBMS for monitoring and display and control where applicable.

6.3. CBMS Dynamic System Graphical Interface Requirements

- A. The work of BMS installation projects in UBC Buildings shall include the integration of the building BMS facilities into the CBMS. The integration of the individual building BMS into the campus BMS shall include the provision of Dynamic BMS System Graphical Interface. All graphics will be a clear representation of all BMS monitoring and control facilities/systems within the building. The BMS Designer shall specify detailed requirements for the BMS Graphic Schematics in the BMS/CBMS Design Documents.
- B. The CBMS System Graphics shall be fully dynamic colour graphics. One graphic shall be provided for each BMS monitored/controlled system. Miscellaneous HVAC and electrical values monitored by the BMS shall be displayed in graphic displays of logical groups of equipment.
- C. Graphics shall be provided by the CBMS Contractor and fully integrated into the campus BMS. CBMS System Graphics shall be capable of being displayed at any OWS simultaneously.
- D. CBMS System Graphics shall be developed based on UBC standard graphic symbols and colours. All BMS system graphics shall be coordinated with UBC. The Contractor shall submit copies of proposed graphics in the shop drawings for review and approval by the BMS/CBMS Consultant and UBC. The Contractor will submit individual graphical screenshots of all systems in a fully commissioned state.
- E. CBMS System Graphics shall include the following requirements:
 - 1. Graphics shall be as per standards coordinated with the UBC-BMS group standards that are in place.

2. Graphics shall be vector based and scalable for different sized displays.
 3. Default display size for design shall be 1920 x 1080 (for the graphical workspace).
 4. Supplied graphics package should be continuously improved over time.
- F. Equipment/devices shall be colour coded as follows:
- | | |
|------------------|--|
| Red/Dark red | Hot Water piping (supply/return) |
| Blue/Dark blue | Chilled Water piping (supply/return) |
| Green/dark green | Condenser Water piping (supply/return) |
| Yellow/gold | DES hot water (supply/return) |
| Yellow/Green | Glycol (supply/return) |
- G. BMS analog input and analog output point information shall be displayed as follows:
1. Point Name
 2. Automatic Control Priority (Overridden Value, Automatic Control, Disabled, failed, etc.)
 3. Actual point monitored input / controlled output value.
- H. BMS digital input and digital output point information shall be displayed as follows:
1. Point Name.
 2. Automatic Control Priority (Overridden On/Off, Automatic Control, Disabled, failed, etc.)
 3. Point status.
- I. BMS System Graphics shall be provided as follows:
1. Floor Plans for all building project areas. One graphic per floor level. Floor plans shall indicate the associated AHU service domains. AHU Service domains shall be colour coded, as follows:
 - a. Mechanical room #FF6B8E23 (Olive)
 - b. AHU-01: #FF6495ED (Cornflower blue)
 - c. AHU-02: #FF8A2BE2 (Blue violet)
 - d. AHU-03: #FF7FFF00 (Chartreuse)
 - e. AHU-04: #FF00FFFF (Aqua)
 - f. AHU-05: #FF006400 (Dark green)
 - g. AHU-06: #FF8B0000 (Dark red)
 - h. AHU-07: #FF8B0000
 - i. AHU-08: #FFFFD700
 - j. AHU-09: #FFFF4500
 - k. AHU-10: #FFEE82EE
 - l. AHU-11: #FFADFF2F
 - m. AHU-12: #FFFF0000 (Red)
 - n. AHU-13: #FF00FF7F (Spring green)
 - o. AHU-14: #FFFC0CB (pink)
 - p. AHU-15: #FF0000CD (medium blue)
 - q. AHU-16: #FFF0E68C (khaki)
 - r. AHU-17: #FF708090 (slate grey)
 2. Space temperature, relative humidity, static pressure, air quality sensors, etc. mounted throughout the project spaces shall be displayed on the floor plan system graphic.
 3. Building areas equipped with BMS zone space temperature control facilities shall have a dynamic link to a separate individual graphic for each terminal unit controller.

4. Floor plans shall reflect normal/alarm status for BMS monitored/controlled points based on the following colour codes:
 - a. Green Device On and operating under “normal” automatic control priority
 - b. Red Critical Alarm Condition.
 - c. Blue Device Off and operating under “normal” automatic control priority
 - d. Orange General Alarm Condition.
 - e. Aqua Blue Point Trouble Condition.
 - f. Yellow Immediate Response Alarm Condition.
5. BMS System Graphic shall be provided for each Mechanical and Electrical Equipment Room indicating the BMS monitored/controlled equipment locations.
6. BMS System Graphics shall be provided for all BMS monitored/controlled equipment mounted on building rooftops and exterior building areas.
7. Outside Air Temperature and Relative Humidity shall be displayed on all HVAC System graphic schematics.

6.4. Alarm Management and Annunciation

- A. Alarms shall be generated by the BMS and shall be annunciated at the CBMS upon the occurrence of one of the following events:
 1. Failure of a CCP, DCP, UC, or any other BMS hardware components.
 2. Failure of communications or devices on the Automation Level Network.
 3. A monitored status indicates a discrepancy between the actual and the required value.
 4. A monitored value does not meet criteria established by the operator.
 5. The deviation of a variable from set point exceeds operator established criteria.
 6. The output to a final control element is outside operator established criteria.
 7. A digital input is in the state defined by the operator as indicating an alarm condition.
 8. Software failures and errors shall be diagnosed and annunciated by the BMS.
- B. Provide configuration of alarming for all monitored and controlled points. BMS Specifications shall detail all required alarm states, values and limits.
- C. BMS alarms shall be assigned priority levels as follows:
 1. Priority Level 1 - Critical (less than 70) – Yellow colour
 - a. Sump high level status event
 - b. Fire Alarm status event
 - c. AHU low temperature detection device event
 - d. Main Breaker power fail status event
 - e. Generator fault condition
 - f. Diesel Tank Storage Tank leak detection event.
 - g. Any alarms that would cause a piece of equipment to stop functioning.
 2. Priority Level 2 - Alarm (70 to 119) – Red colour
 - a. General alarms that may need action, but not immediate action.
 - b. Exhaust fan status mis-match
 - c. Zone temperature warning (for non-critical spaces).
 - d. Non critical controller offline.

3. Priority level 3 - Information (120 and above) – Return to normal alarms, or alarms that are for information only.
 - a. Controllers returning to normal function.
 - b. Zone temperatures off set point (but within comfort ranges)
 - c. Transfer buffers full
- D. Defined BMS alarm events shall be communicated by the BMS to the CBMS. Defined alarms shall be annunciated at the CBMS workstation. Alarms shall be retained in the CBMS alarm summary.
- E. All alarms shall have the ability to include the following identification;
 1. DCC Network Descriptor acronym
 2. Expanded DDC Network Descriptor,
 3. Date
 4. Time
 5. Point Name
 6. Expanded Point Descriptor
 7. Alarm Type (e.g.: Operating, Maintenance, Critical, Emergency, etc.)
 8. Alarm Status
 9. Automatic Control Priority (Overridden Value, Automatic Control, Disabled, failed, etc.)
 10. Actual point monitored input / controlled output value.
 11. Alarm Set point
 12. Alarm Message.
- F. The alarm log shall have the capability to be sorted or filtered on any or all of the following values:
 1. DCC Network Descriptor acronym
 2. Alarm Message.
 3. Time
 4. Date
 5. Point Name
 6. Alarm Type (e.g.: Operating, Maintenance, Critical, Emergency, etc.)
 7. Automatic Control Priority (Overridden Value, Automatic Control, Disabled, failed, etc.)
 8. Alarm Status

6.5. CBMS/BMS Alarm Handling Archiving Requirements

- A. The CBMS shall automatically update the HDAS with the alarm message log on a daily basis.
- B. The HDAS shall maintain a historical alarm log that encompasses all alarms for a period of five years.
- C. The historical alarm log shall be searchable and have the capability to be sorted or filtered on any or all of the following values:
 1. DCC Network Descriptor acronym
 2. Alarm Message.
 3. Time
 4. Date
 5. Point Name

6. Alarm Type (e.g.: Operating, Maintenance, Critical, Emergency, etc.)
 7. Automatic Control Priority (Overridden Value, Automatic Control, Disabled, failed, etc.)
 8. Alarm Status
- D. The database sorting and filtering keys shall be a minimum of three levels deep.

6.6. Testing and Commissioning Requirements

- A. Integrated BMS/CBMS joint systems tests shall be undertaken to demonstrate that the interaction between the individual building BMS and the CBMS meets the UBC requirements. The BMS Subcontractor shall participate in joint verification of the integrated systems and cooperate with the Owner in the demonstration of the integrated systems.
- B. The BMS Specifications shall specify the requirements for the BMS/CBMS integration joint systems verification in the BMS and CBMS Specifications and/or Contract Documents. The BMS/CBMS Integrated System Verification shall include the following minimum requirements:
 - 1. Test all BMS monitored and controlled field devices, BMS data points and all BMS input and output points. CBMS monitored data point values shall be verified against actual field device position/state and compared to BMS values to ensure both BMS and CBMS values are the same.
 - 2. CBMS override control of all BMS output points and control data points shall be verified.
 - 3. BMS network and controller device status and data communications status are accurately monitored at the CBMS. Alarms for failed controllers and failed data communications are annunciated.
 - 4. BMS data values displayed on dynamic system graphics or in tabular data format at the CBMS are functional and accurate.
 - 5. CBMS operator control of BMS control output points and control data points is functional via the dynamic graphic interface.
 - 6. CBMS facilities for operator adjustment of alarm definition parameters and thresholds, set point adjustment, control parameter adjustments, point trend initiation and modification to trends, etc. are fully functional.
 - 7. The CBMS performance requirements for the monitoring and control of BMS data and field devices meet the UBC requirements.
 - 8. BMS device addressing and identification definitions are compatible and identical and the addressing scheme meets with UBC requirements.
 - 9. Point naming used is compatible and conformal with the UBC requirements.
- C. Test results shall be documented using test sheets. The test sheets shall be prepared in an appropriate format for the various categories of component and system to be tested. It is the responsibility of the BMS Subcontractor to provide test verification sheets for each component and system that accurately reflect the sequences of operation and appropriate data for the components and systems.
- D. All test documentation shall be maintained in electronic format.

6.7. UBC BMS Point Naming Conventions Requirements

- A. All point naming conventions shall be reviewed and accepted by the UBC Energy, Planning & Innovation department prior to be implemented.
- B. Each point name shall generally consist of the following components:
 - 1. Building number: see records for building number (four digits: 0970 = MSL). or as required by the system being installed
 - 2. System name: See mechanical drawings (AHU-01 or PHW or PCHW etc). or as required by the system being installed
 - 3. Sub system name, if required (VAV boxes for example) (VAV-floor-number) or as

- required by the system being installed
 - 4. Point name (ZN-T, DA-T, MAD-O etc.
 - 5. Example: 0970.AHU-01.VAV-3-15.ZN-T or 1660_PHW_HEX1V-O
- C. Contact EWS-BMS for more detailed point naming
- D. Coordinate with BMS manager for final point naming.

6.8. UBC BMS Controller and Device Addressing and Naming Convention Requirements

- A. All IP addresses are to be provided by UBC personnel once the necessary IT infrastructure is in place.
 - 1. In the event of new building construction this infrastructure will not be in place until the building is near completion.
- B. BACnet device addressing is to be managed by UBC-BMS group and should within the venders assigned address range as follows.
 - 1. JCI:
 - a. 500 – 999 Network Engines
 - b. As per UBC instance number calculator
 - 2. Siemens:
 - a. 300000 – 399999
 - 3. Delta:
 - a. 500000 – 799999
- C. UBC personnel are to provide BACnet device addresses for devices outside of the assigned vender address ranges.
- D. UBC personnel must be provided any necessary tools to change the BACnet device address on any devices installed.

7 GUIDELINES FOR APPLICATION OF BMS TO TYPICAL HVAC SYSTEMS

7.1. *BMS Sequences of Operation, Field Termination Schedules, and System Schematic Diagrams*

- A. This section of the UBC BMS Design Guidelines identifies BMS monitoring and control requirements for typical building HVAC Systems and includes “sequences of operation” for typical building systems. BMS design specifications for all UBC BMS projects shall include BMS Sequences of Operation detailing the BMS monitoring and automatic control logic programming requirements. BMS Sequences of Operation to be provided in BMS Design Specifications shall be in the same format as the sequences of operation identified within these guidelines.
- B. BMS Design Specifications for UBC BMS projects shall detail BMS monitoring and control requirements in Field Termination Schedules and System Schematic Diagrams. Field Termination Schedules and System Schematic Diagrams shall be provided for all BMS monitored and controlled equipment and systems. The Field Termination Schedules and System Schematics shall be provided for each building system and logical group of monitored and controlled equipment. The Field Termination Schedules and System Schematics shall clearly identify BMS monitoring and control requirements and shall be labelled and cross reference the associated sequences of operation. Examples of Field Termination Schedules and System Schematic Diagrams are included in Appendix A1 of these guidelines. Field Termination Schedules and System Schematic Diagrams provided in UBC project BMS Design Specifications shall be based on the same format as indicated within these documents.
- C. Sequences of Operation for typical UBC building HVAC systems are identified within this section. Refer to Appendix A1 of these guidelines for the associated building system Field Termination Schedule and System Schematic Diagrams.
- D. BMS automatic control of building systems and equipment shall not override life safety or equipment protection overrides. The BMS Design Consultant shall specify automatic control interface requirements.

7.2. *BMS Component and Building Equipment Failure Requirements*

- A. The BMS Design Specifications shall clearly specify building system/equipment control requirements in the event of failure of BMS components and in the event of failure of building equipment. The following are general minimum component/equipment failure requirements.
- B. DCP/UC Controller Failure
 - a. Associated BMS controlled electric motors/equipment off.
 - b. AHU mixing dampers to full recirculation position.
 - c. Steam control valves closed.
 - d. Hot water control valves open.
 - e. Cooling coil control valves closed.
 - f. Fan/pump speeds set to minimum position.
 - g. Fan/pump volume flow rate control devices (e.g. inlet vanes, etc.) set to no-load position.
 - h. Isolation dampers closed.
 - i. Exhaust dampers and outside air dampers closed.
- 1. BMS Analog Input Sensor Failure

- a. Associated BMS control output retained in last commanded state. If an alternative sensor can be utilized for satisfactory control the BMS shall incorporate automatic control logic to implement the revised control.
 - b. Failure of information only type BMS input points shall be annunciated as alarms.
2. Controlled Electric Motor/Equipment Failure
 - a. Anytime the status of BMS controlled equipment is different than the associated BMS controlled output status the equipment shall be considered as “failed” and shall be shut down by the BMS. The associated BMS controlled system shall also be shut down. **Project Design Specifications shall specify the post failure equipment restart requirements.**
 - b. Where building systems/equipment are shut down by the by the fire alarm system in an alarm condition or are shut down as the result of a building power failure, the BMS shall restart the failed equipment/systems in an orderly and pre-defined manner following **the cleaning of the Fire Alarm or return to normal power**. The BMS Design Specifications shall specify the post fire alarm equipment restart and the post power failure equipment restart requirements.
 - c. All BMS component failures shall be annunciated as an alarm at the defined BMS main central computer facility.
3. If a BMS controlled motor or equipment fails to start as defined in the sequences of operation, the failure shall be annunciated as an alarm and the associated system shut down.

7.3. **BMS Automatic Sequenced Control of AHU Mixing Dampers and Valves**

- A. See ASHRAE 36.1 specification for standard AHU sequence of operations

7.4. **General BMS Monitoring and Control Requirements**

- A. All BMS alarm limit values and set points shall be on-line adjustable by a BMS Operator with the appropriate password access level.
- B. All BMS Operator monitoring and control functions shall be provided with the appropriate password access control.
- C. A single BMS software control point shall be provided for each BMS controlled system to enable/disable automatic start-up and control of the entire system. BMS controlled systems shall be capable of being started/stopped either by automatic BMS control or via online Operator command.

7.5. **Post Fire Alarm Equipment Restart**

- A. Fire Alarm Systems in buildings will override BMS control of designated equipment in an alarm condition. The BMS shall monitor a set of contacts output from the fire alarm system for status indication of a building fire alarm. The BMS Controls Contractor shall coordinate building equipment that is shut down by the Fire Alarm System.
- B. Upon detection of air handling unit shutdown the BMS shall close associated valves and stop associated pumps.

- C. Alarms shall be annunciated by the BMS to indicate the equipment failure/shut down and the building fire alarm condition. The BMS shall not annunciate nuisance alarms for monitored input points on systems shut down by the BMS or fire alarm system (e.g. high supply air temperature, low duct static pressure, etc.).
- D. Equipment shut down by the fire alarm system shall not be automatically restarted. The BMS shall not restart the equipment until the following:
 - 1. Building fire alarm condition has been cleared.
 - 2. BMS Operator acknowledges the fire alarm.
 - 3. BMS Operator with appropriate access level resets the BMS system shut down software point.
 - 4. BMS Operator with appropriate access level commands a single "Post Fire Alarm Equipment Restart" software command point.
- E. Once the above conditions have been satisfied and the BMS receives a Post Fire Alarm Equipment restart command the BMS shall initiate the restart of any equipment shut down by the fire alarm system. The restart sequence shall provide an orderly start-up of the motors for each individual system with time delay between restarts of individual systems. Start of systems shall be according to normal system start up sequences. Only those motors which should be operational in accordance with the Occupancy Schedule or application software programming requirements shall be restarted.

7.6. Post Building Power Failure Equipment Restart

- A. Power failures in buildings will result in building equipment shutting down. The BMS shall monitor building electrical distribution equipment status for indication of a building power failure condition. Some building equipment will be serviced with stand-by power and UPS power supplies. The BMS Controls Contractor shall coordinate building equipment that is serviced with stand-by and UPS power supplies. BMS provided UPS power supplies are not acceptable.
- B. Post Building Power Failure Equipment Restart facilities shall be provided to ensure the controlled and orderly startup of building equipment following a power failure. The Post Building Power Failure Equipment Restart facilities shall be provided based on the requirements identified above for the Post Fire Alarm Equipment Restart.

7.7. Air Handling Unit Optimum Start and Stop Programs

- A. Air handling optimal start shall be as per the individual controls contractors standard optimal start logic.

7.8. After-hours Equipment Operation

- A. Designated air handling systems shall be off during Unoccupied Periods if all space temperatures are above 15 ° C. If any space temperature falls below 15 ° C. the system shall be started and operate with the mixing dampers in the full recirculation position, the heating pump on and the heating coil valve fully open to flow through the coil. The system shall return to the off position as described in B. above when all space temperatures are above 16 ° C.

7.9. Air Handling Unit Supply Air Temperature Reset Schedules

- A. See AHURAE 36.1 specification for count based discharge air temperature reset sequence of operations.

7.10. *Dynamic Mixed Air Calculations and Mixing Damper Minimum outdoor air positioning*

- A. BMS mixed air calculation shall take into account the cascaded discharge air temperature, the outdoor air temperature, the return air temperature, and zone or return air CO2 levels.

7.11. *Typical Sequence of Operation - Variable Volume Air Handling Unit*

- A. Refer to ASHRAE 36.1 for sequence of operations

7.12. *Typical Sequence of Operation - VAV*

- A. Refer to ASHRAE 36.1 for sequence of operations

7.13. *Chilled Water (CW) and Condenser Water (CSR) Systems*

- A. Sequences are dependent on installation.

7.14. *Supply Hot Water System (SHW)*

- A. Sequences are dependent on installation.

7.15. *Domestic Hot Water System*

- A. Sequences are dependent on installation.

7.16. *Specialty alarming*

- A. UPS Emergency lighting – Alarm dry contact from the emergency lighting UPC shall be connected to the BMS if there is an emergency lighting UPS. UPS is by electrical division. All lighting contactors shall fail to the “on” position for safety.

***** END OF DESIGN GUIDELINES*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 01 78 39 Project Record Documents
- .2 Section 01 78 23 Operation and Maintenance Data
- .3 Divisions 8, 10, 14, 20, 21, 23, 25, 26, 27, 28, 32, 33

1.2 Co-ordination Requirements

- .1 UBC Energy & Water Services (Vancouver)
- .2 UBC Facilities Electrical (Vancouver)
- .3 UBC Information Technology (IT)
- .4 UBC Facility Management (Okanagan)

1.3 Description

- .1 General requirements for all Division 26.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

- .1 The contractor is responsible for and keeps one complete set of white prints, including revision drawings in the job site, office.
- .2 Construction Power
 - .1 (Vancouver) The temporary power service includes a consumption meter. The connection point and voltage for the construction power will be determined by UBC Energy & Water Services.
 - .2 The Contractor shall pay for all materials and installation of equipment for the provision of construction power.
 - .3 The Contractor shall pay for all utility consumption until the building is turned over to UBC.
 - .4 (Vancouver) The Contractor must contact UBC Information Technology for coordination and installation of temporary telecommunications cabling.

UBC Information
Technology IT Plant
Coordinator
Phone: 604-822-8659
<http://web.it.ubc.ca/forms/network>

2.2 High Voltage Vaults *and* Service Rooms

- .1 (Vancouver) All high voltage vaults shall have a floor drain and containment curbs.
- .2 Housekeeping pads shall not extend beyond 100mm (4") from the mounting frame of any electrical equipment within service rooms.
- .3 Main electrical distribution and life safety related equipment (ie: Generators, Transfer Switches, Central Inverters, Fire Alarm Panels) shall be located in electrical room(s) on or above grade level where practicable.

- .4 Main electrical rooms shall not be located more than 2 meters above grade.

2.3 Electrical Receptacles for Specific Purposes

- .1 Provide duplex electrical receptacles of CSA spec 5-20 for custodial use at each floor level and near the doorway in each stairwell.
- .2 Provide at least one convenience duplex electrical receptacle of CSA spec 5-20 in each electrical room, connected to standby power if available.
- .3 A 120V Class A GFCI receptacle is required when the receptacle is located within 1m of any basin in kitchenettes and washrooms.
- .4 Exterior receptacles are only permitted to be installed on the exterior of a building. Exterior receptacles located in site furnishings, trees/greenery and in floor are not permitted.
- .5 Provide Mechanical rooms with CSA spec 5-20 receptacles in areas where operations and maintenance activities will be performed. At minimum 1 receptacle is required per wall.
- .6 Receptacles with proprietary quick connectors are not permitted to be used.
- .7 Red coloured receptacles shall be utilized for receptacles on standby (non-life safety) power.

2.4 General Installation

- .1 The installation shall be installed in a manner that is conducive with quality workmanship. Exposed wiring that is visible in common areas shall be installed square and true to other areas and installations.
- .2 All Electrical Rooms shall be designed in accordance with the requirements outlined in 10 00 10 Special Room Requirements 1.7 Electrical Room.
- .3 Adequate unobstructed wall space shall be provided in all electrical rooms to permit the installation of new (future) equipment and shall not be less than 1.2 m x wall height.
- .4 The designer shall coordinate with the architect to ensure that all electrical and life safety equipment that is installed shall be readily accessible for maintenance, replacement and repair without the use of tools to remove building finishes such as decorative ceiling panels.
- .5 Connection to existing services and street lighting circuits shall be included in detail on the IFC drawing set and shall be coordinated by the Project Superintendent at least 30 days before connection date.
- .6 Do not install flush mounting boxes back-to-back in walls; provide minimum 150 mm horizontal separation. Provide minimum 600 mm separation in acoustic rated walls.
- .7 Pull boxes shall be installed in locations that are easily accessible by maintenance personnel. Placement shall take into consideration the ease of removing panel(s)

and the potential of interference with other systems if access to either is required.

- .8 No electrical equipment shall be masked by architectural finishes, furniture, artwork, bulletin boards or other similar items that would delay identifying their location in an emergency.
- .9 For all Pathway installed for other Divisions systems, please consult that Divisions Guidelines as there can be specific requirements and or restrictions for performance reasons that could supersede code minimums.
- .10 Electrical equipment shall not be abandoned in place and must be removed as part of the project.

2.5 Project Record Drawing Requirements

- .1 The contractor shall be responsible for and keep one complete set of white prints, including revision drawings at the job site.
- .2 The contractor shall deliver to the consultant at "substantial performance" one complete set of white prints, showing by colored lines and suitable notation all work as installed, together with sizes and routes of electrical service lines installed, relocated or adapted under this project. The contractor shall maintain a current record, as the job progresses, of any deviations from contract drawings. Manholes, pulling pits, etc. shall be located at the center lines, by co-ordinates, on a grid system shown on the site plan. Locations and levels shown on plans must be accurate to within 12 mm.
- .3 (Vancouver) Approval for backfilling of underground services will not be given before the UBC Energy & Water Services is satisfied that the exact location of the underground service has been surveyed and recorded. The contractor must employ a qualified surveyor to record the horizontal and vertical location of underground services. This survey information is to be shown on the project record drawings and must indicate the location of all buried services, as well as, those capped or exposed by the work of this contract.
- .4 Project Record White prints shall be delivered to the consultant at "substantial performance" in accordance with Division 01 General Requirements.
- .5 For final Record Drawing submission, refer to Section 01 78 39 Project Record Documents.
- .6 At time of energization of any new electrical installation a one line drawing shall be posted in the main electrical room.
- .7 Upon handover of the electrical systems the project team will be responsible for providing passwords for all applicable equipment to UBC Facilities Electrical.

2.6 Electrical Operating and Maintenance Manuals

- .1 For detailed requirements, refer to Section 01 78 23 Operation and Maintenance Data.

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Division 26, Section 33 71 00 Electrical Utility Transmission and Distribution
- .2 Division 10, Section 1 Room Requirements
- .3 Divisions 27 and 28

1.2 Coordination Requirements:

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Energy & Water Services (Vancouver)
- .3 UBC Information Technology
- .4 UBC Facilities Management (Okanagan)

1.3 Description

- .1 UBC requirements for the Design Development Documents for Division 26.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General Requirements

- .1 Engaged Consultants supplies the University at the preliminary stage of the building project, a Development Brief which contains information listed below:
 - .1 Preliminary drawings clearly defining scope of work and equipment details.
 - .2 Specifications of all electrical systems and equipment.
 - .3 Power Riser Diagram.
 - .4 One Line Diagram.
 - .5 Fire Alarm Riser Diagram.
 - .6 Building area access routes for service of installed systems.
 - .7 Emergency Lighting System equipment details.

2.2 Off Site and Site Services

- .1 Through discussion with UBC Energy & Water Services (Vancouver) / UBC Facilities Management (Okanagan) the Design Development Brief shall include:
 - .1 Underground duct system tie-in to existing duct or manhole.
 - .2 Expected peak demand, in KVA.
 - .3 Manhole size and approximate location, drainage provision.
 - .4 Number, size and type of power cables and neutral.
 - .5 Number of ducts in each duct bank.

2.3 Building Service

- .1 The Design Development Brief shall include the following Building Service information:
 - .1 Size and location of main electrical and sub electrical rooms and distribution centers.
 - .2 Power switching components.
 - .3 Power transformer types and sizes.

- .4 Secondary voltages.
- .5 One line diagram including secondary distribution board, sub distribution centers, motor control centers, and risers.

2.4 Other Services

- .1 The Design Development Brief shall include the following other information:
 - .1 Fire alarm and building alarm components and supervisory equipment.
 - .2 Communication rooms size and location.
 - .3 Other services to be provided such as clocks, bells, telephone/data outlets, TV outlets, closed circuit television system, P/A system, emergency lighting and standby generator.

2.5 Construction Power

- .1 The Consultant obtains from UBC Energy & Water Services (Vancouver) / UBC Facilities Management (Okanagan), the location and voltage level for construction power.
- .2 The Design Development Brief shall include the following construction power information:
 - .1 The Consultant provides in his design, a drawing showing the basic equipment and wiring for the service.
- .3 Construction power consumption and all associated equipment and installation material and labour shall be paid for by the project.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 Related UBC Guidelines

- .1 Division 26
- .2 [Division 27](#)

1.2 Coordination Requirements

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Facility Management (Okanagan)

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

2.1 General

- .1 Wiring exposed to excessive vibration (i.e. generators) shall be copper and type SIS.
- .2 Components used to fasten, mount or secure electrical equipment and cables outdoors or in other corrosive locations shall be suitable and rated for such.
- .3 Drilling is the only permitted method for mounting of electrical equipment. Powder actuated methods are not permitted.
- .4 Permanent motors are required to be hardwired. Cord connected motors are permitted with limited exception where industry standard and hardwired connection is uncommon such as: condensate pumps, glycol tanks with pump and alarm and fractional motors for fans.
- .5 Electrical equipment that is designed by the manufacturer to be surface mounted on vertical surfaces containing pushbuttons, switches or doors shall not be horizontally mounted in ceiling spaces.
- .6 Stored energy devices are not permitted to be installed above ceiling tiles or architectural panels.
- .7 [Boxes and conduit cannot be installed in locations that are easily susceptible to mechanical damage by users.](#)
- .8 [The point of supply for any specialized piece of equipment must be short as practicable. For cord connected equipment the use of extension cords is not acceptable when determining the point of supply.](#)

2.2 Receptacles

- .1 The maximum general use duplex receptacles per circuit shall be installed as per the following:
 - .1 Offices: 3 5-15R or 5 5-20R.
 - .1 Circuits may not be shared between adjacent offices.
 - .2 Designers should allow for 500W motorized desk in a workstation space circuited to general receptacles noted above.
 - .2 Meeting/Conference Rooms: 4 5-15R
 - .3 Break / Printer Rooms: 4 5-15R

- .1 Copiers and other equipment rated at over 1000W require a dedicated circuit.
- .2 Multi-function printers require a dedicated 5-20R
- .4 Reception Areas: 3 5-15R or 5 5-20R
- .5 Kitchen/Kitchenette Countertop Areas: 15-20R
- .6 Washrooms: 2 5-15R
- .7 Locker/Shower Room: 2 5-15R or 3 5-20R
- .8 Service Rooms: 2 5-20R
- .9 Study Carrels: 8 5-15R
- .10 Study Rooms: 4 5-15R
- .11 Corridors / Lobbies / Atrium: 4 5-15R
- .12 Laboratories: 3 5-15R or 4 5-20R
- .1 Equipment rated at over 1000W require a dedicated circuit.
- .13 Lecture Hall / Auditorium: 9 5-15R
- .14 Classroom: 4 5-15R
- .15 Gymnasium/Recreation/Exhibition Rooms: 4 5-15R
- .16 Building Exterior: 2 5-15R
- .17 E-Bike receptacles in Bicycle Rooms: 6 5-15R
- .2 The minimum quantity of general use duplex receptacles is required in the following spaces based on 3 meter spacing between receptacles on usable wall space:
 - .1 Dry and Wet Laboratories
 - .2 Classrooms
- .3 The quantity of receptacles in Bicycles Rooms containing e-bikes shall be a determined using 25% of the total bicycle capacity in the space. Example: 100 Bikes → 25 Bikes → 13 duplex receptacles.
- .4 The maximum size receptacle for cord connected equipment is 60A. Locking receptacles are required for 30A and above
- .5 Red coloured receptacles are required for receptacles on standby (non-life safety) power

2.3 Floor raceway systems:

- .1 On floor raceway systems shall employ an outside the wall configuration. For power only applications connections shall be made to standard wall receptacles if a manufacturer option exists. Otherwise, a direct connection may be utilized mounted at the same height as receptacles in the space. For mixed power and A/V applications connections shall be made to an outside the wall box to allow for ease of repair/replacement of the system without any modification to architectural finishes.
- .2 Power and A/V are the only systems permitted to utilize a on floor raceway system. Voice and Data is not permitted and must adhere to the requirements outlined in Section 27 05 28.
- .3 Pre-wired track systems comprised of modular interconnecting raceway segments are not permitted.

2.4 In floor systems:

- .1 Poke through floor boxes is the default method for in floor systems. Cast in place system may only be utilized when technical challenges are present with poke through boxes. 4" round is the standard size that shall be utilized.
- .2 4" round floor boxes utilizing 1 or 2 gangs shall have covers utilizing side hinged opening flip lids. Covers with a top or bottom hinged opening flip lid that open the entire round cover are not acceptable.
- .3 Floor boxes shall be sized appropriately for the application. Usage of large capacity floor boxes in applications where they are underutilized and oversized is not acceptable.
- .4 Where receptacles are required to be separately mounted within floor boxes, the mounting depth shall not exceed 50mm below finished floor.

2.5 Boxes:

- .1 The following values shall supersede the requirements of CEC Table 22 Space for insulated conductors in boxes:
 - 14 AWG - 30.8mL
 - 12 AWG - 35.9mL
 - 10 AWG - 46.1mL
 - 8 AWG - 56.4mL
 - 6 AWG - 92.1mL
- .2 4 11/16" boxes shall not be used as pullboxes and shall only be used when required for a specific device.
- .3 A gutter box is required for all new panelboards. The box shall be located at a typical of 600mm from the panelboard and can be located on the top or bottom depending on installation requirements. A minimum of 4 – 2" conduits are required between the panelboard and box.
- .4 The maximum amount of extension rings that be utilized per application is 1.

2.6 Raceways:

- .1 Cable ties are not permitted for supporting conduit or armoured cable.
- .2 Raceways shall not be permitted to be utilized as support for other raceways or armoured cables.
- .3 The maximum conduit fill % for 3 or more conductors shall not exceed 32%.
- .4 All EMT conduit runs exposed to weather shall contain supplementary bonding conductors sized in accordance with the CEC. EMT shall not be used as the bonding method.

END OF SECTION

1.0 **GENERAL**

1.1 **Coordination Requirements**

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Energy & Water Services (Vancouver)

1.2 **Description**

- .1 The University owns and operates the power system consisting of 60 KV and 12 KV overhead and underground lines. Two 60 KV lines feed two substations: one located in the South Campus, and one in the Main Campus. The Main Substation supplies a 12 KV indoor and outdoor switching station.
- .2 The 12 KV systems are distributed underground in a combined duct and manhole system which serves throughout Main and South campuses. The 12 KV systems are nominally rated at 12,480 volts, 3 phase Wye System, low resistance grounded. The design limits are Basic Impulse Level 95 KV and Design Fault 300 MVA Symmetrical.
- .3 The power distribution is a Dual Radial System with 500 KCM 15 KV single conductor cable for 12 KV System. For a General Distribution diagram of the 12 KV feeders, refer to Standard Drawing No. E1-1.

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

- .1 All new buildings, UBC Renew projects and any major additions to existing buildings shall be supplied from the 12 KV systems. 12KV main feeds shall NOT be fed as an interconnection from other buildings ("daisy-chaining"). Interconnection might compromise the research in both buildings, should a problem occur.
- .2 Any major renovation adding electrical loads to an existing building that exceeds 300kW must discuss with UBC Energy & Water Services prior to design submission to ensure available system capacity. There are no exceptions.
- .3 Any request for variance, such as where small buildings are concerned, must be reviewed with Building Operations Electrical Technical Support.
- .4 Refer to Standard Drawing No. E1-1 attached as Appendix "A" in regard to the supply feeders into each building.
- .5 Note that a ground of equivalent size (in general a 4/0) shall be installed to each building switch room. This ground conductor shall tie into the existing ground system and also be connected to an accessible ground bus on which all equipment and service grounds are to be terminated. Provisions shall be made for at least two spare connecting points for additional grounding, other than for the Telephone Company, fire alarm, etc.

END OF SECTION

1.0 GENERAL

1.1 Coordination Requirements

- .1 UBC Energy & Water Services
- .2 UBC Facilities Electrical (Vancouver)
- .3 UBC Facilities Management (Okanagan)

1.2 Description

- .1 UBC requirements for Protective Device Coordination and Arc-Flash Analysis for AC or DC electrical equipment.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General

- .1 The engaged consultant shall review and validate the short circuit analysis and protective device coordination studies as prepared by the equipment manufacturer for all electrical protective devices to verify each device can safely withstand and interrupt the available fault currents.
- .2 (Vancouver) Utility information shall be provided, upon request, to the consultant or equipment manufacturer by UBC Energy & Water Services
- .3 Coordination information shall be shown on a graphical chart in log-log format for all applicable low voltage devices and for all devices used for Medium Voltage protection. All device settings shall be indicated either on the chart or accompanying the chart.
- .4 The maximum allowable Arc Flash Hazard category for any part within Medium Voltage unit substations shall not exceed level 2 (8 cal/cm²) as per Section 26 11 13 Primary Unit Substations, 2.1.9 and 2.13.
- .5 The engaged consultant shall review and validate the Arc Flash hazard analysis for all applicable components of the project's electrical distribution system per CSA Standard Z462.
- .6 The engaged consultant shall ensure that every effort is given to minimize the Arc Flash Hazard category while maintaining selective device coordination. Reduce distribution transformer sizes or incorporate circuit breakers with LSI capabilities to achieve a maximum of 8 cal./cm sq. at all switches, circuit breakers and MCCs.
- .7 The Arc Flash hazard analysis shall clearly indicate the Incident Energy, Arc Flash protection boundary and Hazard Category for each applicable device.
- .8 All documentation shall be in colour and provided in soft copy PDF format. Scanned copies shall not be permitted.
- .9 All applicable equipment shall have Arc Flash Hazard labels affixed as required in Section 26 10 00 Secondary Power Distribution, 3.0.
- .10 A copy of the model shall be provided to UBC Facilities Electrical after the final report has been issued. The files provided shall be in the default ETAP or SKM format.

END OF SECTION

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 Division 26

1.2 **Coordination Requirements**

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Energy & Water Services (Vancouver)
- .3 UBC Facilities Management (Okanagan)

1.3 **General**

- .1 The University has adopted a series of standards covering various electrical components such as manholes, duct systems, lighting poles, etc.
- .2 These Standard Drawings can be found in this [PDF document](#).
- .3 Wherever applicable, these standards shall be used on University work.
- .4 Any electrical civil standard not listed below shall be performed to MMCD and CEC specifications.

1.4 **Index to Standard Electrical Drawings**

AutoCAD files can be found on the Technical Guidelines website under Division 26.

<u>Drawing No.</u>	<u>Description</u>
E1-1	Single line diagram. Distribution systems 12 KV dual radial feeders typical building supply (Vancouver)
E1-2	Electrical unit substation one line diagram (Vancouver)
E1-2b	Electrical outdoor unit substation one line diagram (Vancouver)
E1-2c	Outdoor substation general layout (Vancouver)
E1-3	Electrical unit substation key interlocks (Vancouver)
E1-4	Typical electrical room layout (Vancouver)
E1-5	Jurisdictional block diagram (Vancouver)
E1-6	Unit substation feeder transfer control box (Vancouver)
E2-1	Standard concrete-encased electrical ductbank (Vancouver)
E2-2	Standard electrical service conduit directly buried (Vancouver)
E2-3	Standard electrical ductbank concrete encased (Vancouver)
E2-4a	Electrical ductbank clearances to DES Hot Water Lines (Vancouver)
E2-4b	Electrical ductbank clearances to DES Hot Water for 600 volts or less (Vancouver)
E2-4c	Electrical ductbank clearances to DES Hot Water for 12,000 volts or less (Vancouver)

<u>Drawing No.</u>	<u>Description</u>
E3-1	Standard electrical precast manhole (Vancouver)
E3-2	Standard electrical manholes pour in place (Vancouver)
E3-3	Additional reinforcing for pour in place electrical manholes (Vancouver)
E3-4	Standard electrical manhole cover and riser details (Vancouver)
E3-5	Standard electrical manhole sump detail (Vancouver)
E3-6	Typical manhole grounding and details (Vancouver)
E3-7	Typical manhole separations (Vancouver)
E3-8	Standard Manhole Cable Support Detail (Vancouver)
E4-1	Cable identification tags 12 KV (Vancouver)
E4-2	Mounting and shield grounding details for splices between 2 (or more) 15 KV 'X' - Link 500 MCM & 4/0 cables (Vancouver)
E4-4	Schneider Electric PM8240 meter 120/208V, 3 phase, 4 wire system. 3 element wiring connection diagram (Vancouver)
E4-5a	Schneider Electric PM8240 meter 347/600V, 3 phase, 4 wire system. 3 element wiring connection diagram (Vancouver)
E4-5b	Schneider Electric PM8240 meter 600V, 3 phase, 3 wire system. 2 element wiring connection diagram (Vancouver)
E4-5c	Setra Networked Multi-circuit power meter 208V or 600V wiring connection diagram, 4-wire system (Vancouver)
E4-5d	Setra Networked Multi-circuit power meter 600V wiring connection diagram, 3-wire system (Vancouver)
E4-6	Water and gas meter integration into electrical metering system, tenant and core buildings (Vancouver)
E4-6c	District Energy System Metering ION Network Interface (Vancouver)
E10-2	Interior Wiring Systems, Standard Transformer and Panel Identification
E11-1	Fire Alarm System Monitoring Equipment Installation
E12-1	Exterior Lighting and Receptacle Control

END OF SECTION

1.0 **GENERAL**

1.1 **Coordination Requirements**

- .1 UBC Energy & Water Services
- .2 UBC Facilities Electrical

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Performance Standards**

- .1 High Voltage Cable shall comply with the requirements of the most recent edition of:
 - .1 I.P.C.E.A. S-66-524/NEMA WC7.
 - .2 CSA C68.3.

2.2 **U.B.C. Power System Characteristics**

Voltage	12480V
Phases	3
Wires	3
Frequency	60 Hz
System Neutral	Low resistance grounded 100A, 10 sec, 7.2 KV, 72 ohms
Available short circuit capacity	Maximum 300 MVA, 13.9 kA

2.3 **Detailed Cable Specifications**

Insulation	220 mil ethylene-propylene (EPR) insulation (133%), suitable for continuous operation at 105C conductor temperature, emergency conditions at 140C and 250C for short circuit conditions.
Shield	Metallic: 5 mil bare copper tape with 100% coverage and a minimum of 12.5% overlap.
Conductor	ASTM Class B soft bare copper, compact stranded.
Size	Building Services: 1 Conductor - 4/0 AWG per phase
	Feeders: 1 Cond. 500 KCM per phase
Construction	Solid plastic
Jacket, Outer	PVC
Rated Voltage	15 KV

2.4 **Applicable Manufacturers**

- .1 Aetna Insulated Wire Company.
- .2 Phillips Cable.
- .3 Prysmian Cable.
- .4 Alcatel.
- .5 Okonite
- .6 Southwire
- .7 All substitutes shall be pre-approved by UBC Energy & Water Services.

2.5 **UBC Underground Duct System Consideration**

- .1 All cables will be pulled into underground duct systems constructed to UBC Standards.

- .2 The duct system is not waterproof and the cables may be immersed in water for long periods of time.
- .3 Ducts are to be constructed as per UBC Standard Drawings E2-1, E2-2 and E2-3.

2.6 Ground Wires

- .1 Grounding conductors shall be installed to UBC standards and as required by the Code. Specify wire size 4/0 and 500 kCM.

2.7 High Voltage Cable Termination

- .1 High voltage cable terminations shall be Elastimold #K656 BLR 600 amp series only, unless otherwise specified.
- .2 Termination cable kit shall match conductor insulation diameter for 500 kCM or 4/0 conductors.
- .3 Refer to UBC Standards Drawing # E4-2.

2.8 Interruption of Services

- .1 Shut down for any 12 KV circuits must be requested 4 weeks in advance of the actual shutdown date.
- .2 At any time no more than one 12 KV circuit can be shut down.

2.9 Manhole Access

- .1 Permission to access any utility manhole must be coordinated and approved by UBC Utility Department. A Manhole Entry Permit must be approved before entry.
- .2 Entry into any manhole must be made in the company of UBC Utility personnel.

2.10 Safety Standards

- .1 All work within a utility manhole shall comply with WorkSafeBC confined space access requirements.

2.11 Labeling

- .1 Feeder labels to be installed around feeders at cable heads, stress cones, manholes, pull pits, etc. Refer to UBC Standard Drawing E4-1.
- .2 Feeders revised from existing circuit arrangements shall be relabeled at all "downstream" locations such as manholes, pull pits and building switchgear.

2.12 Testing

- .1 Tests to be performed using qualified personnel. Provide necessary instruments and equipment.

- .2 Perform Hi-pot testing of cable at a voltage level not exceeding cable rating on the original reel at the UBC site. Failure to comply will void the factory warranty and the installation will be at the Contractor's risk.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check insulation resistance after each splice and/or termination to ensure that the cable system is ready for acceptance testing.
- .5 Acceptance Testing
 - .1 Ensure terminations and accessory equipment is disconnected including ground shields, ground wires, metallic armour and conductors not under test.
 - .2 UBC Energy & Water Services shall perform installed cable acceptance tests on all new cable installations using VLF testing equipment. All tests performed to NETA specifications.
 - .3 Review test with the Engineer before proceeding.
 - .4 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.
 - .5 Remove and replace entire length if cable fails to meet the test criteria. Contractor will be responsible for the cable and installation costs to replace damaged cable.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Divisions 20 to 28

1.2 Coordination Requirements

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Facilities Management (Okanagan)

1.3 Description

- .1 UBC Requirements for Wire and Cables (0-1000 V).

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General Requirements:

- .1 Wires shall be copper throughout with R90 XLPE 90°C insulation. Minimum wire size shall be #12 AWG except for control wire. Wires #12 AWG and larger shall be stranded. #14AWG conductors shall be an acceptable minimum size if no part of the conductor is installed outside of the Student Housing and Community Services residential suite it services.
- .2 Color shall be impregnated in the insulation for wire #3 and smaller. Larger wire shall be clearly identified with colored vinyl tape at both ends and at all splices for large wire.
- .3 Control wiring shall be clearly identified if AC or DC.
- .4 Color coding for motor control wiring shall reflect accepted industry standards, but be sized no smaller than #18.
- .5 Wiring installed in underground ducts installed outside of building footprint (i.e. Building Services, Distribution or Lighting) shall be copper, RWU rated, XLPE.
- .6 Splicing is only permitted for Normal and Standby conductors. Splicing is not permitted for Emergency and Life Safety conductors.
- .7 Shared neutrals is not permitted between 2 or more circuits. The only exception where shared neutrals is permitted is for lighting circuits. Proper labelling must be applied to ensure clear identification of shared neutrals for operations staff.
- .8 For splicing of conductors long barrel compression connectors with water-tight heatshrink must be utilized. Raychem or UBC Facilities Electrical approved equivalent.
- .9 The largest conductor size that may be utilized is 500 MCM.

2.2 Raceway Requirements:

- .1 Raceways are required for all installations and cannot be substituted with armoured cable.
- .2 The following raceways are acceptable for use:
 - .1 EMT Conduit – $\frac{3}{4}$ " minimum size
 - .2 Rigid PVC Conduit

- .3 Rigid Metal Conduit.
- .4 Surface Metal Raceway. It is preferred to utilize surface raceway in renovation projects where EMT may prove problematic due to limits of existing finishes.

- .3 The following raceways are not acceptable for use:
 - .1 ENT Conduit.
 - .2 Non Metallic Raceway.

- .4 Flexible conduit shall not be used as a general purpose raceway. The conduit shall not be less than 300mm and greater than 750mm.

- .5 An additional conduit matching the largest utilized size, shall be provided for all building power feeds, power sub-feeds, and all electrical systems requiring inter-building connections.

- .6 Conduit or cables entering boxes or equipment located in outdoor environments shall be bottom entry.

- .7 Utility High Voltage conductors run within buildings shall be installed in rigid steel conduit unless encased in no less than 50mm of concrete and clearly marked with embedded brass plate indicating danger, voltage and burial depth.

2.3 Armoured cable may only be used for the following:

- .1 Drops to individual luminaires and shall have a maximum length of 1.5m (5'). Daisy-chaining of luminaires is not permitted.

- .2 Final connection to motors, transformers or vibrating equipment to a maximum length of 3m. Cable shall be run neatly, not secured to heat emitting mechanical systems and secured using mechanical fasteners not cable ties.

- .3 Armoured cable is not permitted for final connections to receptacles.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 Related UBC Guidelines

- .1 Divisions 26 and 28
- .2 Division 27 Section 27 05 26 Grounding and Bonding for Communications Systems

1.2 Coordination Requirements

- .1 UBC Energy & Water Services (Vancouver)
- .2 UBC Information Technology
- .3 UBC Facilities Electrical (Vancouver)
- .4 UBC Facility Management (Okanagan)

1.3 Description

- .1 UBC requirements for Electrical Grounding.

2.0 **MATERIALS DESIGN REQUIREMENTS**

2.1 Grounding

- .1 **General**
 - .1 Grounding conductors shall be installed as required by the latest edition of the Canadian Electrical Code. In all cases the material shall be copper.
 - .2 From the neutral ground position of each transformer, a grounding conductor shall be extended to the UBC system ground bus.
 - .3 Ground wires for ground electrodes in 600V systems or lower may be sized as per Canadian Electrical Code, latest edition. Ground wires to ground electrodes for high voltage systems shall be #4/0 copper. All ground wire shall be tested for continuity. Record each continuity test and include in ground system report.
 - .4 In all buildings with 600V distribution a system ground bus shall be installed in each Electrical Room housing a Distribution Centre rated 400A or larger or a transformer 15kVA or larger.
 - .5 Insulated ground wires shall be utilized for all applications.
 - .6 Unit substation and pad-mounted transformers servicing buildings shall have a ground grid.
- .2 Ground Rods
 - .1 Ground rods shall be 3/4" x 10' copper clad ground rods.
- .3 Ground Fittings
 - .1 Ground connections shall be made with compression fittings that are CSA approved for grounding.
 - .2 Ground grid connections for buried ground grid splices shall be CSA approved compression connected.
 - .3 All ground connections shall be labeled. The label shall contain at minimum the type of equipment grounded, location of the equipment and equipment name as identified on the single line diagram.

2.2 Bonding

- .1 General
 - .1 An additional bonding conductor is required for equipment when a raceway is installed as per the following:
 - .1 EMT in exterior, non-conditioned and uncovered locations.
 - .2 EMT is installed in slab for part or all of the run.
- .2 Telecommunications Bonding
 - .1 Please refer to 1.1.2 Section 27 05 26 Grounding and Bonding for Communications Systems for specialized telecommunications bonding requirements.
- .3 Fire Alarm Bonding
 - .1 Please refer to Section 28 31 00 Fire Detection and Alarm for specialized Fire Alarm systems bonding/grounding.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Division 26

1.2 Coordination Requirements

- .1 UBC Energy & Water Services
- .2 UBC Facilities Electrical (Vancouver)
- .3 UBC Facility Management (Okanagan)

1.3 Description

- .1 UBC seismic requirements for Electrical Equipment.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

- .1 Submit a detailed and sealed report from Structural Engineer of record who shall also ensure the specified restraint system has been installed.
- .2 All electrical equipment shall be seismically secured in compliance with BC Building Code.
- .3 All secondary distribution transformers shall incorporate vibration isolation reviewed and approved by the structural engineer.

2.2 Transformer and Unit Substation Seismic Support

- .1 The Substation Manufacturer shall have a Seismic Engineer design and select, the seismic restraint system.
- .2 Structural Engineer of record shall ensure the floor is sufficiently thick for the required bolting and that the specified restraint system has been installed.
- .3 For substations located on grade on slab, mount core and coil assembly on bridge bearing neoprene Super 'W' pads, and provide hemi grommets for each bolting location designed to suit system. Alternatively, if substation is located on a suspended floor above grade, mount core and coil assembly on Lo-Rez spring isolators designed to suit system and provide separate seismic snubbers for use with springs.
- .4 Supply chemical bolts for securing the transformer.
- .5 Submit bolting requirements for all substation cubicles.
- .6 Acceptable manufacture of seismic restrain system is Mason Industries.
- .7 Provide flexible braid connections at transformer line and load connections. Cable connections are not acceptable.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 26 05 06 Standard Drawings

1.2 Coordination Requirements

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Energy and Water Services (Vancouver)
- .3 UBC Facility Management (Okanagan)

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 Labeling Requirements

- .1 Feeder labels to be installed around feeders at cable heads, stress cones, manholes, pull pits, etc. Refer to Standard Drawing E4-1.
- .2 Feeders revised from existing circuit arrangements shall be relabeled at all 'downstream' locations such as manholes, pull pits and building switchgear.
- .3 Engraved lamacoid nameplates with the name of the load shall be installed on breakers or switches at the switchgear cubicles and elsewhere where called for on the drawings.
- .4 Nameplates shall be securely fastened and screwed or riveted.
- .5 Exterior cubicle nameplate dimensions shall be engraved brass 4" x 1 ½" black lettering.

2.2 Labeling General

- .1 Labelling is required for any electrical equipment rated at 20kW and above.
- .2 Junction Boxes
 - .1 Junction boxes in visible areas shall be labeled with machine printed material. The label(s) shall consist of Panel #, Cct #(s), FA zone #, etc.
- .3 Disconnects
 - .1 Disconnects (Non Fused/Fused/Breaker) shall have a firmly affixed lamacoid label indicating the following (as applicable):
 - 1. Downstream device tag #
 - 2. Disconnect maximum rating
 - 3. Fuse/Breaker rating
 - .2 If a VFD is upstream of the disconnect an additional label must be placed stating the following: Disconnect shall not be operated until motor has been verified to be disengaged at the VFD.
- .4 Labels Outside
 - .1 Labels located outside shall be of the engraved lamacoids type and be affixed with UV or corrosion resistant ties.

- .5 Equipment and Devices
 - .1 All equipment and devices shall be labeled with their tag # first and if this is not available the circuit #, IP address or Zone shall be labeled with machine printed material. Examples of the equipment and devices that shall be labeled:
 - 1. Receptacles
 - 2. Light switches
 - 3. Motors / Pumps
 - 4. AHU's
 - 5. Heaters
 - 6. Equipment specific to the area
 - 7. Fire Alarm System field devices
 - 8. Unit Equipment

2.3 Distribution Equipment and Panel Board Identification

- .1 Panel Boards, Load Centers and Transformers shall be labeled and identified in accordance with Standard Drawing E 10-2 in all new buildings, UBC Renew projects and in any major additions to existing buildings.
- .2 Secondary distribution equipment, such as Panel Boards, Load Centers and MCCs shall have conspicuously attached a permanent 2" X 4" Hazard Warning Label to meet OSHA and NFPA standards that clearly identifies:
 - .1 Incident Energy
 - .2 Arc Flash protection boundary
 - .3 Hazard Category
 - .1 Secondary distribution equipment that is identified as Hazard Category two or higher, the above label shall be 3.5" X 5"
- .3 The following outline the color requirements for lamicoids at distribution equipment:
 - .1 Utility Power:
 - 1. Black with White Letters
 - .2 Generator Power:
 - 1. Single generator with 1 transfer switch (Life Safety and Standby / Life Safety only loads):
 - 1. ATS (Red with White) → Main EM distribution (Red with White) → Downstream distributions (Red with White)
 - 2. Single generator with 1 transfer switch (Standby only loads):
 - 1. ATS (Yellow with Black) → Main EM distribution (Yellow with Black) → Downstream distributions (Yellow with Black)
 - 3. Generator(s) with 2 or more transfer switches:
 - 1. Generator Main Distribution (Red with White)
 - 2. ATS and downstream distributions for Life Safety (Red with White)
 - 3. ATS and downstream distributions for Standby (Yellow with Black)
 - 4. ATS and downstream distributions for Data Center/IT Equipment/UPS/IT Exclusive loads (Blue with white)
 - .3 UPS/Inverter power:
 - 1. UPS and Downstream Distributions (Blue with white).

2.4 Secondary Distribution Raceways and Cables Identification

- .1 Raceways and cables for interior LOW VOLTAGE systems shall be identified in accordance with Drawing E10-1.

2.5 Concealed Equipment Identification

- .1 BLUE colored dots shall be utilized for identification of concealed electrical equipment where removable panels/tiles exist. This includes but is not limited to:
 - .1 Suspended T-Bar ceiling
 - .2 Wall or Ceiling.
- .2 Equipment Type:
 - .1 Lighting Controllers
 - .2 Electrical boxes
- .3 Dot requirements:
 - .1 Provide self-adhesive color coded dots 13 mm in diameter.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Coordination Requirements**

- .1 UBC Facilities Electrical
- .2 UBC Energy & Water Services

2.0 **REQUIREMENTS FOR COMMISSIONING AND TESTING**

2.1 **Testing**

- .1 Unit Substation Factory Testing
 - .1 Production tests: Perform all production tests listed in CSA Standard C22.2 No. 31 (current edition) and submit a detailed test report signed by the chief engineer or chief testing engineer.
 - .2 Provide a production heat run test on the transformer to verify temperature rise.
 - .3 Provide a factory sound level test for this transformer to verify transformer sound level. Submit copy of this test prior to shipping transformer.
 - .4 Provide a three phase energization of transformer and switchgear at factory at both rated voltage and 110 % rated voltage. Verify that all meters and trip circuits function correctly. Consultant and UBC Utility Engineer shall witness the energization test.
- .2 Unit Substation Tests
 - .1 After manufacture, perform corona test to verify rating. A certificate signed by the Chief Testing Engineer shall be provided to verify the corona level and other production tests required by CSA C22.2 No. 31.
- .3 High Voltage Cable
 - .1 High voltage cables shall be tested as outlined in Section 26 05 05 High Voltage Cables.

2.2 **Commissioning**

- .1 12 KV Unit Substation
 - .1 Manufacturer shall provide on-site direction to the Contractor for reassembly of 12 KV unit substation.
 - .2 Upon completion of reassembly, the manufacturer shall provide visual inspection to review and check all components for condition and correctness of installation.
- .2 Vacuum and Cleaning
 - .1 All electrical equipment tested shall be cleaned and left in first class condition.
 - .2 Accumulated dirt and dust visible equipment shall be removed with high volume, low pressure blow-type vacuum.
 - .3 Wiping shall be performed where required.
 - .4 At completion of testing and cleaning, area around and adjacent to electrical equipment shall be cleaned and left in first class order.
- .3 Insulators
 - .1 Station insulators shall be inspected as follows:
 - .1 Clean and inspect insulators for chipped porcelains and radial cracks and foreign contaminants.
 - .2 Test insulators with DC high potential test set to the value specified by the manufacturer.

- .4 Fuses
 - .1 Fuses shall be inspected and checked as follows
 - .1 Check fuse links for continuity.
 - .2 Check fuse cartridge and holder for correct alignment and adjustments.
 - .3 Inspect fuse mounting and grounding.
 - .4 Inspect for spare fuses & report any set of fuses without spare back-up fuses.
- .5 Interlocks
 - .1 Verify system interlocking & labeling.

2.3 On-Site Testing – Switchgear Test

- .1 Immediately prior to energization the Contractor shall make all arrangements and pay all costs of field testing, cleaning and calibrating of the following items.
- .2 The on-site testing, cleaning and calibration shall be performed by qualified field personnel from the following companies, if required:
 - .1 Wismer & Rawlings – Service Division.
 - .2 Schneider Canada.
 - .3 Prime Engineering.
 - .4 Eaton Technical Services.
 - .5 Or other approved testing firms.
- .3 The tests and work to be performed are outlined as follows:
 - .1 12 KV Unit Substation
 - .1 Inspect all porcelain bushings and stand-off insulators for cracks, chips, dust, dirt and tightness.
 - .2 Inspect the operation of each breaker in its cell; checking auxiliary contacts and all tripping devices.
 - .3 Inspect and test overall grounding system.
 - .4 Inspect all stress cones.
 - .5 Test the insulation resistance of all bus using a DC Hi Potential test set. Measure current leakage of each phase to ground with all other phases grounded.
 - .6 Inspect and tighten, if necessary, all connections.
 - .7 Verify all C.T. characteristics.
 - .8 CT saturation test.
 - .9 Inspect the operation of each breaker in its cell; checking the racking mechanism and ground bus.
 - .2 Breaker Remote Controls and Synch Check
 - .1 Verify each breaker can remotely open and close when voltage is present.
 - .2 Verify closed transition transfer between normal and alternate feeders and back.
 - .3 Verify system lockout on attempted out of synch or dead bus closure for all combinations of phase orientation.
 - .4 Verify time delay for all breaker close and rack in/out functions.
 - .5 Verify no time delay for all breaker open functions.
 - .6 Verify all pilot lights indicate correctly.
 - .3 High Voltage Vacuum Circuit Breakers
 - .1 Verify that cell electrical and mechanical interlocks function correctly.

- .2 Remove the breaker from the cell, and check the tightness of all control wiring.
 - .3 Check motorized racking mechanism for operation and binding.
 - .4 Check power and control stabs.
 - .5 Check porcelain and insulating for cracks and holes.
 - .6 Open and close breaker to check for friction and binding.
 - .7 Manually rack in and close breakers and check contacts for alignment mating and wipe.
 - .8 Operate the breaker and check the operation of the assembly.
 - .9 Follow manufacturers' specifications for lubrication.
 - .10 Operate the breaker electrically.
 - .11 Verify mechanical emergency open function of breaker.
 - .12 Put the breaker in test position in the cell; operate the breaker using the control switch.
 - .13 Open the breaker by closing the relay tripping contacts.
 - .14 Insulation resistance test measurements from phase to phase and phase to ground.
 - .15 Pole resistance to be measured by a contact resistance test set.
 - .16 Supply copy of Fuse Coordinate Study to UBC Facilities Electrical.
- .4 Protective Relays – Phase and Ground Protection
- .1 Electrical Tests
 - .1 Zero adjustment.
 - .2 Pickup value test.
 - .3 Time current characteristic tests - two points on curve.
 - .4 Instantaneous element pickup test.
 - .5 Differential protection test.
 - .6 Target and seal-in unit operation test.
 - .7 Check all settings to the co-ordination study or setting data sheet.
 - .8 Prove tripping circuit via primary injection from C.T. terminals.
- .5 Ground Fault Protection
- .1 Check mechanical tightness of all electrical connections from the zero sequence or other ground fault C.T.'s.
 - .2 Verify settings as per co-ordination data.
 - .3 Test pickup value.
 - .4 Test the time current characteristics.
 - .5 Prove C.T. and tripping circuits via primary injection.
 - .6 Verify that the breaker and relay will reset after a tripping operation.
- .6 Ground Electrode Resistance
- .1 Ground resistance tests for substation grounding electrode shall be performed using the fall-of-potential method. A test mat will be established approximately 100 to 150 meters out from the ground grid and 9 to 15 traverse readings taken. From the resulting readings a curve will be plotted to establish the ground mat resistance.
- .7 Surge Arrestors
- .1 Visual inspection for
 - .1 Cracked and/or chipped porcelain.
 - .2 Check for overall cleanliness.
 - .3 All electrical connections are secure.
 - .2 Meggar test insulating base and cable.

- .8 Cast Coil Transformer
 - .1 Insulation resistance tests to be carried out using an insulation resistance test set and the resulting insulation resistance values corrected to a base of 20° C. Polarization of Index readings at 1 (1) minutes and 10 (10) minutes shall be recorded.
 - .2 Winding resistance measurements to be taken on all windings and all positions of the off-load tap-changers, where applicable.
 - .3 Ratio, polarity and phase relationship tests completed for all taps, where applicable.
 - .4 Core insulation tests (when core ground is accessible).
 - .5 Cooling equipment and associated auxiliary controls to be inspected.
 - .6 Temperature indicator and associated control and alarm systems to be checked for continuity of wiring from instrument to transformer control cabinet and or wiring from transformer control cabinet to external system.
 - .7 Test insulation resistance of auxiliary and control wiring.
 - .8 All external bushing connections to be inspected for tightness.
 - .9 Inspect all bushings and insulators for cracks, chips, dust and overall cleanliness.
 - .10 Inspect transformer core, coils, terminal boards, tap changer, and all insulated surfaces for visible damage, foreign material or moisture, and tighten all electrical connections as necessary.
 - .11 External inspection of cell for rusting damage and apparent impediments of ventilation.
 - .12 Measure noise level rating around transformer with readings taken adjacent to each core & coil and between each core & coil.
- .9 Secondary Distribution
 - .1 Inspect all bushings and stand-off insulators.
 - .2 Inspect buss supports and check all connections.
 - .3 Check insulation resistance; phase to phase and phase to ground.
 - .4 Verify all C.T. characteristics
 - .1 Meggar.
 - .2 Check Polarity.
 - .5 Verify all V.T. characteristics.
 - .1 Meggar.
 - .6 Check C.T. secondary circuits by secondary current injection of the C.T. terminals to verify the operation of all relays and meters.
 - .7 Check V.T. secondary circuits by voltage source at the V.T. terminals to verify the operation of all associated relays, meters, and control circuits.
 - .8 Test and calibrate all secondary breakers over 225 amps.
 - .9 Record and report all field settings for each LSI and thermal magnetic circuit breaker.
 - .10 Record and report all conductor termination torque settings applied.
- .10 Transfer Switches
 - .1 Visual inspection for condition.
 - .2 Confirm nameplate, warning decals & arc flash labels are attached to the operating side of the equipment and are legible.
 - .3 Check insulation resistance; phase to phase and phase to ground.
 - .4 Verify all C.T. characteristics
 - .1 Meggar.
 - .2 Check Polarity.
 - .5 Verify all V.T. characteristics.
 - .1 Meggar.

- .6 Check C.T. secondary circuits by secondary current injection of the C.T. terminals to verify the operation of all relays and meters. Ensure shorting block is accessible and clearly labeled.
- .7 Check V.T. secondary circuits by voltage source at the V.T. terminals to verify the operation of all associated relays, meters, and control circuits. Ensure V.T. fusing is accessible and labeled.
- .8 Test and calibrate all active components.
- .9 Record and report all field settings.
- .10 Record and report all conductor termination torque settings applied.
- .11 For closed transition transfer switches confirm shunt trip operation of upstream utility CB by 3rd party injection testing of reverse power relay. Provide 3rd party report as part of transfer switch submittal package.
- .12 UBC Energy and Water Services require the following tests and submittals for closed transition transfer switches:
 - .1 CTTS factory settings for maximum interconnect duration shall not exceed 100msec.
 - .2 CTTS factory settings shall not permit peak shaving or soft load transfer.
 - .3 CTTS factory settings shall include passive synchronization for closed transition.
 - .4 CTTS shall incorporate a separate reverse power relay (32R) set to a maximum of 5% generator rating for 1 second. The reverse power relay shall be mounted on the operating face of the transfer switch, incorporate a resettable "flag" and be capable of being reset without opening the transfer switch enclosure.
 - .5 The 32R relay must connect to a shunt trip device in the transfer switch utility supply breaker. This operation shall be commissioned by a 3rd party using injection testing of the 32R relay.
- .11 Panelboards and Disconnects
 - .1 Visually inspect all internal components and ratings.
 - .2 Check all internal connections and confirm wire sizes.
 - .3 Ensure bushings are installed and all unused conduits are capped.
 - .4 Confirm nameplate, warning decals and arc flash labels are attached to the operating side of the equipment and are legible.
 - .5 Confirm required spaces and spare circuit breakers are installed.

2.4 Voltage Calibration

- .1 After energization and loads applied, secondary voltages of each transformer shall be checked against rated voltage. Taps shall be changed to correct deficiencies as required.
- .2 Record output wattages of all transformers under load conditions. Voltage readings shall include all phases-phase and phase-neutral conditions.

2.5 Reporting

- .1 Reports on all inspections and tests must be submitted with 10 working days of completion of tests.

END OF SECTION

1.0 **GENERAL**

1.1 **Coordination Requirements**

- .1 UBC Energy & Water Services. Refer to <https://energy.ubc.ca>.

1.2 **Description**

- .1 UBC requirements for Indoor and Outdoor Unit Substations.

2.0 **MATERIAL AND DESIGN REQUIREMENTS – INDOOR UNIT SUBSTATIONS**

2.1 **Indoor Unit Substations General Requirements**

- .1 The unit substation assembly shall be CSA approved 15 KV rated and be a completely unitized assembly of components as described in the next section.
- .2 Outdoor fluid filled padmount unit substations are acceptable to UBC and shall meet the minimum requirements in sub-section 3.0 and only in coordination with Energy & Water Services - Electrical Technical Services.
- .3 Switchgear located in sprinklered rooms, or rooms where the likelihood of water ingress could occur from above, shall have drip hoods installed on all cubicles. Openings for ventilation shall have suitable sprinkler protection. Where multiple cubicles are joined to form a single unit, individual drip hoods shall form a single continuous water barrier by means of factory provided upturned flanges or approved caulking methods.
- .4 Air conditioning units located within electrical rooms shall not have evaporator coils, drains, condensers or any powered equipment located directly above unit substations.
- .5 Unit Substation Components shall consist of:
 - .1 15 KV switchgear.
 - .2 Main feeder and standby feeder cable entrance sections.
 - .3 Drawout, 15KV vacuum circuit breakers and protection relay.
 - .4 Cast coil transformer, (aluminum shall not be specified).
 - .5 Metering.
 - .6 Secondary Distribution (if applicable).
- .6 Characteristics of the unit substation shall be:
 - .1 Primary voltage
 - .1 12,480 volts.
 - .2 Secondary voltage
 - .1 347/600 volts or 120/208 volts.
- .7 Transformer KV Rating
 - .1 KVA rating as required.
 - .2 Fan cooling to provide 50% additional capacity.
- .8 High voltage equipment shall be rated.
 - .1 3 phase 60 hertz.
 - .2 95 KV BIL.
 - .3 300 MVA interrupting capacity at 12.5 KV.

- .9 Primary service connections shall be nominal 3 phase 3 wire 12.5 KV.
- .10 Secondary voltage shall be 347/600 volts 3 phase, 4 wire, or 120/208 volts 3 phase, 4 wire.
- .11 Maximum allowable Arc Flash Hazard/Risk Category within any part of the unit substation between primary cable entrances and main secondary bus shall not exceed level 2 (8 cal/cm²).
- .12 All equipment shall be housed in factory assembled enclosed cubicles. Adjacent cubicles shall be separated by metal barriers.
- .13 Where it is necessary to construct the components in separate enclosures these, when mounted and bolted together, shall present a unified appearance as to height, form and color.
- .14 All exterior surfaces shall be free from projections. Cubicle construction shall be rigid with formed metal corner posts and with all metal edges returned.
- .15 Access to all individual components must be readily obtainable. All cubicles shall have hinged doors to allow for easy infrared scanning. Doors shall be maximum 1200 mm wide with a minimum 90 degree opening. All panels on which relays, meters, or instruments are mounted shall have a barriered compartment with hinged door. All hinges shall be concealed.
- .16 Cubicles shall have heavy duty locks with common key or inter-lock.
- .17 Access doors shall have two vault-type handles with padlocking feature or be secured with bolt(s) where required. This will allow easy infrared scanning.
- .18 Interlocking shall be to Canadian Electrical Code and UBC Utility Requirements.
- .19 Inside of cubicles shall be painted white or ASA 61 grey. Exterior shall be ASA 61 grey, two coats of high gloss enamel.
- .20 All power connections shall be rigid bussing adequately supported for available fault currents. All equipment shall be wired at manufacturer's plant and required field connections wired to accessible load terminals. Grounding ball studs shall be affixed to bus at each cable entrance compartment and on the high voltage bus within the transformer section.
- .21 All ground conductors including equipment ground shall be copper.
- .22 A flat copper bonding strip of 0.50 sq. in. (1.3 sq. cm) minimum cross sectional area shall extend the length of the unit substation and be extended to all non-current carrying metal parts of the unit substation and the neutral grounding bus. Grounding ball studs shall be located for easy access during maintenance and shall be located within easy access of all door openings.
- .23 All control fuses mounted in substation shall have downstream long life LED indicating lights, with nameplates, to indicate circuits are energized. Supply one set of spare fuses for all fuses locations.
- .24 Provide wiring terminal box with terminal block for all outgoing control circuits and spare contacts. Terminal block shall be located where access is possible without de-energizing.

- .25 Corrosion resistant approved warning signs shall be securely mounted on the outside of the unit substation cubicles.
- .26 All operating control and indicating equipment shall be clearly labeled with lamacoid labels. Provide engraved brass nameplates for each section and general nameplates directed by Engineer.
- .27 All high voltage vaults must have floor drains and containment curbs.
- .28 Approved manufacturers of unit substations are as follows:
 - .1 Eaton.
 - .2 Electric Power Equipment.
 - .3 Schneider Electric.
 - .4 Unit Electrical Engineering (UEE).
 - .5 Prime Engineering.

2.2 Performance Standards

- .1 Unit substation assembly installation shall comply with:
 - .1 CSA C22.2 No. 31, current edition and CSA labeled.
 - .2 BC Hydro "Requirements for Primary Substations Supplied at 12.0 KV and 25.0 KV".
 - .3 Canadian Electrical Code.
 - .4 BC Electrical Regulations and Bulletins.
 - .5 UBC Utility Standards.

2.3 Submittals

- .1 Shop drawings shall include:
 - .1 All major electrical equipment.
 - .2 High voltage switch.
 - .3 Unit substation
 - .1 High voltage breaker.
 - .2 12 KV switchgear.
 - .3 Transformer cubicle.
 - .4 Protection and control.
 - .4 Factory Transformer Test Report – test report of no-load and load losses, winding resistance tests and impedance test.
 - .5 Co-ordination study and curves.
 - .6 Secondary distribution.
 - .7 High voltage cable.
 - .8 High voltage terminations.
 - .9 Secondary bus.
 - .10 Distribution centre.
 - .11 Revenue metering.
 - .12 Seismic restraints.
 - .13 Ground pad.
- .2 Submit the following test reports associated with the unit substation:
 - .1 Production Tests - manufacturer's standard product test as requested in Section 26 08 00 Commissioning of Electrical Systems 2.1.
 - .2 Unit Substation Test - manufacturer's factory test on supplied unit substation as specified in Section 26 08 00 Commissioning of Electrical Systems 2.1.
 - .3 Site Commissioning - test report on site commission as specified in Section 26 08 00 Commissioning of Electrical Systems 2.3.

- .4 Factory Transformer Test Report – test report of no-load and load losses, winding resistance tests and impedance test. Refer to Section 26 12 00 Medium-Voltage Transformers, sentence 2.4.4, for required loss limits for various size transformers.
- .3 Station Ground Resistance
 - .1 Submit ground resistance test as outlined in Section 26 08 00 Commissioning of Electrical Systems 2.3.6.
- .4 Cable Testing
 - .1 Submit conductor and cable test reports as outlined in Section 26 05 05 High Voltage Cables 2.12 Testing.
- .5 Voltage Calibration
 - .1 Submit voltage calibration report as outlined in Section 26 08 00 Commissioning of Electrical Systems 2.4.
- .6 Seismic Certification
 - .1 Submit certification of compliance with seismic requirements as specified in Section 26 05 48 Vibration and Seismic Controls for Electrical Systems.
- .7 Final Inspection Certificate
 - .1 Submit a copy of the final provincial electrical inspection certificate.
- .8 Operating & Maintenance Manuals
 - .1 Operating and maintenance manuals shall be submitted.
- .9 Project Record Documents
 - .1 Project record documents shall be submitted as specified and as per CCDC standards.
- .10 Shop drawings shall be submitted for review prior to construction. Shop drawings shall be AutoCAD or PDF with minimum 600 dpi resolution. Hard copies shall be on AO (841 mm x 1189 mm) sized drawings. Supply digital files with Shop Drawing submittal.
- .11 Before assembly of the unit substation, submit the following information in digital format:
 - .1 Electrical one-line diagram.
 - .2 Protective device co-ordination graph.
 - .3 Layout plan with dimensions.
 - .4 Reviewed and approved equipment cubicle drawing, including circuit breaker control wiring diagrams and key interlock scheme.
 - .5 Shop drawing information.

2.4 Drawing Requirements

- .1 AutoCAD Drawings Shall Include:
 - .1 Equipment layout and overall dimensions.
 - .2 Equipment specifications.
 - .3 One line diagram.
 - .4 Relating information including relay specs; time-current graphs; wiring diagrams, and tripping system.
 - .5 Seismic support and restraints.
 - .6 Metering information.
 - .7 Terminal block wiring and labeling.
 - .8 Labels.

- .2 Electrical One-Line Diagram
 - .1 The electrical one-line diagram shall show the connection of all the service entrance equipment. It shall contain the proposed service entrance relay settings.
- .3 Protective Device Co-ordination Graph
 - .1 A standard size 4 ½ x 5 cycle log-log graph shall be used for the co-ordination study. It is mandatory that the service entrance protective device setting be compatible and co-ordinate with UBC Energy & Water Services protective equipment. The manufacturer shall provide the required co-ordination study. Refer to Section 26 05 04 Protective Device Coordination and Arc Flash Analysis.
- .4 Equipment Drawing - Unit Substation
 - .1 The unit substation shop drawings shall be submitted for review prior to assembly.
 - .2 The drawings shall show fully dimensioned equipment assembly details and the wiring diagram of the circuit breaker control scheme.

2.5 Metering Requirements

- .1 Metering shall be supplied by Switchgear Manufacturer at the project's cost and installed by manufacturer.
- .2 Switchgear manufacturer to incorporate Schneider Electric PM8240 meter with i/o module meter into construction.

2.6 Testing & Commissioning

- .1 Factory tests shall be performed as specified in Section 26 08 00 Commissioning of Electrical Systems. Provide written report of test results prior to shipment of unit substation.
- .2 Provide written report of test results prior to energization of unit substation.
- .3 Unit substation, when fully assembled, shall be made available for inspection in the factory by the Engineer.
 - .1 Unit substation to have factory test and site and commissioning as outlined in the Specification.

2.7 Cubical Specifications

- .1 Cable Entrance and Withdrawable Breaker Cubicles
 - .1 Shall house incoming cable terminations with provision for stress cones and cable supports.
 - .2 Shall include grounding ball studs on both incoming buses.
 - .3 Shall house Capacitive Voltage Transformers (CVT).
 - .4 Shall house Current Transformers (CT).
 - .5 Shall house electrically operated withdrawable vacuum circuit breakers.
 - .6 Shall house electrical operating controls for breaker racking mechanism behind lockable door.
 - .7 Shall house electrical operating controls for breaker open/close override behind lockable door.
 - .8 Shall include viewing windows.
 - .9 Doors shall have provisions for heavy duty padlock.
- .2 Transformer Cubicle
 - .1 Shall house cast coil transformer. Aluminum transformers are not permitted.

- .2 Ventilation louvers and fan cooling shall provide adequate cooling and ventilation.
- .3 Access doors shall be interlocked with main breaker.
- .4 May house metering equipment if not located in secondary distribution.
- .5 Transformer mounting shall meet seismic requirements.

2.8 Stress Cones

- .1 Stress cones shall be Raychem "Hot Shrink" or 3M "Cold Shrink" termination kit for 4/0 XLPE 25 KV rated.

2.9 15kV Cable Entrance

- .1 All components with the 15kV cable entrance section shall be fully accessible after substation installation.
- .2 The cable entrance section shall house the 15kV Current Transformers (CT) and Capacitive Voltage Transformers (CVT).
- .3 Grounding ball studs shall be installed on all incoming feeder connections and shall be positioned to allow access after the equipment is installed.
- .4 Cable support blocks shall be installed such that they do not interfere with cable terminations or cause undue mechanical stress to cable or connections. Supports blocks shall be constructed of electrically insulating material rated for the application. Support blocks shall utilize a clamping method to secure cables. Cable ties are not permitted.

2.10 Primary Bussing

- .1 15 KV primary copper bussing, minimum 600 Amp capacity.

2.11 15kV Withdrawable Circuit Breakers

- .1 15kV, 3 pole, 600 Amp group operated vacuum circuit breaker with magnetic actuator.
- .2 Each vacuum interrupter shall be mounted in molded epoxy housing with a minimum pole spacing of 210 mm. Vacuum interrupters shall be designed and rated as "sealed for life".
- .3 The breaker shall be operated by an electrically operated magnetic actuator controlled by position sensors and by electronic module. The energy required for operation shall be provided by integrated capacitors capable of storing sufficient energy for a complete operating cycle: open – close – open.
- .4 The breaker shall have local control buttons for open and close with an emergency mechanical opening operation and shall include a position indicator.
- .5 Rated interrupting capacity shall be minimum 300 MVA and 16kA RMS symmetrical at 15kV. Rated current 630 Amps. Rated duty cycle: open - 0.3 sec. - close/open - 15 sec. - close/open.
- .6 Number of operations at rated current = 30,000. Number of operations under short circuit = 100.
- .7 Rated impulse withstand of 95 KV BIL.
- .8 Breaker shall be type tested in accordance with ANSI Standard C57 and/or IEC 62271-100, CEI 17-1 file 1375.

- .9 Breaker shall be withdrawable type via motorized operator and manual racking lever.
- .10 Electric operators shall be 24 or 48V DC type compatible with unit substation control voltage and be powered directly from the DC Battery System.
- .11 The breaker shall have position sensors to prevent racking out while breaker is in the closed position.
- .12 The breaker shall have an integrated lockable hasp for the provision of personal lockout with mechanical and electric interlock to prevent the breaker from being able to be racked in.
- .13 The breaker shall be able to be fully racked in and out with the doors closed.
- .14 The breaker door shall be able to be closed after applying personal padlocks to the breaker.
- .15 All doors shall have provisions for padlocks.
- .16 A window shall be provided to permit viewing of the breaker in both the open, closed and racked out position.
- .17 Approved manufacturers are:
 - .1 ABB
 - .2 Eaton
 - .3 Schneider Electric

2.12 15kV Breaker Trip

- .1 Tripping power shall be obtained from the DC battery system.
- .2 The operating voltage for breaker trip shall be either 24 or 48 V DC.
- .3 Auxiliary trip coils shall be DC operated and independent of availability of AC current.
- .4 In addition, provide a shunt trip for over temperature and ground fault trip. Power to be from the DC battery system. Provide LED lamps for monitoring of shunt trip.
- .5 Provide one set of NO and NC auxiliary contacts to indicate whether breaker is open or closed wired to a terminal block located in an outlet box at the top of the cubicle.

2.13 Relay Current Transformers and Zone of Protection

- .1 Current Transformers (CT) shall be installed within the switchgear to create a complete protection zone. The zone of protection shall include cable terminations for both incoming feeders, HV circuit breakers, main transformer and main secondary bus and distribution board.
- .2 Provide window style, 600V, relay accuracy C100 CT's, ratio XX:5, in each 15kV cable entrance section. CT window shall be sized to allow for cable to pass through without interference to cable or its termination. CT's shall be permanently and securely mounted in switchgear cable entrance section.
- .3 Provide window style, 600V, relay accuracy C100 CT's, ratio XXX:5 in the low voltage section. Locate CT's as close as possible to the secondary connections of the transformer to maximize the protection zone area. CT's shall be permanently and securely mounted in switchgear.

- .4 The Arc Flash Hazard category within any area covered by the Zone of Protection shall not exceed level 2 (8 cal/cm²).

2.14 Protection Relay

- .1 Overcurrent and short circuit protection shall be provided by a single Schweitzer Engineering Laboratories (SEL) 700GT+ series relay.
- .2 The SEL relay shall also provide protection for primary and secondary ground faults.
- .3 Protection shall be of the circuit closing type with programmable current range from 0.1 to 96.0 amps.
- .4 CT inputs shall be rated for 5 amp CT secondary.
- .5 The SEL relay shall be powered directly from the DC Battery System.
- .6 The SEL relay shall be surface mounted on the switchgear.

2.15 Capacitive Voltage Transformers

- .1 Three (3) Capacitive Voltage Transformers (CVT) shall be installed in each 15kV cable entrance section.
- .2 CVT's shall be mounted on the line side of each 15kV breaker and used exclusively for the purposes of live line detection.
- .3 CVT's shall have a voltage rating of at least 22kV to permit high potential cable testing.

2.16 Breaker Remote Operation

- .1 Both the normal and alternate breakers shall normally be operated remotely via control cabinet located in an area outside of the arc flash protection boundary.
- .2 The control cabinet shall house a single operating switch to transfer from one feeder to the other.
- .3 The control cabinet shall house operating controls to open and close individual 15kV breakers.
- .4 The control cabinet shall house pilot lamps to indicate breaker position for both 15kV feeders.
- .5 A time delay shall be incorporated of up to 15 seconds before the first action for the purposes of transferring between feeders or closing an individual breaker. This time delay will allow sufficient time for anyone that may still be within an arc flash protection zone to safely exit the area before the breakers operate. There shall be no time delay associated with opening an individual breaker.
- .6 Control wiring between the unit substation and the control cabinet may be via individual control wires, fibre optic cables or a combination of both.
- .7 All breaker operations shall be supplied from the DC Battery System.
- .8 The control cabinet shall have a hinged cover with provision for a heavy duty padlock.
- .9 The control cabinet controls shall look similar to that in UBC Standard Drawing E1-6.

2.17 Location of Auxiliary and Control Equipment

- .1 All components used for protection and control shall be housed in a separately barriered compartment from any high voltage equipment. This also applies to all auxiliary components including terminals, relays and pilot lamps.
- .2 Provide a 27mm conduit extending from the barriered control section of each feeder to a junction box on top of the substation equipment to allow for connection to external devices or monitoring equipment.

2.18 DC Battery System

- .1 Provide 24 or 48 volt DC battery system complete with heavy duty charger. Batteries shall have sufficient storage capacity to fully operate the circuit breakers (open – close – open), pilot lights and protection and control system in the event of a power failure.
- .2 Batteries shall store sufficient energy to ably maintain, monitor and control for up to 24 hours.
- .3 The DC charger shall be fed directly from the substation at 120 volts.
- .4 The DC charger shall have output relays with Form C dry contacts for the following conditions:
 - .1 AC power loss
 - .2 Charger failure
 - .3 DC power loss
- .5 The DC charger shall have an internal audible alarm that will annunciate during any of the above abnormal conditions.
- .6 The DC Battery System may be located in a separately barriered section of the switchgear or stand-alone outside of the switchgear. The system shall be designed such that any component of the system can be readily and safely accessed without shutting down the substation.

2.19 Main Secondary Breaker

- .1 A main secondary breaker, 600 or 208 volt, is not preferred.
- .2 In lieu of a secondary main breaker, provide current transformers (CT) to perform necessary overload, short circuit protection and Arc Flash Hazard Category reduction as outlined in Section 26 11 13 Primary Unit Substations, 2.1.8.
- .3 A main secondary breaker may only be provided for the purposes of derating downstream buses or as approved by UBC Energy & Water Services.

3.0 MATERIAL AND DESIGN REQUIREMENTS – OUTDOOR UNIT SUBSTATIONS

3.1 Outdoor Unit Substations General Requirements

- .1 Substation assembly shall be CSA, cUL or field (SPE-1000) certified.
- .2 15kV, 16kA rated, switchgear, solid dielectric or gas insulated with integrated high voltage main feeder and standby feeder cable entrance section.

- .3 Fluid filled transformer and integrated vacuum fault interrupter, with FR3® Envirotemp insulating fluid.
- .4 Overcurrent protection and auxiliary control components.
- .5 Low voltage distribution equipment, if required.
- .6 Outdoor transformers shall be sized not more than 3MVA.
- .7 Outdoor transformers may have a distribution panel integrated within the low voltage section rated not more than 3000 amps.
- .8 In installations requiring integrated distribution equipment, no single circuit breaker shall be rated higher than 1600 amps.
- .9 Overhead services for outdoor unit substations is not allowed.

3.2 15 KV Outdoor Switchgear Minimum Requirements

- .1 16kA rated equipment maintenance free design.
- .2 Dead front cable entrance and exit sections. Cable connections shall be IEEE 386 15kV, 600 amp deadbreak type.
- .3 Cable connection bushings shall be minimum 30" from bottom of equipment.
- .4 Solid dielectric or gas insulating medium only. Air insulated equipment shall not be permitted.
- .5 2 separate high voltage 3 phase fully load break rated isolating switches (2 ways) in a loop/feed through configuration within in common tank.
- .6 Each operating switch shall have one cable entrance connection with a 3rd outgoing cable connection directly on the common bus.
- .7 Cable entrance and exit connections shall only be mounted on front, back or side walls. Cable connections shall not be permitted on top or bottom of equipment.
- .8 Load break isolating switches shall have either 2 operable positions, Closed-Open or 3 operable positions, Closed-Open-Ground.
- .9 Load break Isolating switches shall be padlockable in the Open position to meet WorkSafe BC requirements.
- .10 Ability to operate load break isolating switches independently of each other while energized.
- .11 Large viewing window(s) for load break isolating switch contact position verification.
- .12 Approved manufacturers of outdoor solid dielectric or gas insulated switchgear are:
 - .1 Eaton/Cooper
 - .2 G&W Electric
 - .3 S&C Electric
 - .4 Prime Engineering

3.3 Fluid Filled Transformer with Integrated Vacuum Fault Interrupter Minimum Requirements

- .1 XXXX kVA 3 Phase Transformer
- .2 Insulating fluid FR3® environmentally friendly fluid for transformers
- .3 Integrated single vacuum fault interrupter (VFI) device installed by transformer manufacturer fully immersed in common tank
- .4 Factory supplied external 3 phase self-powered protection controller with auxiliary shunt trip inputs in a NEMA 4 enclosure
- .5 VFI operating handle and contact position viewing window in separate section from HV or LV cable entrances.
- .6 Cooling Welded Panel Type Radiators
- .7 Coatings ANSI 61 grey 3 mil
- .8 Touch-Up Paint (aerosol cans) (Qty: 2)
- .9 Notifications Standard Aluminum Nameplate
- .10 Notifications CSA, cUL Listed & Labeled
- .11 Nitrogen Blanket Nitrogen blanket With Purge Valve
- .12 Liquid Level Gauge Liquid Level Gauge
- .13 Liquid Temp Gauge Liquid Temp Gauge with Alarm Contacts
- .14 Pressure Vacuum Gauge Pressure Vacuum Gauge
- .15 Pressure Relief Cover Mounted Pressure Relief Device
- .16 Valves Upper Fill Valve (1")
- .17 Valves Drain Valve (2") with Sampler
- .18 Tank Designed to meet seismic requirements of BC Building Code, current edition
- .19 Tank Designed for Skid Mounting, Continuous Operation @ 4-5° Tilt
- .20 Tank Welded Main Cover with Handhole
- .21 Tank Manhole Cover (Qty: 1)
- .22 Tank Stainless Steel Ground Pads
- .23 Installation Location Outdoor
- .24 Temperature Rise 65
- .25 Cooling Class KNAN
- .26 Frequency 60
- .27 Impedance 5% - 7% max
- .28 Efficiency Standard CSA C802.1
- .29 Elevation Designed for operation at 1000 m (3300 ft) above sea level
- .30 High Voltage 12,480 Delta
- .31 Primary Conductor copper
- .32 Primary BIL 95 kV
- .33 Taps 2 - 2.5% taps above and 2 - 2.5% taps below nominal
- .34 High Voltage Bushings, IEEE 386, 15kV 600amp deadbreak
- .35 High Voltage Bushing location Sidewall minimum 36" AFF
- .36 600 volt donut style XX:5 C100 (C50 minimum) CT's (3) field mounted within incoming cable section
- .37 Primary Phasing H1-H2-H3 (Left to Right)
- .38 Low Voltage 600Y/347 Wye solidly grounded
- .39 Secondary Conductor copper
- .40 Secondary BIL 30 kV
- .41 Secondary Bushing Location Sidewall
- .42 Secondary Phasing X1-X2-X3-XO (Left to Right)
- .43 Integrated overcurrent protection and controls section (see item 6 below)

3.4 Secondary Cabinet Minimum Requirements

- .1 Secondary Cabinet Front access door, including either 2 padlockable handles or a single padlockable handle and 2 tamperproof pentahead bolts.

- .2 Secondary Cabinet Side access panel.
- .3 600 volt donut style XXX:5 C100 (C50 minimum) CT's (3) permanently mounted at secondary phase bushings.

3.5 Overcurrent Protection and Auxiliary Control Equipment Minimum Requirements

- .1 Provide a 3000VA 600/120-240V station service transformer with primary class CC fuses installed in a NEMA enclosure within the transformer VFI operating section.
- .2 Provide a 60 amp rated 120/240V, 8 circuit load centre within the VFI operating section.
- .3 Provide a single 20 amp, 5-20R, GFCI convenience receptacle within the VFI operating section.
- .4 Provide 120VAC - 24VDC power supply c/w sealed lead acid battery backup. Batteries shall be sufficiently sized to provide protection and control for up to 24 hours. Batteries shall be provided by UBC.
- .5 24VDC power supply shall have integrated form C relay output and local audible alarm that activate on loss of AC or general trouble.
- .6 Provide 24VDC powered SEL 700 GT+ relay for primary, secondary 50/51 and ground fault protection.
- .7 Provide 120VAC heater, thermostatically controlled, mounted in the control cabinet and the LV section (when distribution equipment is installed).
- .8 Provide 120VAC heater in the 15kV switchgear cabinet enclosure.
- .9 Heaters, lights and convenience receptacle shall be supplied directly from the load centre.
- .10 Provide 600 volt donut style CTs, field mounted, in transformer high voltage cable entrance section.
- .11 Provide (3) 15.3 kV MCOV surge arrestors with 600 amp IEEE 386 connection for installation in high voltage cable entrance section.
- .12 Provide 600 volt donut style CTs, factory mounted, on secondary transformer bushings.
- .13 All auxiliary protection and control equipment shall be powered from the station service transformer and located within the transformer primary VFI operating switch section within a separately barriered enclosure mounted into a rigid side panel but accessible with transformer doors closed.
- .14 All operating and control components shall be located behind lockable NEMA 3R or 4 rated panel covers.

3.6 Approved Manufacturers of Outdoor Transformers and Associated Enclosures

- .1 Eaton/Cooper
- .2 Vantran Industries
- .3 Partner Technologies Inc. – PTI

- .4 Prime Engineering
- .5 Schneider Electric

3.7 Relay Current Transformers and Zone of Protection

- .1 Primary and secondary Current Transformers (CTs) shall be installed within the transformer enclosure to create a complete protection zone. The zone of protection shall include all components within the entire transformer enclosure and incorporate the VFI, transformer and secondary supply cables.
- .2 The Arc Flash Hazard category within any area covered by the Zone of Protection shall not exceed level 2 (8 cal/cm²).
- .3 The SEL 700GT+ relay shall act as the main protection device for the zone of protection and programmed with the following settings:
 - 1. HV 50/51
 - 2. HV 51N
 - 3. LV 50/51
 - 4. LV 51G
- .4 All other ancillary protective devices (49, 63, etc.), if used, shall connect into the SEL 700GT relay.
- .5 The factory supplied protection controller (if provided) shall act as a backup protection device and shall effectively coordinate with the SEL 700GT+ relay.
- .6 Refer to UBC standard drawing E1-2b for Protection and Control Single Line.

3.8 Switchgear and Transformer Cable Interconnection

- .1 High Voltage cable interconnection between the switchgear and transformer shall be installed by UBC Energy & Water Services only and charged to the project.
- .2 All protection and control equipment wiring shall be installed by the contractor.

3.9 Concrete Equipment Pad and Seismic Anchoring

- .1 The contractor shall design and provide the concrete equipment pad and all interconnecting conduits.
- .2 15kV switchgear and transformer shall be physically separated by the minimum requirements of the equipment supplier and applicable codes with a minimum of 300mm clearance between equipment.
- .3 UBC Energy & Water Services shall approve all concrete pad layouts along with all protective bollard locations or architectural surrounds prior to any installation.
- .4 Refer to typical concrete pad layout in UBC standard drawing E1-2c.
- .5 UBC Energy & Water Services may refuse permanent power connection to any installation that is not installed as per approved layout design.
- .6 The contractor shall ensure all seismic anchoring requirements are met as per UBC Technical Guidelines section 26 05 48.

3.10 Grounding and Bonding

- .1 Counterpoise grounding and bonding shall be designed, installed and tested as per UBC Technical Guidelines section 26 05 26.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Coordination Requirements**

- .1 UBC Energy & Water Services
- .2 UBC Facilities Electrical

1.2 **Description**

- .1 UBC requirements for Substation Transformers.

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

2.1 **Primary Bussing**

- .1 15 KV primary copper bussing, minimum capacity 600 amps, 300 MVA bracing.

2.2 **Surge Arrestors**

- .1 Provide three 15.3 kV MCOV distribution class surge arrestors. Install immediately upstream of transformer primary connection. Ground arrestors directly to ground bus with 4/0 copper.

2.3 **Transformer Connection**

- .1 Flexible copper braid connections at both primary and secondary connections of transformer.
- .2 Grounding ball studs shall be affixed to the primary transformer bus and meet accessibility requirements as per section 26 11 13 2.1.

2.4 **Cast Coil Transformer**

- .1 Substation transformer(s) to step down voltage from 12.48 KV to 347/600V or 120/208V shall be cast coil type, Class F insulation.
- .2 Cast coil transformer with fan cooling to provide 50% additional load capacity. The transformer cubicle shall contain transformer core and cast coils, fans and controls, temperature measuring assembly, neutral/ground CT, primary and secondary busses and ground bus.
- .3 The transformer shall be designed and built in accordance with the current issues of CSA Standard C9 and ANSI Standard C57.12.00.
- .4 Losses shall be in compliance with or exceed CSA Standard C802 requirements.

Transformer Size (KVA)	No. Load Losses (Watts)	Load Losses (Watts)
750	2,300	7,500
1000	2,900	9,000
1250	3,250	10,100
1500	3,800	12,100
2000	5,200	14,300
3000	5,700	19,500

- .5 The transformer shall be a 3 phase core type with cast epoxy coils fiber glass reinforced, type AN with forced air cooling. To provide 50% additional capacity both HV and LV coils shall be cast under a hard vacuum in steel moulds and the cores shall be mitered.
- .6 Insulation system shall be Class F (185 °C) but the average winding temperature rise shall be 80 °C maximum, at rated voltage and full load.
- .7 Windings shall be copper. Aluminum shall not be used.
- .8 Each LV winding shall be equipped with embedded temperature sensors connected to the detection system temperature relay unit with separate output dry contacts for fan operation, remote alarm and tripping corresponding to 80% and 95% and 105% of rated operating temperature.
- .9 Provide a digital readout for each phase and constant memory of the highest temperature with readout on demand.
- .10 Provide remote contacts for high temperature monitoring wired to outlet box at roof of transformer.
- .11 Mount temperature relay unit and thermometer on a hinged panel of a barrier instrument compartment on the side of cubicle. Connect tripping contacts to trip the primary vacuum breaker. Extend 1-NO and 1-NC alarm contact to terminal blocks in a six inch outlet box on the roof of the transformer enclosure.
- .12 Power supply for cooling fan shall be supplied from power source in transformer cubicle (secondary connection).
- .13 Provide design data and shop drawings for all transformer characteristics for approval by the consultant before proceeding with manufacture.
- .14 The core shall be protected against corrosion by a coating of epoxy resin not less than 1 mm thick. All steel parts other than the core shall be hot dip galvanized with a minimum coating thickness of 0.1 mm or epoxy painted.
- .15 After manufacture, the transformer shall be partial discharge and sound level tested in addition to standard production tests list in CSA Standard C9 to verify the specified ratings. The partial discharge shall not exceed 15 pico coulombs at a corona extinction voltage of 120% of rated voltage when energized by induction from a three phase, 60 HZ or higher frequency source. A certificate issued by the Testing Engineer shall be provided verifying the results of all factory tests.
 - .1 Continuous (XXX) KVA rated output.
 - .2 (XXX) KVA fan cooled rated output.
 - .3 Insulation Class - F 185 °C maximum winding temperature.
 - .4 Temperature Rise Design - 80 °C average winding temp rise.
 - .5 Frequency – 60 Hz.
 - .6 Rated Primary voltage – 12,480V.
 - .7 Rated secondary voltage 347/600V or 120/208V.
 - .8 Connections - delta / grounded Wye.
 - .9 Impedance 5% min. to 7% max.
 - .10 Off load taps - 4 - 2 1/2%, 2 FCAN, 2 FCBN.
 - .11 Basic Impulse Level – 95 KV.
 - .12 Available fault current rating - 300 MVA sym.
 - .13 Number of phases is three (3).
 - .14 Maximum noise level 65 dBA at full load at one meter.

- .16 Approved Manufacturers are:
 - .1 LG Industrial Systems.
 - .2 ABB Resibloc Cast Resin.
 - .3 LSIS
 - .4 Jinpan International
 - .5 Hammond EnduraCoil
 - .6 Rex Power Magnetics
- .17 Provide the Following Features for the Transformer:
 - .1 Access doors key interlocked with primary circuit breaker.
 - .2 Engraved transformer nameplates including connections, voltage ratings, impedance, and other data as required by CSA, one on core and coils and one on exterior of enclosure.
 - .3 On completion of manufacture, but prior to shipment, the following tests shall be performed and results certified by a registered Professional Engineer.
 - .1 All CSA C9 tests, including losses.
 - .2 Partial discharge test – Factory Test.
 - .3 Sound level test – Factory Test.
- .18 Three copies of these results shall be forwarded to the Consultant for approval prior to transformer shipment from the factory.

2.5 Transformer Neutral

- .1 Transformer secondary neutral shall be solidly grounded to ground bus mounted in transformer cubicle.
- .2 Connect grounding bus in transformer cubicle with ground bus in 12 KV switchgear.

2.6 Ground Bus

- .1 Provide a ground bus capable of terminating all ground and neutral connections. Allow for 3 spare 4/0 lugs and space for 6 future lugs.

2.7 Ground Fault Protection

- .1 Current Transformer
 - .1 Ground fault sensor current transformer sized to match requirements of ground fault relay up to full load current rating of transformer.
- .2 Ground Fault Relay (51G)
 - .1 Provide a secondary over current ground fault relay 50/51M with current pick-up range (0-XXX) amps, 0 - 10 seconds, adjustable definite time, with current transformer sensor in the neutral conductor of the transformer relay. Ground fault conductor shall trip main vacuum breaker.

2.8 Temperature Relay

- .1 Transformer temperature relay with 3 temperature sensors, one for each winding. Relay shall have three contact settings to be set at:
 - .1 80 °C Alert.
 - .2 100 °C Alarm.
 - .3 120 °C Trip.

2.9 UBC Energy and Water Services Revenue Meter

- .1 Revenue meters shall be switchboard mounting, 3 element watt hour demand type, Schneider Electric PM8240 meter with i/o module.
- .2 Multifunction Meter with Ethernet capability. Refer to Section 26 27 13 Metering.

2.10 System Monitoring

- .1 The following monitor points and contacts shall be wired out to a terminal block located in a junction box on the unit substation roof for future connection to UBC BMS system to monitor:
 - .1 Circuit breaker #1 status.
 - .2 Circuit breaker #2 status.
 - .3 SEL Relay health status.
 - .4 DC Battery System – AC power loss.
 - .5 DC Battery System – Charger failure.
 - .6 DC Battery System – DC power loss.
 - .7 Transformer fan on transformer temp 'alert'.
 - .8 Transformer temp 'alarm'.
 - .9 Three (3) spare spaces.
- .2 Refer to Section 25 05 00 Building Management Systems (BMS) Design Guidelines for technical requirements of BMS.

2.11 Interlocking

- .1 Safety interlocks shall be provided as required, equal to Kirk or FPE. Load break switches shall be interlocked with the transformer tap door. Refer to interlocking diagram.

2.12 Vibration Isolation Requirements

- .1 Particular attention shall be paid to the installation of the transformer to reduce the noise level in the transformer room.
- .2 Supply transformers generating a space average noise level in the transformer room not exceeding 60 decibels measured in any third octave band between 50 Hz and 1000 Hz based on a 300 KVA transformer.
- .3 Other sizes shall meet equivalent noise level with noise correction based on 10 Log KVA re. 300 KVA.
- .4 Supply vibration isolation such that the airborne noise isolation provided by the building structure is not limited by structure borne noise transmission. The following are minimum isolation requirements:
 - .1 Mount the transformer core on 25 mm deflection spring isolators, including in series neoprene elements with an effective deflection of 2.5 mm, and restraints meeting the National Building Code with respect to seismic requirements.
 - .2 For a slab on grade installation, use neoprene isolators sized for a minimum 2.5 mm deflection, with seismic restraints.
 - .3 If the transformer core is mounted on separate transverse steel supporting members, independent of the transformer enclosure, size the members for a 140 Hz cantilever resonant frequency under the dead load of the member (0.013 mm dead load cantilever deflection) and the spring stiffness.

- .4 Provide sufficient flexibility in the braided connectors on both the low voltage and high voltage sides of the transformer such that the vibration isolation provided by the spring/neoprene isolator supports is not limited by the braided connectors. If such flexibility is impractical, isolate the cabinets on neoprene isolators with 2.5 mm deflection and isolate the conduit.
- .5 Within the electrical room, provide neoprene hangers with 0.1" static deflection in threaded rod supports for all new conduit, cable trays, etc. Avoid rigid connections to the structure. Avoid any contact of electrical equipment to drywall partitions where transformer rooms are located adjacent to occupied spaces.
- .5 Submit shop drawings detailing proposed isolation.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 33 10 00 Water Utilities - 2.4
- .2 Section 33 51 00 Natural Gas Distribution - 2.4
- .3 Section 33 63 00 Steam Energy Distribution - 2.5
- .4 Section 27 05 08 Description of System – 1.4
- .5 Section 25 05 00 Building Management System (BMS) Design Guidelines.
- .6 Section 26 27 13 Secondary Metering

1.2 Coordination Requirements

- .1 UBC Energy & Water Services

1.3 Description

- .1 UBC requirements for Metering for revenue grade applications. Refer to Section 26 27 13 for secondary metering requirements.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General

- .1 Switchgear manufacturer shall supply and install Revenue grade meter at the project's cost.

2.2 Revenue Metering

- .1 Revenue grade meter shall be Measurement Canada approvable, Schneider Electric Type PM8240 Multifunction Meter with i/o module and Ethernet options.
- .2 It shall be for use with 3 current transformers and programmed for CT's to allow for direct readout.
- .3 The meter shall be flush mounted @ 54" above finished floor (centre of meter) in a separately barriered instrument compartment in the distribution enclosure. Provide a 10-pole test block for current and potential circuits, surface mounted on the outside of the door of the metering compartment.
 - .1 For 120/208V Systems wire the meter as shown on Drawing E4-4.
 - .2 For 347/600V 4W Systems wire the meter as shown on Drawing E4-5a.
 - .3 For 347/600V 3W Systems wire the meter as shown on Drawing E4-5b.
- .4 Approved Test Block Manufacturers:
 - .1 ABB type FT-1.

2.3 Metering Transformers

- .1 Metering transformers shall be provided by the switchgear manufacturer.
- .2 Three current transformers (CT's) shall include revenue metering accuracy of 0.3B0.9, ratio XXX/5 for Schneider Electric PM8240 with i/o module multifunction meter. Mount CT's on transformer secondary bus.

- .3 Metering at 600V, 4 wire secondary shall include three voltage transformers, revenue accuracy, 360:120 ratio shall be mounted in a separately barriered instrument compartment. For 3 wire systems, the consultant or manufacturer shall contact UBC Energy & Water Services for recommended solutions.

2.4 Mechanical Meters

- .1 Main building gas and water meters are to be integrated into the electrical metering system. Pulse outputs from each of these meters are to be brought to the Schneider Electric PM8240 meter for recording purposes. Refer to standard drawing E4-6 for wiring connections.
- .2 The Division 26 contractor shall install all pathways and wiring between the mechanical meters and the electric meter. Coordinate with Division 20 contractor and UBC Energy & Water Services.
- .3 District Energy meter shall be network connected directly to UBC ION metering network. Refer to Division 20, 23 and 27 for applicable details and Drawing E4-6c.
- .4 Refer to Drawing E4-6 for wiring requirements of the gas and water metering integration into Schneider Electric PM8240 meter.

3.0 Other

- .1 A raceway shall be provided between the PM8240 meter and the nearest communications closet. Provide an IT demarcation box within 3 metres of the PM8240 meter. Refer to Division 26 standard drawing E4-6 and Division 27 standard drawing ITSTD-22.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Coordination Requirements**

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Facility Management (Okanagan)

1.2 **Description**

- .1 The Low-Voltage Transformer technical guideline outlines the requirements for dry type distribution transformers utilized at UBC facilities with primary/secondary voltages between the ranges of 120 to 600 volts.

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

2.1 **Design**

The following variables must be evaluated when specifying a transformer:

- .1 Primary and Secondary voltage/phase/frequency requirements.
- .2 Total loading on the transformer.
- .3 Future capacity required.
- .4 Type of loads.
- .5 % of linear and non-linear loads.
- .6 Environmental requirements (Water/dirt egress, sound).
- .7 Spacing and weight requirements for proposed location.
- .8 Adequate ventilation in proposed location.
- .9 Mounting type.
- .10 Mechanical protection.
- .11 Tamper resistance in areas accessible to the public.
- .12 Ease of access for inspection, maintenance, removal and replacement.

2.2 **Transformer Types**

- .1 Isolation transformers are required for all installations. The only exceptions are the following:
 - .1 Transformer serving a single piece of equipment that does not contain a switching power supply.
 - .2 Serving a single piece of equipment with written confirmation from the manufacturer that an alternative type of transformer is acceptable for use.
- .2 The following dry type transformers may be specified based on the following requirements:
 - .1 General Purpose:
 - .1 General purpose transformers shall be specified when there are less than 15% non-linear loads.
 - .2 K-Factor Rated:
 - .1 K-Factor Rated transformers shall be utilized in applications where 15% or greater non-linear loads are present:
 - 15-35% non-linear loads → K-4 rated transformer.
 - 36-75% non-linear loads → K-13 rated transformer.
 - 76-100% non-linear loads → K-20 rated transformer.
 - .3 Harmonic Mitigating:
 - .1 Harmonic Mitigating transformers can be specified for the following applications:

- Mitigation of potential nuisance tripping of overcurrent protection upstream in the distribution due to harmonics.
- Mitigation of harmonics to sensitive equipment that are highly susceptible to voltage distortion.
- Improving the effects of decreased Power Factor due to harmonics.

.4 Encapsulated:

.1 Encapsulated transformers can be specified for the following applications:

- Harsh environment locations (i.e.: Laboratories, Street Lighting).
- Hazardous locations requiring Class 1, Division/Zone 2 rated equipment.

2.3 Material Specifications

- .1 Capacity: The allowable range of capacities shall be from 3kVA minimum to 300kVA maximum.
- .2 Frequency: 60Hz shall be the default frequency.
- .3 Cooling: ANN Air Natural Convection Cooling shall be utilized for all transformers.
- .4 Winding Configuration: The transformer shall be delta connected primary with wye connected secondary unless another winding configuration is explicitly stated and required.
- .5 Conductors: Core conductors shall be copper windings, with terminations brazed, welded or bolted. Aluminum windings are only acceptable for transformers sized at 30kVA or less that service normal distribution equipment (emergency, essential, stand-by and life safety do not qualify).
- .6 Insulation: Insulation class shall be 220°C with 150°C temperature rise for all open wound transformers. Encapsulated transformers insulation class shall be 180°C with 135°C temperature rise.
- .7 Impregnation: All open wound transformers shall be immersed and baked in a CSA/UL recognized 220C varnish. Encapsulated transformers shall be completely encased in an approved resin or epoxy.
- .8 Efficiency: The transformer shall be meet the following Energy Efficiency Standards: Canada - (NRCAN 2019) SOR/2018-201, Amd. 14 & ON Reg. 404/12
- .9 Basic Impulse Level: Transformers shall have a minimum 10kV BIL unless otherwise stated.
- .10 Impedance: Shall not be greater than 6%.
- .11 Grounding:
 - .1 A ground terminal for all grounding and bonding conductor connections shall be secured inside the transformer enclosure and not installed on or over any vented portion of the enclosure.
 - .2 Ground core & coil assembly to enclosure with a flexible copper grounding strap or equivalent.
- .3 Transformer secondary neutral shall be solidly grounded to the ground bus.

- .1 The neutral is always required to be tied back to the building main ground bus. The only exception is the following:
 - .1 Transformer is equal to or less than 75kVA and
 - .2 Only serves a single piece of equipment. Panelboards and distributions do not qualify.
- .12 Neutral: Wye connected secondaries shall have the neutral brought out to a separate fully rated neutral bus.
- .13 Sound Level: The transformer shall at minimum shall meet the sound requirements outlined in NEMA Standard ST-20 Table 3.9.

kVA	NEMA Standard ST-20
3-9	40dB
10-50	45dB
51-150	50dB
151-300	55dB

Lower dB ratings shall be specified for sensitive locations that require minimal sound disturbance.

- .14 Enclosure Type:
 - .1 General purpose areas: NEMA 1
 - .2 Locations where water ingress will occur: NEMA 3R
 - .3 Locations where pressurized water ingress will occur: NEMA 4
 - .4 Wood processing locations and locations subjected to circulating dusts/lints/fibers: NEMA 12
- .15 Enclosure Finish: ANSI/ASA 61 grey finish.
- .16 Seismic Rating: International Building Code (IBC), SDS=2.00g ; z/h = 1.00 ; Ip = 1.5 rated transformers shall specified by the designer as required for critical applications.
- .17 Installation Hardware: Where applicable, lifting lugs shall be adequately strengthened, sized and arranged on the transformer to provide a suitable lift for the completely assembled unit. Provision on the transformer base for skidding and jacking shall be provided as required.
- .18 Windows: Infrared windows shall be required for transformers 112.5kVA and larger.
- .19 Nameplate: The nameplate shall meet or exceed the requirements of the Canadian Electrical Code and CSA/cUL.
- .20 Certifications: All transformers shall bear a CSA or cUL certification label. Alternatively, ensure the equipment has any Nationally Recognized Testing Laboratory (NRTL) member organization's certification label, certifying the equipment for installation in Canada.
- .21 Standards: All transformers shall be constructed and tested to CSA C9, C22.2-47, IEEE C57.12.01, IEEE C57.12.91 and NEMA ST-20. In addition to the standards listed prior, K-Factor Rated and Harmonic Mitigating transformers must incorporate IEEE C57.110 and IEEE Std 519 standards.
- .22 Warranty: Minimum of 1 year of warranty required.
- .23 Approved Manufacturers are:
 - .1 Schneider Electric / Square D.
 - .2 Eaton.
 - .3 Hammond.

- .4 Delta.
 - .5 Rex Power Magnetics.
 - .6 Marcus
- .24 Provide design data and shop drawings for all transformer characteristics for approval by the consultant before proceeding with manufacture.

2.4 Installation Requirements

- .1 Location:
 - .1 Location shall comply with all applicable codes and standards. This includes requirements set out by the CEC, Technical Safety BC and the BC Building Code.
 - .2 Location shall consider the entire life cycle of the transformer. The transformer must be installed in a location that can be easily accessed by maintenance personnel. Access for removal and replacement of the transformer must be considered and any location that will require modification to building infrastructure for removal will not be deemed acceptable.
 - .3 The impact of the sound and vibration of the transformer must be considered when finalizing the location. Sensitive business and research operations must be considered.
 - .4 If applicable, mechanical protection shall be added in locations that are exposed to an increase risk of damage.
 - .5 Any equipment installed above or below the transformer shall not affect access or performance of either piece of equipment, such as:
 - .1 Pull Boxes.
 - .2 Junction Boxes.
 - .3 Cable Tray.
 - .4 Mechanical Equipment - Smoke, Heat, CO2 detectors.
 - .6 [Transformers are not permitted to be concealed.](#)
- .2 Clearance:
 - .1 A minimum of 1m (3.28 feet) of clearance is required in front of the transformer as per the Canadian Electric Code.
 - .2 The following clearances are required on the sides, back, and top at a minimum:
 - .1 Transformers up to and including 150kVA: 152mm (6 Inches).
 - .2 Transformers over 150kVA to 300kVA: 305mm (12 inches).
- .3 Mounting:
 - .1 Floor:
 - .1 All floor mounted transformers shall be on a concrete pad. Mounting directly on the floor is not permitted. [For renovations standard feet may be considered with approval from UBC Facilities Electrical if it is determined to not be feasible due to shutdown and/or space restrictions.](#)
 - .2 Concrete pad dimensional requirements:
 - .1 Minimum 4 inch height.
 - .2 Minimum of 6 inches of extension past transformer sides.
 - .2 Wall:
 - .1 The largest size permitted is 75kVA.
 - .2 Where applicable utilize manufacturer approved wall mounting kits.
 - .3 Ceiling:
 - .1 The largest size permitted is 30kVA.
 - .2 Where applicable utilize manufacturer approved ceiling mounting kits.

- .4 Stacked: Stacking of transformers is only permitted if all other options have been exhausted due to lack of space. Stacking is only applicable to floor mount applications and is not permitted for ceiling or wall mount configurations. Stacking shall comply with the following requirements:
 - .1 The transformer stacked on top is the same size or smaller than the transformer below.
 - .2 The conditions outlined in 2.4.2 have been satisfied.
 - .3 The ambient temperature must not exceed 30°C.
- .4 Connections:
 - .1 Flexible metal conduit shall be utilized for final connections to the primary and secondary sides of the transformer to reduce vibration and sound transmission. Teck cable is an acceptable alternative.
- .5 Grounding:
 - .1 The ground terminal shall be connected back to the main building ground bus.
 - .2 The minimum size grounding conductor shall be #6AWG.
- .6 Vibration Isolation:
 - .1 All transformers shall have vibration isolation pads between the core and coil assembly and the enclosure.
 - .2 Spring based vibration isolation mounts are required to be installed between the transformer and mounting surface. Where possible utilize mounts offered by the same manufacturer as the transformer.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Division 26

1.2 Coordination Requirements

- .1 UBC Energy & Water Services (Vancouver)
- .2 UBC Facilities Electrical (Vancouver)
- .3 UBC Facility Management (Okanagan)

1.3 Description

- .1 UBC requirements for Secondary Power Distribution.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General Requirements:

- .1 Two secondary voltage levels are acceptable at the University:
 - .1 120/208 Volt, 3-Phase 4-Wire Wye System
 - .2 347/600 Volt, 3-Phase 4-Wire Wye System.
 - .3 (Vancouver) 600 Volt 3-Phase 3-Wire Wye System. 3 wire supply from EWS can be utilized as long as a solidly grounded system is maintained and tied back to the utility neutral point.
- .2 All secondary distribution equipment shall be installed inside conditioned rooms.
- .3 The selection of distribution voltage shall be based on building layout. Conditions such as large distribution loads, high building and large footprint shall be used to determine the preferred secondary distribution.
- .4 If a 600V secondary distribution is selected, all motors 3/4 hp and over shall be supplied at this level. ECM motors 2HP and below shall be except.
- .5 Life Safety, Stand-by, Emergency Power distribution shall not contain any switches between the generator distribution overcurrent device and each transfer switch. All CBs upstream of Life Safety transfer switches shall have auxiliary contacts monitored by the transfer switch or generator or fire alarm system that will notify building maintenance personnel of a "not normal" situation. The monitoring wiring diagram shall form a separate section of the generator submittals.
- .6 The electrical distribution shall be designed to limit incident energy to maximum 8 cal/cm² at all switches, circuit breakers and MCCs while retaining acceptable coordination selectivity. Incorporate LSI Circuit Breakers, not fuses, where necessary to achieve the desired results.
- .7 Secondary power distribution equipment shall have NEMA ratings dependent on the following type of locations:
 - .1 General purpose areas: NEMA 1
 - .2 Locations where water ingress will occur: NEMA 3R
 - .3 Locations where pressurized water ingress will occur: NEMA 4

- .4 Wood processing locations and locations subjected to circulating dusts/lints/fibers: NEMA 12
- .8 Used or Refurbished distribution equipment is not permitted to be utilized.
- .9 Mixing of manufacturers within distribution equipment is not permitted.
- .10 The entire electrical system must be fully rated. Series rated systems are not acceptable.
- .11 Any new single load added to an existing distribution 36kW or greater requires approval from UBC Facilities Electrical prior to proceeding with design.

2.2 Service Entrance Requirements:

- .1 Service Entrance disconnects shall only be circuit breaker type with the ability to be lockable in the open position.
- .2 Any building or addition supplied by 208 or 600 Volts shall have entrance switchgear designed and labelled as "Suitable for Service Entrance".
- .3 Minimum requirements for breakers at service entrance distributions (unless determined otherwise by coordination study):
 - .1 LSIG trip units:
 - .1 Any breaker 600A and larger.
 - .2 Any breaker 400A and larger that feeds a mechanical distribution.
 - .3 Any breaker 400A or larger feeding a distribution that contains 2 or more sub distributions/panelboards.
 - .4 Any breaker feeding a separate building.
 - .5 Any breaker feeding a bus duct system.
 - .6 Life safety distributions shall not have LSIG trip units.
 - .2 LSI trip units are required for other breakers not mentioned in .1.

2.3 Switchboard Requirements:

- .1 When a switchboard is fed from a 150kVA transformer or larger the following is required:
 - .1 The transformer primary breaker shall be LSI complete with arc flash reduction/maintenance mode functionality.
 - .2 A remote selector switch shall be installed at the same location as the switchboard that can activate the maintenance mode/arc flash reduction. The remote selector switch shall have indicator lights to confirm the status of arc flash reduction/maintenance mode.
- .2 Lockout hasps are required on all distribution boards and for all circuit breakers feeding panelboards.
- .3 Surge Protective Devices (SPD/TVSS) are required for switchboards feeding laboratory, research and elevator loads.

2.4 Panelboard Requirements:

- .1 New Panelboards shall utilize bolt-on molded case circuit breakers. Panelboards shall contain copper buswork. All panelboards shall have phases balanced to within 15% and shall contain a typewritten directory on cardstock. The directory shall include the circuit

number, room(s) number and load description. All new panelboards shall be located on the same floors as the loads they serve.

- .2 Panelboards serving laboratory or research spaces where final equipment lists are unknown or the space is designed to have a rotation of researchers shall have a minimum of 50% spare circuit capacity. All other panelboards shall have a minimum of 30% spare circuit capacity.
- .3 Tandem/skinny/piggyback circuit breakers shall not be utilized.
- .4 All panelboards and loadcentres shall have main lugs only. Panelboards servicing CRUs are exempt and will require a main breaker. Panelboards and loadcentres shall not be back-fed through a circuit breaker.
- .5 Where possible every load shall be supplied by a panelboard on the same floor.
- .6 Daisy-chaining of electrical panels shall not be permitted. All panelboards shall be fed from separate overcurrent devices.
- .7 Panelboards shall not be used as splice boxes.
- .8 CTs shall not be installed inside panelboards and shall be located in a separate enclosure.
- .9 Surge Protective Devices (SPD/TVSS) are required for panelboards feeding laboratory, research and elevator loads.
- .10 The minimum panelboard ampacity shall be 100A. The only acceptable panelboard sizes are the following: 42, 66 and 82 CCT.

2.5 Disconnect Requirements:

- .1 Disconnect switches shall not be used as junction boxes.
- .2 Fused disconnect switches shall be utilized for single loads of 30kW and greater.
- .3 Refer to Section 11 60 00 Cranes and Hoists for disconnect requirements for Cranes and Hoists.
- .4 UPS Disconnect Requirements:
 - .1 30A or smaller shall be cord connected with twist lock receptacles.
 - .2 For all other scenarios a separate disconnect is required for the UPS line side connection.
- .5 Fused disconnects with fast acting fuses are required for boilers and other types of loads involving an immersed element in liquid.

3.0 SECONDARY DISTRIBUTION EQUIPMENT IDENTIFICATION AND LABELING

- .1 Refer to Section 26 05 53 – Labeling for secondary distribution labeling requirements.

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 26 16 00 Metering
- .2 Section 25 05 00 Building Management System (BMS) Design Guidelines
- .3 Section 01 92 00 Monitoring Based Commissioning

1.2 Coordination Requirements

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Energy and Water Services BMS (Vancouver)
- .3 UBC Facility Management (Okanagan)

1.3 Description

- .1 This section details the minimum requirements for the electrical sub meters. Refer to Division 25 05 00 Section 4.6 for additional BMS specific requirements. Any meters required for Service Main and revenue applications shall meet the requirements outlined in Section 26 16 00 Metering.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General

- .1 The BMS vendor shall provide an approved electrical sub meter assembly as required for the building design. The electrical sub meters shall be integrated into the appropriate BMS system and also into the UBC Sky Spark system.
- .2 All electrical sub meters shall meet all required local and national certification requirements.
- .3 BACnet network requirements:
 - .1 BACnet IP requirements
 - .1 BACnet IP is the only acceptable communication protocol.
 - .2 UDP port configuration is required (47800 – 47820)
 - .3 Devices must comply with all other BMS requirements.
 - .2 Meters shall be ANSI X12.20-2015 class0.2 revenue grade meters.
- .4 All electrical sub meters shall comply with section 8.4.3 (electrical energy monitoring) of the most current ASHRAE 90.1 standard, and any other code requirements.
- .5 Meter shall support multiple 3-phase metering inputs for monitoring multiple distributions. Allow for a minimum of 1 spare 3-phase input for future use.
- .6 Commercial Rental Unit (CRU) shall meet the requirements outlined in Section 26 16 00 Metering.
- .7 Approved Manufacturers: Setra or approved equivalent.
- .8 Metering is required at the following locations:

- .1 Service Entrance Distribution
 - .1 Service Main (Vancouver uses PM8240 meter as per 26 16 00).
 - .2 All feeders for downstream distributions.
- .2 Life Safety (Emergency Power) Distribution
 - .1 Main only.
 - .2 Additional as required for LEED (mech/lighting)
- .3 Standby Distribution
 - .1 Main.
 - .2 All feeders for downstream distributions.
 - .3 Additional as required for LEED (mech/SHW/lighting/plug loads)
- .4 Mechanical Distribution
 - .1 Main.
 - .2 All feeders for downstream distributions.
 - .3 Additional as required for LEED (mech/SHW/lighting/plug loads)
- .5 Lighting Distribution
 - .1 All feeders for downstream distributions.
 - .2 Additional as required for LEED
- .6 Power Distribution:
 - .1 Mains. (if not covered by 1.)
 - .2 All feeders for downstream distributions.

2.2 Controls trade responsibilities

- .1 Electrical sub meters shall be provided and integrated by the controls trade.
 - .1 All network integration shall comply with all other TG requirements outlined in this document.
 - .2 All wire from the demark enclosure shall be provided by controls trade.
 - .3 BMS must provide direction to the electrical trade for current transducers to meet the requirements for the BMS provided sub meter.
- .2 Refer to Standard drawing E4-5c and E4-5d for division of responsibilities between trades.

2.3 Electrical trade responsibilities

- .1 Demark enclosure shall be provided by the electrical trade including:
 - .1 Circuit breakers (as required).
 - .2 Enclosure for demark point.
 - .3 Current transducers, as required to connect to the BMS provided sub meter (coordinate with the BMS trade). Rogowski coils shall be utilized.
- .2 Refer to Standard drawing E4-5c and E4-5d for division of responsibilities between trades.

2.4 Standard Drawing

- .1 Refer to the following Standard Drawings:

- .1 E4-5c. Setra Networked Multi-Circuit Power meter 208 or 600V Wiring Connection Diagram – 4 Wire System. This drawing outlines the installation requirements for 208V or 600V 4 wire submetering applications.
- .2 E4-5d. Setra Networked Multi-Circuit Power meter 600V Wiring Connection Diagram – 3 Wire System. This drawing outlines the installation requirements for 600V 3 wire submetering applications.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 Division 20 00 05 Mechanical General Requirements

1.2

.1 **Coordination Requirements**

- .2 UBC Facilities Electrical (Vancouver)
- .3 UBC Facility Management (Okanagan)

1.3 **Description**

- .1 This section outlines electrical requirements of Motor Control which includes Variable Frequency Drives.

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

- .1 Refer to Division 20 00 05 Mechanical General Requirements for mechanical requirements of VFDs.
- .2 Variable Frequency Drives (VFD)
 - .1 VFDs shall have an adjustable carrier/switching frequency with a minimum adjustment range from 1 - 12kHz.
 - .2 VFDs operated at low carrier frequency's can lead to high motor noise. Higher frequencies can reduce noise but may require upsizing the VFD. Another strategy to reduce noise is to install output reactors/sine wave filters.
 - .3 It is recommended (at the designer's discretion) that VFDs are selected at a minimum carrier frequency of 8kHz so that the switching frequency can be adjusted upward, if required to reduce noise. However, VFDs should be operated at the lowest possible carrier frequency that produces acceptable noise levels as this will generate the least heat and be the most efficient.
 - .4 It is the designer's responsibility to select an appropriate carrier frequency and/or sine wave filters to mitigate the possibility of noise issues.
 - .5 Specify matched motors and variable frequency drives with low harmonic content and harmonic filters. Maximum acceptable harmonic content as per IEEE Standard 519 and 1100.
 - .6 All VFDs shall have an internal line reactor and DC choke. For motors sized at 5HP and greater, an additional external 3% line reactor is required if the internal line reactor is less than 3%.
 - .7 VFD Load side conductors shall always be less than 100 feet from the motor. 3% load reactors are required for all installations greater than 50 feet.
 - .8 All VFDs shall include an integral lockable disconnect that is lockable in the open position.
 - .9 Installation Requirements:
 - .1 Load side wiring of each variable frequency drives (VFD) shall utilize a dedicated raceway. Load side wiring shall not share raceways or junction boxes with other VFD's or loads. Load side wiring shall be directly connected to the

load without a disconnecting means in the circuit. The only exception shall be air-conditioning and refrigeration equipment. Any other instance will require approval from UBC Facilities Electrical. For any instances where a disconnect is approved for use a lamicoid will be required stating the following: "MOTOR MUST BE STOPPED AT THE VFD PRIOR TO OPERATION OF DISCONNECT".

- .2 Flexible conduit shall be used for VFD line and load size conductors. EMT is not acceptable.
- .3 Teck cable is permitted to be utilized on load side wiring under the following conditions:
 - .1 Mechanical Penthouse / Rooftop VFDs feed Rooftop Units (RTU).
 - .2 VFD and motor are located in a space that utilizes cable tray as the primary means of cable transport.
 - .3 VFD and motor are located within 5 meters and line of sight of one another.
- .4 VFDs shall only be installed in conditioned rooms.
- .5 VFDs shall not be mounted on surfaces that are susceptible to vibrations. The only exception is for certified engineered solutions which integrate a VFD and motor/pump together in a prefabricated package.
- .6 VFDs mounted adjacent to sources of liquid (i.e. Piping fittings, valves) will require either a rated enclosure for the environment or a barrier such as metal flashing for protection of the VFD from potential water ingress.
- .7 Conductors/conduits shall be bottom entry.
- .8 Drip hoods are required for all VFDs in sprinklered areas.
- .9 VFDs shall be installed such that no operating handle, buttons, displays or switches are greater than 1.8m above the finished floor level.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Division 27, Section 27 05 05 Communication Rooms Design Guidelines – 2.6
- .2 Division 26, Section 26 51 00 Interior Building Lighting – 2.6

1.2 Coordination Requirements

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Facilities Management (Okanagan)
- .3 UBC Information Technology

1.3 Description

- .1 Generator for emergency and stand-by power. Items with (Vancouver) or (Okanagan) only apply to the respective campus.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General Requirements

- .1 Generators for emergency and stand-by power shall be installed in buildings as defined in .2 below.
- .2 If any of the following are included in building design, then a generator for emergency and standby power shall be installed within the building structure or in an enclosure on the building site.
 - .1 10,000 GSM or larger
 - .2 Active smoke control
 - .3 High Building as defined by the latest edition of BCBC
 - .4 Where defined by the Project Design Brief (i.e.: may be required for long-duration research equipment, critical infrastructure, freezer storage or animal care). Required non-life safety power shall be confirmed with user groups early on during the planning stage.
- .3 When a generator is installed, the following equipment shall be connected to the emergency/standby source.
 - .1 All active smoke control equipment and controls
 - .2 Fire Alarm Control Panel
 - .3 Emergency and exit lighting
 - .4 Heat Trace wiring
 - .5 Sprinkler system equipment (dry and pre-action system compressors, excess pressure and fire pumps, heating systems for water service rooms, etc.)
 - .6 Sanitary sump pumps and storm sump pumps
 - .7 Main electrical, communications and mechanical room lighting and least one convenience receptacle
- .4 If a generator is installed then all emergency power shall be supplied from it and battery packs shall not be used other than at the generator/transfer switch location to allow for breakdown maintenance.

- .5 In general, fume manifold and bio-hazard hoods should not be supplied from emergency power. Alternate proposals to supply fume and bio-hazard hoods from emergency power may be discussed with UBC Facilities Electrical (Vancouver) / Facilities Management (Okanagan).
- .6 In general, elevators not designated as "Elevator for Use by Firefighters" by the BC Building Code should not be powered from generators unless specifically required to be by the BC Building Code. Alternate proposals to supply non-designated elevators from emergency power may be discussed with UBC Facilities Electrical / Facilities Management (Okanagan).
- .7 Emergency generators shall be diesel fuel type only.
- .8 Emergency generators shall have a minimum 24-hour run time under 100% loading without refueling.
- .9 All generators shall be capable of being refuelled from ground level. The refuelling location shall be accessible for fuel trucks to park within 5 meters.
- .10 Confirm positive fuel prime to all fuel pumps as required.
- .11 See Section 25 05 00 Building Management Systems (BMS) Design Guidelines for requirements for BMS and Section 28 31 00 Fire Detection and Alarm for fire alarm system for generators.
- .12 In buildings where generators are installed a 5-20R receptacle supplied by a dedicated over current device shall be installed immediately below each panel that derives its supply from the emergency/standby distribution.
- .13 Standby loads may be connected to emergency power circuits provided that the addition of such equipment does not cause the total connected load to exceed 80% of the rated capacity of the emergency generator. The addition of loads with high in-rush current requirements may require the 80% maximum capacity limit to be lowered to maintain a reasonable margin of safety.
- .14 Overhead services for generators located exterior of the building is not [permitted](#).

2.2 Generator Housing and Location

- .1 Generators to be primarily located at ground level in separate enclosures.
- .2 Generators should be housed in areas which are large enough to allow for maintenance, testing and repair, and remove and replace components, without having to remove portions of the structure in which they are mounted.
- .3 The areas shall be insulated and heated so as to minimize maintenance on the units.
- .4 Generator rooms and transfer switch locations shall be provided with an emergency battery lighting pack for breakdown safety and maintenance on the units.
- .5 Sound Attenuation: Generators housings shall be Level III (68 to 70dBA)

2.3 Equipment Type

- .1 All generators shall be supplied with remote generator annunciator mounted at transfer switch location.
- .2 Generators shall be sourced from original equipment suppliers so that parts are readily available and locally supplied and supported [within a 100km radius](#).
- .3 [The following are approved manufacturers:](#)
 1. [Cummins](#)
 2. [Finning/CAT](#)
 3. [Blue Star](#)
 4. [Simmax](#)
 5. [Generac](#)

[System shall be compatible with existing UBC operating control systems.](#)

2.4 Loadbank Requirements

- .1 To assist with maintenance, generators shall have a second circuit breaker rated for 100% load on the generator output prior to the transfer switch. This is for tying in load banks for annual testing without disturbing cables and lugs of normal loads, as per CSA C282-05 B18. [The load bank breaker shall have a shunt trip that will activate upon operation of the transfer switch](#). The output of the second breaker shall extend to a 3R outdoor-rated Cam-Lok 1016E female connection box mounted on the generator enclosure or in an accessible location exterior to the building envelope.

2.5 Generator Transfer Switches

- .1 Automatic Transfer Switches (ATS) shall be supplied with fully rated double-bypass isolation capability.
- .2 Transfer Switch Type:
 - .1 (Vancouver): Unless requested, all transfer switches shall be Open transition type.
 - .2 (Okanagan): Unless requested, all transfer switches shall be Closed transition type.
- .3 The entire ATS & bypass assembly shall be certified to CSA C22.2 No. 178.
- .4 ATS shall have a minimum 18 cycle Withstand and Close-on Rating on all equipment rated at 400 amps and greater.
- .5 ATS bypass/isolation handles shall be permanently attached & require a maximum of two steps to perform bypass/isolation operation.
- .6 ATS main contacts and bypass contacts shall be fully withdrawable on equipment rated at 400 amps and greater.
- .7 All components within the ATS shall be supplied, commissioned and supported by the ATS provider.
- .8 Closed Transition Transfer Switch Requirements:
 - .1 Closed Transition Transfer Switches (CTTS) shall include a separate redundant protection relay to prevent any possible back feed to the utility. (Vancouver) All methods of providing this form of protection shall be submitted to UBC Energy & Water Services for approval prior to equipment installation. (Okanagan) UBC Okanagan must coordinate and receive approval from Fortis BC prior to finalizing CTTS specifications.

- .2 CTTS redundant backfeed protection may be a reverse power relay set not more than 5% of the generator rating and extended parallel relay set at not more than 1 Second.
- .9 Transfer switches shall be motorized or solenoid contact type.
- .10 Consultant recommended programmable settings shall be reviewed with UBC as left condition.

2.6 Fuel Tanks

- .1 All diesel fuel tanks shall be above ground and double walled unless a single walled tank is contained by a separate containment tank, for example, a day tank.
- .2 Underground tanks that are inherited with their piping systems shall be removed as part of any replacement.
- .3 Fuel storage tanks shall be protected from freezing.

2.7 Maintenance Manuals

- .1 At least two complete sets of manuals, (these shall include operators, owners, troubleshooting, full repair manuals as well as any disks and software diagnostics), shall go to the shop level before sign off and acceptance of units. One digital copy is required.
- .2 A complete set of manuals for each Transfer Switch shall be provided. The manuals shall include all schematics and wiring diagrams for actual supplied components and commissioning report. Generic manuals will not be accepted.

2.8 Central Inverter Systems

- 1. For buildings 2,500 GSM to 10,000 GSM a Central Inverter System shall be provided to supply all BCBC required exit signs and egress lighting.
- 2. A single piece of Unit Equipment shall be installed at each Central Inverter System location.
- 3. Total loading shall not exceed 60% of system capacity as calculated for BCBC requirements.
- 4. The Central Inverter System shall be [capable of connecting](#) to the BMS system for monitoring of all inverter alarms [using dry contacts](#).
- 5. [Approved manufacturer is Ready-Lite or approved equal.](#)

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Division 7
- .2 Division 25
- .3 Division 26

1.2 Coordination Requirements

- .1 UBC Facilities Electrical (Vancouver)
- .2 UBC Facilities Management (Okanagan)

1.3 Description

- .1 UBC Requirements for rooftop Solar Photovoltaic (PV) systems

1.4 Definitions

- .1 Unless otherwise specified or indicated, electrical terminology used in this specification shall be as defined by the latest EGBC adopted version of the Canadian Electrical Code C22.1, Part I.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General Requirements

- .1 The Solar PV System shall be connected to the UBC electrical grid at 120/208 volts AC.
- .2 All design, material procurement, and construction shall be completed in accordance with CSA, IEEE, NEMA, and local codes, as specified in the UBC Technical Guidelines, and as shown in the drawings.
- .3 The total nameplate module power (total installed DC capacity) for the Solar PV System shall be 100 kW DC or less, with consideration for host facility loads and limited export. This is determined without estimating bifacial gain.
- .4 Proponent shall provide a simulation production report using PVsyst or Helioscope as a part of the bid package. Refer to section 2.9 Simulation Production Report Parameters.
- .5 Proponent shall provide ETAP simulation to show impacts of project within existing UBC model. Current model shall be provided by UBC.
- .6 The sum of the maximum DC and maximum AC wiring voltage drop from photovoltaic source circuits to the points of interconnection shall not exceed 3.0%.
- .7 Voltage drop calculations shall be as outlined in the Canadian Electrical Code and include all vertical and horizontal lengths, resistivity values, and a 7.0% slack factor.
- .8 All terminals used for all power conductors within the Solar PV System shall be rated CU9AL.

- .9 All equipment exposed to direct sunlight and environmental elements shall be outdoor-rated and sunlight-resistant.
- .10 All equipment shall be installed and protected to maintain its enclosure protection rating.
- .11 All AC electrical distribution used for the Solar PV System shall be sized for continuous load at 100% of PV inverter nominal AC power.
- .12 All female and male PV connector connections shall be mated pairs from the same manufacturer and model family.
- .13 Rodent protection of PV conductors is required as per CEC Rule 64-210 5). The proposed solution (enclosed wireway, mesh, split loom, etc.) shall be reviewed and approved by UBC and TSBC during the design phase and prior to procurement. The proposed solution shall be designed and installed with materials and in a manner to last the life of the project. An estimate of bifacial loss due to the proposed solution shall be provided by the design-builder as a part of simulation and performance verification activities.
- .14 The Solar PV System shall be designed such that access for maintenance, repair and testing of the system does not require personnel-lifts or fall protection. The entirety of the system shall be located at least 3 meters from a fall hazard or unprotected edge (Any side or edge (except points of access) of a walking/working surface where there is no wall or guardrail system at least 1070mm or parapet at least 1.2m high).
- .15 The Solar PV System shall allow for access to other equipment and systems (mechanical, envelope, etc.) for maintenance and replacement without requiring personnel-lifts or fall protection.
- .16 Exemptions to design requirements will be considered on a case-by-case basis by UBC.

2.2 DC Wire and Wire Management Specifications

- .1 Characteristics of the PV wiring shall be:
 - .1 Copper
 - .2 RPVU90, XLPE, CSA approved.
 - .3 1000V rated.
 - .4 Sunlight resistant.
 - .5 -40°C to 40°C ambient temperature rated.
 - .6 90°C operating temperature rated.
 - .7 Red for positive, black for negative
- .2 Characteristics of the PV wire management shall be:
 - .1 Cables shall be run to connect adjacent panels using the leapfrog method.
 - .2 Cables at the source circuit shall be permitted to be routed along PV module frames and racking system with or without a raceway but must be protected from damage.
 - .3 Cables beyond 300mm of the array must be in a raceway.
 - .4 Cable runs shall be continuous, and splices are not permitted.
 - .5 Cables shall be protected from any sharp edges by use of protective grommets.

2.3 PV Combiner Specifications

- .1 Solar PV systems incorporating combiners will be evaluated on a case-by-case basis, combiners generally used for larger, utility-scale projects and applications.

- .2 Characteristics of PV combiners shall be:
 - .1 PV Combiner Type
 - .1 Disconnect Combiner.
 - .2 Ungrounded PV.
 - .3 Positive and Negative Fused.
 - .4 Continuous Rated.
 - .2 Safety Features
 - .1 Load Break Rated and Lockable DC Disconnect.
 - .2 Dead Front Over Live Parts.
 - .3 Lockable Cover.
 - .4 Touch-Safe Fuse Holders.
 - .5 Transient Surge Protection.
 - .6 90 °C terminals (source and output).
 - .3 Enclosure Protection Rating
 - .1 NEMA 3R or 4X.
 - .4 Certifications and Approvals
 - .1 CSA C22.2 107.1 Power Conversion Equipment.
 - .2 UL 1741 Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources.
 - .5 DC-AC Ratio
 - .1 Rated maximum DC current shall allow for DC-AC ratio of connecting PV inverter to be 1.4 or greater.
 - .6 Operating Temperature Range
 - .1 Minimum temperature shall be -25°C or lower.
 - .2 Maximum temperature shall be 40°C or higher.
 - .7 Storage Temperature Range
 - .1 Minimum temperature shall be -40°C or lower.
 - .2 Maximum temperature shall be 60°C or higher.
 - .8 Manufacturer Warranty
 - .1 Standard shall be 5 years or longer.
 - .2 Optional extensions shall be available.
- .3 Approved manufacturers of photovoltaic combiners are as follows:
 - .1 SolarBOS.
 - .2 Bentek Solar.
 - .3 Additional manufacturers will be considered at the discretion of UBC.
- .4 Depending on selection of PV inverters, PV combiners may not be required.

2.4 PV Module Specifications

- .1 Characteristics of the PV modules shall be:
 - .1 Module Type
 - .1 Bifacial or monofacial.
 - .2 Mono-crystalline or poly-crystalline silicon.
 - .3 60 or 72 full-cell modules.
 - .4 Anodized aluminum frame.

- .5 Anti-glare glass.
- .6 Potential Induced Degradation-free certified.
- .2 Module Power
 - .1 Front-side STC power shall be 375 watts DC or greater.
 - .2 Power tolerance shall be positively sorted.
- .3 Maximum System Voltage
 - .1 UL rated for 1500 volts DC or greater. IEC ratings are not acceptable.
- .4 Junction Box Protection Rating
 - .1 IP 67 or IP 68.
- .5 Certifications and Approvals
 - .1 ULC/ORD C1703 Standard for Flat-Plate Photovoltaic Modules and Panels.
- .6 Module Efficiency
 - .1 Front-facing STC efficiency shall be 19% or greater.
- .7 Bifaciality Ratio
 - .1 Module power bifaciality shall be 70% or greater.
- .8 Temperature Coefficients
 - .1 Maximum power temperature coefficient shall be higher than -0.36% per °C.
 - .2 Open-circuit voltage temperature coefficient shall be higher than -0.30% per °C.
 - .3 Short-circuit current temperature coefficient shall be lower than 0.06% per °C.
- .9 Operating Temperature Range
 - .1 Minimum temperature shall be -25°C or lower.
 - .2 Maximum temperature shall be 85°C or higher.
- .10 Mechanical Loading
 - .1 Front side maximum static loading shall be rated for 5400 Pa or higher.
 - .2 Rear side maximum static loading shall be rated for 2400 Pa or higher.
- .11 Manufacturer Warranty
 - .1 Standard product warranty shall be for 12 years or longer.
 - .2 Standard performance warranty shall be linear and for 25 years or longer.
 - .3 At the end of year 1, actual power output shall be guaranteed for greater than 97.4% of the front-side STC power. (low Light Induced Degradation)
 - .4 At the end of year 25, actual power output shall be guaranteed for greater than 80% of the front-side STC power.
 - .5 For installations lower than -25°C, manufacturer letter required stating extreme minimum that is compliant with warranty
- .2 Approved manufacturers of PV modules are as follows:
 - .1 Canadian Solar.
 - .2 Hanwha Q Cells.
 - .3 LG.
 - .4 Longi Solar.
 - .5 Trina Solar.
 - .6 Jinko Solar.
 - .7 Additional manufacturers will be considered at the discretion of UBC.

2.5 PV Inverter Specifications

- .1 Characteristics of the PV inverters shall be:
 - .1 Voltage
 - .1 PV inverters shall be 3 phase only.
 - .2 PV inverters shall be rated for 120/208 volts AC.
 - .3 AC connection topology shall be grounded-wye, with or without neutral.
 - .2 Safety Features
 - .1 DC Reverse Polarity Protection.
 - .2 DC AFCI Arc-Fault Protection.
 - .3 Remote Disable for Rapid Shutdown.
 - .4 DC Ground Fault Protection.
 - .5 DC Disconnect.
 - .6 Grid-Interactive Protection Features (IEEE 1547 compliant).
 - .3 Enclosure Protection Rating
 - .1 NEMA 3R or 4X.
 - .4 Interconnection Standards
 - .1 IEEE 1547-2018 Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.
 - .5 Certifications and Approvals
 - .1 CSA C22.2 107.1 Power Conversion Equipment.
 - .2 UL 1699B Standard for Photovoltaic (PV) DC Arc-Fault Circuit Protection.
 - .3 UL 1741-SA Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources.
 - .6 Efficiency
 - .1 California Energy Commission (CEC) determined efficiency shall be 97.0% or greater.
 - .7 DC-AC Ratio
 - .1 Rated maximum DC power to AC nominal power shall be 1.4 or greater.
 - .8 Operating Temperature Range
 - .1 Minimum temperature shall be -25°C or lower.
 - .2 Maximum temperature shall be 60°C or higher.
 - .9 Storage Temperature Range
 - .1 Minimum temperature shall be -40°C or lower.
 - .2 Maximum temperature shall be 60°C or higher.
 - .10 Manufacturer Warranty
 - .1 Standard shall be 5 years or longer.
 - .2 Optional extensions shall be 15 years or longer.
 - .3 For installations lower than -25°C, manufacturer letter required stating extreme minimum that is compliant with warranty.
 - .4 Manufacturer shall provide letter and custom nameplate labels for de-rated inverters.
 - .11 Grid Support Features
 - .1 Low/High Voltage Ride-Through Capability.

- .2 Low/High Frequency Ride-Through Capability.
 - .3 Non-Unity (Reactive) Power Factor Capability.
- .12 Monitoring and Control
 - .1 PV inverters shall have read and write capabilities to communicate with the monitoring and control platform.
- .13 Connectivity and Configuration
 - .1 PV inverters shall communicate with the monitoring and control platform and be configured via ethernet port.
 - .2 Where an ethernet connection is not possible, Bluetooth connectivity requirements shall be provided to UBC IT for review prior to selection.
 - .3 Where required, Bluetooth connectivity shall only be enabled for configuration of PV inverters, and shall be disabled once configuration is complete.
- .2 Approved manufacturers of PV inverters are as follows:
 - .1 SMA.
 - .2 Sungrow.
 - .3 Fronius.
 - .4 Additional manufacturers will be considered at the discretion of UBC.

2.6 Weather Station Specifications

- .1 Minimum sensor requirements of the weather station shall be, but not limited to the following:
 - .1 Plane-of-array (POA) Pyranometer.
 - .2 Ambient Temperature Sensor.
 - .3 Cell Temperature Sensor.
 - .4 Wind Direction Sensor.
 - .5 Wind Speed Sensor.
- .2 Approved manufacturers of weather stations are as follows:
 - .1 Campbell Scientific.
 - .2 Hoskin Scientific.
 - .3 Hukseflux.
 - .4 Kipp and Zonen.
 - .5 Additional manufacturers will be considered at the discretion of UBC.
- .3 Monitoring and Control
 - .1 Weather station shall have read and write capabilities to communicate with the monitoring and control platform.
- .4 Certifications and Approvals
 - .1 All weather station components to be certified for use in Canada (CSA, ULC, ETLC, or TUV).

2.7 Monitoring and Control Platform Specifications

- .1 Characteristics of the monitoring and control platform shall be to:
 - .1 Measure and monitor all inverters within the system.
 - .2 Provide an illustrative display of the status, power flows, and environmental impact of the system.
 - .3 Provide multi-level fault reporting to UBC personnel based on measured data and reading device fault and alarm registers.

- .4 Provide local access to monitoring and control platform via ethernet port for connection to a laptop.
- .5 Provide SIM/cellular data connection for internet access where required.
- .6 Bluetooth connectivity for configuration and commissioning only shall require UBC IT review.
- .2 Approved manufacturers of monitoring and control platforms are as follows:
 - .1 Fronius Smart Meter
 - .2 Cachelan
 - .3 Meteocontrol
 - .4 AlsoEnergy
 - .5 Additional manufacturers will be considered at the discretion of UBC.

2.8 Integration with Building Management Systems

- .1 Provide a bi-directional meter for each project, refer to requirements listed in Division 25 Building Management Systems (BMS) Design Guidelines.
- .2 Provide contact-based connection to BMS to allow for monitoring of PV system.
- .3 Provide required information to reprogram existing building protection relays to meet EWS requirements for bi-directional power flows.

2.9 Rooftop Racking Specifications

- .1 Characteristics of the rooftop racking system shall be:
 - .1 Aluminum rails.
 - .2 Ballested.
- .2 Approved manufacturers of racking systems are as follows:
 - .1 Terragen
 - .2 Polar Racking
 - .3 Kinetic
- .3 Certifications and Approvals
 - .1 CSA SPE-900-13 Solar photovoltaic rooftop-installation best practices guideline.

2.10 Simulation Production Report Parameters

- .1 The Geographical Site shall be West Point Grey, Canada
- .2 Parameters for the simulation production report shall be as follows:

Table 1 Summary of Simulation Report Parameters

MODEL PARAMETER	INPUT/VALUE	NOTES
PVsyst Version	7.2 or newer	Other variants should be verified before use
Project Location	As per design	
Meteorological Data	West Point Grey, Meteonorm 8.0 ,Sat=100% - Synthetic	
Module	As per design	
Inverter	As per design	
DC Capacity	As per design	
AC Inverter Capacity	As per design	
Racking Configurations and Dimensions	As per design	

Tilt Angle	As per design	
Azimuth	As per design	
Horizon	Free Horizon	
3-D Model/Near Shading	2-D Layout	
Transposition Model	Perez	
Bifacial Setting - Albedo	Concrete 0.35	
Bifacial Setting - Height	As per design	
Bifacial Settings - Rear Shading Factor	Industry Standard Value - 8.5%	Update Rear Shading Factor based on design.
Bifacial Settings - Rear Mismatch Loss	Industry Standard Value - 6.0%	Update Rear Mismatch Loss based on design.
Bifacial Settings - Bifaciality Factor	As per design	
Bifacial Settings - Transparency	0%	
String Length	As per design	
Sub Arrays	As per design	
Soiling Loss	As per Table 2 or Townsend model	
IAM	Default or Module manufacturer provided	
Thermal Loss Factor	Constant Value - 29.0 W/m ² k Wind Value – 0 W/m ² k/m/s	
LID (Light Induced Degradation)	2%	
Module Quality Loss	Module datasheet	
Module Mismatch	2%	
Global DC Losses at STC	As per design	
AC Losses at STC	As per design	
Transformer Losses - Iron Loss	Transformer datasheet	
Transformer Losses - Resistive/Inductive Losses	Transformer datasheet	
Auxiliaries Losses	As per design	
Availability Loss	0%	To be accounted for by Owner
Grid Power Limitation	As per design	
Power Factor	As per UBC requirements	

Table 2 Array Soiling Losses

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
16.4%	7.7%	2.6%	2%	2%	2%	2%	2%	2%	2%	5.7%	17.9%

The above soiling losses are to be used for projects where soiling is not estimated on a site-specific basis. The above soiling losses are not applicable for ground-mount projects.

3.0 ACCEPTANCE TESTING

- .1 Photovoltaic module manufacturer, photovoltaic combiner manufacturer, inverter manufacturers, and weather station manufacturer shall provide factory test reports for the procured equipment for UBC's review and approval.
- .2 Acceptance testing shall include, but not limited to the following:
 - .1 IV Curve Tracing

- .1 Commissioning personnel shall IV curve trace each PV string to demonstrate acceptable performance of the photovoltaic modules across the possible range of voltage and current levels.
- .2 System Performance Testing
 - .1 Commissioning personnel shall demonstrate over 3 separate days that the measured exported energy from the solar photovoltaic system is greater than 90% of the modeled exported energy determined by the as-built solar simulation model using the same meteorological dataset.
 - .2 During the testing period, the following variables shall be measured and recorded:
 - .1 Weather conditions
 - .2 Time
 - .3 Irradiance
 - .4 Temperature
 - .5 Output power
 - .3 The expected output power shall be calculated from the following formula:

$$P_E = P_{STC} \times (I_{MEASURED} / I_{STC}) \times [1 + (C_T \times (T_C - T_{STC}))] \times PF \times D_T$$
 where:
 P_E = the expected instantaneous output power
 P_{STC} = the module power rating at STC multiplied by the number of modules
 I_{STC} = the irradiance at STC (1000 W/m²)
 C_T = the module temperature coefficient
 T_{STC} = the module temperature at STC (25°C)
 PF = power factor set (as required by UBC)
 D_T = total calculated system derate factor

D_T is determined as a sum of the following derate factors:

Average Module Quality
 Module Mismatch
 CEC Inverter Efficiency
 DC Wire Losses
 AC Wire Losses
 Weighted Transformer Efficiency
 Annual Average Soiling
 Light Induced Degradation
 Yearly Degradation

For an example of how D_T is calculated, see Table 3 below:

Table 3 Example Derate Factors

Description	Loss
Average Module Quality	-0.98%
Module Mismatch	0.4%
Inverter Efficiency Loss	3.5%
DC Losses	1.5%
AC Losses	1.0%
Transformer Loss	2.0%
Annual Average Soiling	2.0%
Light Induced Degradation	1.5%
Yearly Degradation	0.7%
Total Calculated System Derate D_T	88.38%

- .4 All system derate factors shall be approved by UBC prior to their use in performance testing.
- .3 Local Command Testing
 - .1 Commissioning personnel shall demonstrate that the solar production system can accept commands to transfer between grid-interactive and standalone modes.
- .4 Power Quality Testing
 - .1 Commissioning personnel shall demonstrate that the solar photovoltaic system complies with the frequency, voltage, power factor, and harmonic distortion requirements of UL 1741 in both grid-interactive and standalone modes.
- .5 Anti-Islanding Testing
 - .1 Commissioning personnel shall demonstrate that the solar photovoltaic system complies with the anti-islanding requirements of UL 1741 in both grid-interactive and standalone modes.
- .3 Deliver the following documents on completion of the project:
 - .1 As-built drawings
 - .2 Shop drawings
 - .3 Manufacturer Operating and Installation Manuals
 - .4 Datasheets
 - .5 Warranties
 - .6 Additional Maintenance instructions, as applicable.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 27 05 05 Communication Rooms Design Guidelines – 2.13

1.2 Coordination Requirements

- .1 UBC Energy & Water Services (Vancouver)
- .2 UBC Facilities Electrical (Vancouver)
- .3 UBC Information Technology.
- .4 UBC Learning Space Design Guidelines
- .5 UBC Facility Management (Okanagan)

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General

- .1 All interior building lighting shall be supplied from 120 volt power systems.
- .2 Lighting design shall incorporate the principles of sustainability (environmental & financial) and its products and systems shall be energy conserving, long life, have a low cost of ownership and be accessible for service and maintenance.
- .3 For interior building lighting solutions, preference shall be given to Light Emitting Diode (LED) light sources. HID lighting shall not be permitted.
- .4 Daylight harvesting opportunities shall be implemented in areas where natural daylight is available. Where required by code, all classrooms, lecture theatres, large offices, corridors, stairways and other public spaces shall incorporate daylight harvesting via use of interior mounted photocells and arranged to take advantage of free illumination while maintaining acceptable minimum illumination levels within the space.
- .5 Uniformity and low brightness contrast shall be achieved by judicious use of luminaires and their locations.
- .6 All lighting shall be designed to suit the task and task location rather than the general lighting. ASHRAE 90.1, IESNA and WorkSafeBC guidelines shall be taken into consideration and calculations submitted where requested.
- .7 As a general rule, the following task lighting levels shall be used:
 - .1 Offices 500 lux maintained.
 - .2 Classrooms and Seminar Rooms 500 lux maintained.
 - .3 Corridors 100 lux maintained.
 - .4 Washrooms 150 lux maintained.
 - .5 Special areas such as laboratories, Audio/Video rooms, drafting rooms, etc., in accordance with the user's task requirements and IESNA recommendations.
- .8 When mounting luminaires in high ceiling spaces, consideration must be given to ensure access for maintenance such as fixture, driver, lamp and ballast replacement. The use of scaffolding is discouraged. Indoor lighting shall be accessible either from ladders on flat surfaces such as floors or stair landings or from powered lifts with a maximum lift of 6.1

- m. Building access, floor construction, and elevators shall permit entry and use of existing UBC lift equipment for proper and safe maintenance (Genie GR20 with weight of 1,112 kg (2451 pounds) and able to pass through a standard 3'x7' door opening.) If special equipment is required for lighting maintenance, then the consultant shall present a preliminary Lighting System Maintainability Plan to UBC Facilities Electrical (Vancouver) / Facility Management (Okanagan) for review and approval. The preliminary plan shall contain a high-level overview of the special equipment and processes required for maintenance of the system. Architectural, Structural and Conveyancing requirements must be confirmed for moving special equipment to and from the locations after construction is completed. The finalized plan will be submitted by the contractor and it shall contain detailed documentation describing the special equipment, maintenance procedure/schedule and spare parts list. Existing operations and Work Safe BC Fall Protection procedures shall be minimized by the design. Refer to Section 11 81 29 Facility Fall Protection for more details.
- .9 The lighting design proposed for all public areas such as corridors and stairways shall ensure the life safety of building occupants at all times and shall also minimize lighting energy required to maintain BCBC minimum levels (i.e. lights off until occupancy has been detected or an emergency has occurred). A portion of the lighting fixtures shall be wired to a Life Safety power panel if an emergency generator or Central Inverter is available. Lighting circuits fed from emergency power panels shall be arranged so that they may be switched or dimmed during normal operation.
- .10 Suspended luminaires shall be direct/indirect. Full indirect suspended luminaires are not acceptable. Suspended luminaires shall be avoided in rooms with audio-video projection systems.
- .11 Non-linear specialty fixtures and other decorative lighting shall be minimized and shall not exceed 10% of the total quantity of fixtures in the building project. [Specialty/decorative lighting includes the following: cylinders, sconces, wall washers, pendants, chandeliers, cove light, track light \(monorail\), spot light, pin hole light, fiber optic lighting and LED strips.](#)
- .12 Metal Halide (MH) lighting solutions are not acceptable. LED solutions, especially for high bay applications, shall be pursued.
- .13 Banks of multiple switches shall be labeled to avoid confusion.
- .14 All light fixtures provided shall be stock items (no custom made fixtures) readily available from local suppliers. The fixtures are required to be in current production with no plans to cease production and support within a 5 year period.
- .15 Light fixtures shall not contain batteries.
- .16 All light fixtures shall be attached to building structure using mechanical fasteners. Tape and or adhesive methods shall not be used.
- .17 Stage lighting fixtures and control for audio-video enabled spaces shall be provided by Division 27 Audio-Video.
- .18 [Lighting integrated into handrails is not permitted.](#)

2.2 Lamps (Renovations Only)

- .1 Preference will be given to LED linear T8 lamps, linear fluorescent T8 lamps shall not be used.
- .2 T8 LED lamps shall be rated for at least 50,000 hours operation with 3 hours per start. Acceptable manufacturers are: General Electric, Osram, Sylvania, or Philips.
- .3 T8 - 15 watt (maximum) LED lamps with 3500' K color temperature operating from 120 volt instant start ballasts with standard ballast factors shall be the standard.
- .4 T8 LED lamps shall not be line-voltage connected.
- .5 LED lamps shall be used as substitutes for traditional applications involving CFL, MR-16, PAR 20, PAR 30, PAR 38 lamps. LED lamps shall be Energy Star rated. Acceptable manufacturers are: General Electric, Osram, Sylvania, or Philips.

2.3 Ballasts (Renovations Only)

- .1 If fluorescent lighting must be used, the ballasts specified shall be compatible with GE and Philips T8 LED lamps. Ballasts shall have parallel lamp operation. Acceptable manufacturers are: General Electric, Osram, Sylvania, Philips/Advance or Universal.
- .2 Ballast output frequency shall be greater than 42 kHz.
- .3 Dimming ballasts shall be instant start with 0-10 volt control.
- .4 Ballasts shall have lamp end-of-life detection and shutdown circuitry that meets ANSI standards.

2.4 Lighting Controls

- .1 Design Philosophy:
 - .1 Lighting Control Panel(s) shall be used in the following areas: Entrances, Vestibules, Lobbies, Atriums, Corridors, General/Public/Circulation Areas
 - .2 Room Controllers shall be used in areas that require zoning, dimming, occupancy sensing and daylight harvesting (if applicable). This includes but is not limited to the following areas: Meeting Rooms, Classrooms, Offices, Restrooms, Gymnasiums, Laboratories (Dry, Wet) and Reception Areas.
 - .3 Service rooms shall utilize ON/OFF switching only. This includes but is not limited to the following areas: Electrical Room, Mechanical Room, Generator Room, Elevator Machine Room.
 - .4 Areas that require single zoning, dimming and occupancy sensing shall utilize standalone line or low voltage control with wall or ceiling occupancy sensors.
 - .5 Areas that require single zoning and occupancy sensing shall utilize standalone line or low voltage control with wall or ceiling occupancy sensors.
 - .6 Stairwells shall utilize standalone line voltage control with fixture mounted occupancy sensors.
- .2 The following lighting control protocols shall be utilized at UBC:

- .1 0-10V - All spaces shall utilize 0-10V control systems except for the locations described in the subsections .2 and 3.
- .2 DALI - Locations with specific lighting requirements that cannot be satisfied by 0-10V. IE: Research, Animal care.
- .3 DMX - Theatrical Spaces.
- .3 Manufacturers:
 - .1 The following product lines are approved for use by UBC. Alternative product lines are not approved (including alternative lines from a manufacturer listed below) and must be reviewed by UBC Facilities Electrical (Vancouver) / Facility Management (Okanagan):
 - .1 Legrand Wattstopper
 - .2 Copper Greengate
 - .3 Hubbell Current
- .4 Lighting Control Panels and Controllers:
 - .1 Control Panels and Room controllers are required to operate standalone. Networking between panels and controllers will only be permitted in instances required by ASHRAE or where specific operational requirements of a building deem it a necessity.
 - .2 Where low voltage lighting controls are provided they shall include a BACNET compatible BMS interface device.
 - .3 The lighting control system shall have the capability of being controlled by the BMS system however will not be connected to it and will operate independently. A 1" conduit (with pull string) between the lighting control panel(s) and BMS system will be required for future connection between systems.
 - .4 Wireless controls and programming solutions shall not be utilized unless approved in writing by UBC IT information security office and UBC Facilities Electrical (Vancouver) / Facilities Management (Okanagan).
 - .5 Hardwired programming is required for all panels and controllers. Systems that require special software and/or licensing fees are not acceptable. Main control panels or controllers shall have the ability to access the programming or firmware updating through an IP based web browser method.
- .5 Occupancy Sensors, Switching and Dimming:
 - .1 Occupancy sensors shall meet the following requirements:
 - .1 Dual technology type with both Passive Infrared (PIR) and acoustic/ultra-sonic sensors,
 - .2 Line voltage or low voltage types.
 - .3 Low voltage occupancy sensors shall have 1 or 2 poles, local power packs and Form C dry contact isolated relays for BMS connection. Slave power packs are not acceptable.
 - .4 Occupancy sensor time delay settings shall be adjusted to 20 minutes for offices, classrooms, theatres and washrooms.

- .5 Occupancy sensors shall be positioned, masked and calibrated to prevent triggering by motion in adjacent areas.
- .6 In classrooms and lecture theatres, occupancy sensors shall cover 100% of the seating area and instructor area. The occupancy sensor shall be able to detect the lower activity levels of seated occupants.
- .7 Where cubicles exist occupancy sensors shall be placed to cover all workstations.
- .2 ASHRAE requirements for occupancy sensors and timers shall be overridden in interior spaces where a hazardous situation may be introduced to building users due to the absence of light. This includes but is not limited to spaces such as Laboratories and Service Rooms. Designers shall consult with users to confirm specific space requirements that require omission.
- .3 Offices, classrooms, and lecture theatres shall have light control switches at all entrances, exits and vestibules. These interior spaces shall also have occupancy sensors, mounted at a high level in a corner and arranged for semi-automatic operation such that manual operation of the local switches is required to energize the lighting while occupancy sensors and local switches will de-energize the lighting. Large spaces may need more than one sensor.
- .4 Entry/Vestible/Corridor switches shall not be located in publicly accessible locations and shall be in areas accessible by maintenance personnel. Custodial rooms are preferred. Switches shall not be located in electrical or mechanical service rooms.
- .5 LED dimmers shall be compatible with the LED lamps used and their drivers.
- .6 Installation Requirements:
 - .1 Lighting controllers shall be installed in locations that do not exceed 4 meters of elevation and are easily accessible by maintenance personnel. The preferred location is adjacent/above entrance doorways.
 - .2 Concealed lighting controllers must be accessible by a removable tile, panel or hatch. The access must be sized large enough to allow for all tasks that will be required for replacement and maintenance of the controllers. Controllers shall not be concealed behind equipment that may require removal for proper access to controllers.
 - .3 The following is required for control wiring:
 - .1 Wiring shall utilize an independent, dedicated raceway.
 - .4 The following is required for Cat5/Cat5e/Cat6 communication cables used for connections between devices and controllers:
 - .1 Purple/Violet coloured jacket.
 - .2 Cable shall not be in free air in excess of 300mm.
 - .3 Cable shall utilize an independent raceway. Usage of cable ties and supporting off other raceways is not acceptable.
 - .4 Cable cannot be utilized in the same raceway as IT.

2.5 Lighting Controls – AV Enabled Space Requirements

- .1 Lighting in audio/video enabled spaces, including theatre (type 1), classroom (type 2), seminar room (type 3), and video-conferencing/AV capture enabled shall be controlled by Crestron lighting control or equivalent. Equivalents will be evaluated by UBC IT Audio

Visual. Approval of equivalent equipment will be provided in writing by UBC IT Audio Visual Technical Specialist. Refer to UBC Learning Space Design Guidelines for space type definitions and further lighting requirements.

- .2 Each lighting controller in an audio/video enabled space shall have an IT network data drop in order to allow control from the AV system. Firewall rules shall be arranged with UBC IT to allow communication between lighting controller and AV system controller as required. Refer to Section 27 05 08 for IT cable infrastructure requirements.
- .3 Lighting in audio/video enabled spaces, including informal learning spaces (type 4) and dry and wet labs (type 5) do not require audio/video integration and can match other controller solutions in the building.
- .4 Audio/video enabled spaces shall have lighting zones to accommodate the use-cases of the spaces. The extent of zoning will vary depending upon the size and geometry of the spaces.
 - .1 Spaces with 75 seats or more shall have, at minimum, the following zones:
 - .1 Zone 1 – Marker boards/blackboards should have uniform lighting with sufficient illumination for legibility of writing from all seats.
 - .2 Zone 2 – Front of the room should have uniform lighting for the front of room instructor area with sufficient illumination to support visibility of instructor, other front of room participants, and anticipated demonstrations, without directing light onto the screen surface.
 - .3 Zone 3 – Front seating should have uniform lighting for the front rows of seats with sufficient illumination to support reading, note-taking and visibility of seat occupants by the instructor and by other room occupants.
 - .4 Zone 4 – Back seating should have uniform lighting for the back rows of seats with sufficient illumination to support reading, note-taking and visibility of seat occupants by the instructor and by other room occupants.
 - .5 Refer to UBC Learning Space Design Guidelines for additional lighting zone guidelines.
 - .2 Spaces with less than 75 seats shall have, at minimum, the following zones:
 - .1 Zone 1 – Front of the room should have uniform lighting for the front of room instructor area with sufficient illumination to support visibility of instructor, other front of room participants, and anticipated demonstrations, without directing light onto the screen surface.
 - .2 Zone 2 – Seating should have uniform lighting for all rows of seats with sufficient illumination to support reading, note-taking and visibility of seat occupants by the instructor and by other room occupants.
 - .3 Refer to UBC Learning Space Design Guidelines for additional lighting zone guidelines.
 - .3 Video conferencing enabled spaces shall have, at minimum, the following zones:
 - .1 Zone 1 – Front of the Room should have uniform lighting for the front of the room area with sufficient illumination to support visibility of the presenter, without directing light onto the screen surface.
 - .2 Zone 2 – Primary seating should have uniform lighting for all seats with sufficient illumination to support reading, note-taking and visibility of seat occupants by the instructor, and by other room occupants. Each occupant location shall have an average of 1.2:1 to 2.5:1 key:fill luminance ratio to allow for optimal facial rendering by the video conferencing camera.

- .3 Zone 3 – Rear and side walls should have uniform lighting with sufficient illumination to provide an average of 0.7:1 to 1.8:1 wall:occupants luminance ratio to allow for optimal depth rendering by the video conferencing camera.
- .4 For all other audio/video enabled spaces, the lighting zones shall be designed to meet the application of the space and shall take into account audio/video technology being used. The design shall be approved by UBC IT Audio Visual in writing.
- .5 Low-voltage lighting button panels in audio/video enabled spaces shall confirm to the following guidelines:
 - .1 Lecture theatres shall have a button panel at each entrance/exit with the following button and label:
 - .1 ALL ON
 - .2 All other spaces with an audio/video touch panel shall have a button panel at each entrance/exit with the following button and label:
 - .1 ALL ON
 - .2 ALL OFF
 - .3 All other spaces without an audio/video touch panel shall have a button panel at each entrance/exit with buttons and labels for each zone's "ON" and "OFF" control.
- .6 For spaces with an audio/video touch panel and integration to the local lighting controller, the lighting system shall implement simple button panel switches and not touch panels for every location defined in this section.
- .7 [Lighting equipment dedicated to AV spaces shall only be installed in AV rooms/closets.](#)
- .8 Refer to Section 2.4.6 for Installation requirements.

2.6 Exit Signage

- .1 Exit lighting shall be provided in accordance with the BC Building Code and the Canadian Electrical Code as amended by BC Electrical Safety regulations.
- .2 All exit signs shall be illuminated by LED light sources.
- .3 Exit signs shall be powered at 120 volts from Life Safety power panels or central inverter power panels if available. If not available, Exit Signs shall be AC/DC compatible and be fed from Unit Equipment DC supply.
- .4 Approved manufacturers are Ready-Lite, or approved equal.
- .5 Exit signs shall not incorporate batteries or any other type of stored energy source.

2.7 Emergency Lighting

- .1 Emergency lighting shall be installed in accordance with the B.C. Building Code and the latest edition of the Canadian Electrical Code.
- .2 Emergency lighting Unit Equipment shall only be installed in buildings less than 2,500 GSM. In no case shall the total pieces of Unit Equipment installed in a single building exceed 10.

- .3 Emergency lighting installed as part of renovations or tenant improvements shall be designed to incorporate the existing emergency lighting system in the building.
- .4 Individual light fixtures shall not contain batteries.
- .5 All Unit Equipment lighting, remote heads and exit lights shall be manufactured by 'Ready-Lite' or approved equivalent.
- .6 The Unit Equipment shall be 360 Watt battery pack capacity, 12V DC or approved equivalent. The Unit Equipment shall not be self-testing.
- .7 Unit Equipment shall be mounted on a manufacture-supplied shelf specifically design for the purpose.
- .8 [Main electrical rooms, life safety electrical rooms and rooms with generators or transfer switches shall be provided with unit equipment.](#) The unit equipment shall be sized to run for a minimum of 4 hours.
- .9 Unit Equipment and remote heads shall be 12V, minimum 5W LED lamps.
- .10 Unit Equipment shall be inclusive of a cord-set for cord-connection to a 120V receptacle mounted adjacent to the unit. Receptacle shall be connected to a local, un-switched 120V lighting circuit. In buildings with existing 347V lighting, 120V receptacle shall be connected to a dedicated circuit from a local panel.
- .11 Unit Equipment is not permitted to be installed above ceiling tiles or architectural panels.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 Related UBC Guidelines

- .1 [UBC Vancouver Campus Plan Lighting Guidelines](#)
- .2 [UBC Okanagan Campus Plan](#)

1.2 Coordination Requirements

- .1 UBC Energy & Water Services (Vancouver)
- .2 UBC Facilities Electrical (Vancouver)
- .3 UBC Facility Management (Okanagan)

1.3 Description

- .1 UBC requirements for Exterior Lighting, Street Lighting and Landscape Lighting.

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

- .1 For each project, exterior lighting must be provided for all lanes, roadways, plazas, walks, steps, etc., to a level sufficient to meet safety requirements of all users. [The requirements outlined in UBC Vancouver Campus Plan Lighting Guidelines \(Vancouver\) and UBC Okanagan Campus Plan \(Okanagan\)](#) shall be utilized for lighting design requirements in the public realm. [The IESNA published standards shall be utilized for areas not covered under the Campus Plans.](#) Where public use of the project at night is required, this lighting shall extend beyond the boundaries of the project site to include contiguous access and parking areas.
- .2 Lighting design shall incorporate the principles of sustainability and its products and systems shall be energy conserving, long life, have a low cost of ownership and shall be easily and safely accessible for service and maintenance. If special equipment is required for lighting maintenance then the consultant shall, prior to tender, present a preliminary Lighting System Maintainability Plan to UBC Electrical (Vancouver) / Facility Management (Okanagan) for review and approval. The preliminary plan shall contain a high-level overview of the special equipment and processes required for maintenance of the system. Architectural, Structural and Conveyancing requirements must be confirmed for moving special equipment to and from the locations after construction is completed. The finalized plan will be submitted by the contractor and it shall contain detailed documentation describing the special equipment, maintenance procedure/schedule and spare parts
- .3 Exterior lighting is supplied with electrical energy from nearby buildings. For each project where existing exterior lighting will be impacted by planned new construction, the new project scope shall include all needed adjustments, removals or relocations to the existing systems to ensure continued operation of existing exterior lighting systems beyond the project boundaries, as well as new exterior lighting for the new project. The scope for remediation of existing lighting systems shall be as per the original design intent. All impacted existing systems shall require coordination with UBC Facilities Electrical (Vancouver) / UBC Facility Management (Okanagan). UBC Facilities Electrical / Facilities Management Policies and Procedures shall be followed when investigating and/or modifying existing systems.
- .4 Lighting equipment shall be vandal proof by use of proper design and sufficient mounting height. Specifically, post top units at low mounting height (below 5m) and bollards shall not be used. [Refer to UBC Vancouver Campus Plan Lighting Guidelines for height requirements.](#)

- .5 Retrofits of existing streetlights, where full replacement is not feasible, should provide light of similar quality, color, and illuminance as specified in the lighting plan. When new streetlights are added between existing ones, the luminaires shall be adjusted to ensure appropriate light levels are achieved.
- .6 When existing non-compliant light fixtures are identified for repair or replacement, it is expected that the appropriate compliant fixture will be installed. The only exception is in instances where multiple obsoleted fixtures are contained within a row. In this instance the same non-compliant fixture may be installed and used until there is funding to replace the entire row to the new standard.
- .7 Building highlighting/floodlighting is not permitted. Where feasible, floodlighting of high quality, low glare design installed on building areas inaccessible to the public can be used.
- .8 Landscape (garden-shrub-lawn) type lighting is not acceptable.
- .9 Fixtures that are cast in place into concrete or other permanent finishes are not permitted. Only surface mounted fixtures are permitted in these instances.
- .10 Lighting integrated into handrails and stairs is not permitted.
- .11 Exterior lighting that is powered by a building shall be under the control of the BMS scheduling system. The areas shall be divided into the following (as applicable):
 - .1 Building Mounted Exterior Lighting
 - .2 Walkway/Landscape/Area Lighting
 - .3 Street Lighting
 - .4 Street Lighting Receptacles (Mounted on the pole base)

Each area shall contain its own set of HOA, contactors, relay and pilot light for independent control via the BMS. Refer to Standard Detail E12-1 for an example of 2 areas.
- .12 Exterior lighting shall not be dimmable. DMX, DALI and other lighting control systems shall not be used without an approved variance from UBC Electrical (Vancouver) / Facility Management (Okanagan).
- .13 All conduit systems for street lighting shall be sized for designed conduit fill then increased by 1 trade size. Minimum conduit size shall be 37mm. All conduit and fittings shall be RPVC.
- .14 All conductors for street lighting shall be minimum #8AWG RW90XLPE 1000V rated. Control and power conduits shall not share the same conduit system.
- .15 Boxes used for street or landscape lighting shall be sized as per the CEC. All boxes shall be of concrete construction, come with galvanized steel covers labeled "ELEC" and incorporate a bonding lug.
- .16 No electrical equipment such as transformers, ballasts, starters, drivers, etc. shall be installed in in-ground boxes or any below grade installations.
- .17 Exterior lighting pole bases to be installed minimum 13mm above hard scape and 50mm above soft scape. New light fixture base shall project minimum 50mm above finished soft scape grade.
- .18 Poles shall be steel and be painted with one coat of primer and 2 coats of paint.

- .19 Poles complete with luminaries shall be able to withstand 160 km/h winds.
- .20 All light fixtures provided shall be stock items (no custom made fixtures) readily available from local suppliers. The fixtures are required to be in current production with no plans to cease production and support within a 5 year period.
- .21 The following fixtures are required for to be used in the public realm as per UBC Vancouver Campus Plan Lighting Guidelines:
 - .1 Roads:
 - Lumenpulse Pure 100
Colour Temp: 3000 Kelvin
CRI: 92 or higher
Paint Colour: UBC grey (RAL 7043)
 - .2 Pedestrian Areas:
 - Saturn 2 Cutoff by Se'lux
Pole Type S35; Base Type: S35
Paint Colour: UBC grey (RAL 7043)
 - .3 Ceremonial Routes:
 - Match existing
Pain Colour: UBC Grey (RAL 7043)

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

1.2 Description

- .1 Audio-video infrastructure requirements for Sections 27 41 16 to 27 41 52.

2.0 DESIGN REQUIREMENTS

2.1 Consultant Coordination

- .1 Coordination of architectural systems, audio-video power, data and pathways requirements is paramount for a successful implementation of all audio-video systems. It is the responsibility of the Consulting Engineer to ensure that all requirements have been captured in their Construction Documents.
- .2 UBC IT Audio Visual shall be engaged by the project team to provide AV Infrastructure instructions, conceptual drawings or markups to be incorporated into the Consulting Engineer's Construction Documents, or in a case where an external AV system design consultant has been engaged this consultant shall provide same for review and approval by UBC IT Audio Visual. The instructions, conceptual drawings or markups provided by UBC IT Audio Visual shall not be issued to the Contractor performing the work in the Tender, or as a Site Instruction or Change Order. It is the responsibility of the Consulting Engineer to transfer the requirements to their documentation. This will ensure that the proper communication protocol is maintained throughout the project and that the requirements are fully coordinated with other disciplines.
- .3 The Consulting Engineer shall provide UBC IT Audio Visual with Schematic Design, Design Development and Construction Documents for review and sign off at a minimum. Iterative reviews are required to ensure minimal impact prior to Tender. The Consulting Engineer shall provide electronic copies of the Drawings and Specifications for review.
- .4 The Consulting Engineer shall use the UBC IT Audio Visual standard drawing symbols shown in AVSK-01.
- .5 The Consulting Engineer shall provide the Issued for Construction Drawings and Specifications once issued to the Contractor.
- .6 Shop Drawings, Site Instructions and Change Orders that affect audio-video systems shall be submitted to UBC IT Audio Visual for review.
- .7 The Consulting Engineer shall inform UBC IT Audio Visual when audio-video power, data and pathways are ready for rough-in inspection, prior to boarding. UBC IT Audio Visual's site inspection will not remove the responsibility of the Consulting Engineer to ensure that the audio-video power, data and pathways conform to the Issued for Construction Documents requirements.

2.2 Basic Requirements

- .1 Provide electrical power of the voltage, current and phase(s) required, from the main sources of supply to each audio-visual equipment load requiring supply of power. Typically a 120 VAC, 15A, single phase connection is required unless specified otherwise by UBC IT Audio Visual through design consultation.
- .2 Provide an audio-visual raceway system consisting of outlet boxes, conduits, cable trays, pull boxes, sleeves and caps, and pull strings. New conduit for cable runs are preferred for all new buildings. Free-air cabling is permitted for existing buildings where conduit is non-existent and/or inadequate for required AV cabling with permission from UBC IT Audio Visual.
- .3 Provide plywood backing behind finished wall surface for audio-visual equipment such as flat panel displays, projection screens and equipment racks.
- .4 It is not permitted to install audio-visual equipment in an IT communications room, electrical room or mechanical room. Notwithstanding, at the UBC Okanagan campus, audio-visual equipment may be installed in an IT communications room with approval from both UBCO IT Audio Visual and UBCO IT Data & Infrastructure.
- .5 It is not permitted to share conduit pathway with IT communications cabling with the exception of cable/basket tray that has barriers to separate IT and audio-visual cabling to ensure proper cable management for both disciplines. Notwithstanding, at the UBC Okanagan campus, IT and audio-visual cabling may share conduit and basket trays without barrier if they are the same type of cable (i.e. Category 6A) and is approved by both UBCO IT Audio Visual and UBCO IT Data & Infrastructure.

2.3 Performance Criteria

- .1 Basket tray shall be sized for communications and audio-visual cable density plus 25% future expansion capacity:
 - .1 Continuous, rigid, welded steel wire mesh spaced 50mm x 100mm;
 - .2 Continuous T-weld on top rail of tray;
 - .3 And Finish: electroplated zinc coating.
- .2 A zone conduit system shall be used in areas where basket tray is not feasible. Zone pull boxes c/w access hatches shall be spaced maximum 9 meters apart. All outlet box conduits shall homerun to the nearest zone pull box.
- .3 Power connection shall be adjacent to audio-visual outlet box.
- .4 Pathways shall avoid potential sources of electromagnetic interference by maintaining clearances of at least:
 - .1 305mm from fluorescent ballasts;
 - .2 305mm from electrical distribution conduit and cable less than 1kV;
 - .3 1000mm from electrical distribution conduit and cable more than 1kV;
 - .4 1220mm from motors and transformers;
 - .5 And 305mm from HVAC equipment, ducts and pipes.

- .5 Audio-visual outlet boxes shall be masonry back box with minimum depth of 90mm. Outlet box shall be recessed if wall mounted below finished ceiling. All outlet boxes shall have cover plates installed and colour coordinated with other outlets and services.
- .6 Floor boxes with audio-visual requirements shall be able to accept Extron AAP or MAAP plates. Floor box lid shall allow cable egress while in the closed position. Floor box shall be intended for AV cabling and termination use, and allow sufficient room for all required cabling without cable strain at the connectors.
- .7 The bend radius shall be at least six (6) times the internal diameter for conduit that has an internal diameter of 50mm or less. The bend radius shall be at least ten (10) times the internal diameter for conduit that has an internal diameter more than 50mm.
- .8 The maximum number of bends between cable pull boxes in a conduit run shall be two (2) 90 degree bends.
- .9 Conduit runs shall have no continuous sections longer than 30m between pull boxes.
- .10 If a conduit run requires a reverse bend between 100 degree and 180 degree then a pull box shall be inserted into the bend but shall not be used as the bend.
- .11 Pull boxes shall be installed in fully accessible spaces.
- .12 Support and secure all boxes independent of the conduit connected thereto.
- .13 All conduit ends shall be protected by insulating bushings.
- .14 Conduit stub and insulating bushing shall be as short as possible inside the outlet box to ensure that it does not obstruct installation of the audio-visual device. *Refer to AVSK-03 for AV outlet box detail.*
- .15 All conduits shall be left with a nylon pull string installed.
- .16 Plywood backing shall be a minimum of 20mm thick and spanned between a minimum of three (3) studs. The dimensions of the backing shall be sized appropriately for the equipment being installed.
- .17 Each outlet box shall be clearly marked in back of box with an 'AV#' that corresponds to the riser diagram and floor plan.
- .18 Audio-visual conduits and outlet boxes shall be colour coded with paint or similar. The colour shall be different from other systems including communications pathway.

2.4 General Device Power, Data and Pathway Requirements

- .1 This section will aid Consultants and Contractors with general infrastructure requirements for each type of audio-visual device. Final infrastructure requirements shall be verified by UBC IT Audio Visual prior to finishing design or pricing scope of work.
- .2 Ceiling Mount Projector
 - .1 Provide ceiling mount double duplex receptacle, shared with respective electric screen 15A circuit.
 - .2 Provide ceiling mount 2-gang projector outlet box.

- .3 Provide 41mm conduit from projector outlet box to audio-visual rack back box.
- .4 If the room does not have a rack, then conduit shall run to audio-visual input plate outlet box and provide ceiling mount data outlet box adjacent to projector outlet box.
- .3 Wall Mount Flat Panel Display
 - .1 Provide wall mount double duplex receptacle on dedicated 15A circuit.
 - .2 Provide wall mount 2-gang display outlet box.
 - .3 Provide 41mm conduit from display outlet box to audio-visual rack back box.
 - .4 If the room does not have a rack, then conduit shall run to audio-visual input plate outlet box and provide wall mount data outlet box adjacent to display outlet box.
 - .5 Provide plywood backing behind display.
- .4 Wall Mount Digital Signage Flat Panel Display
 - .1 Provide wall mount duplex receptacle.
 - .2 Provide wall mount data outlet box adjacent to duplex receptacle.
 - .3 Provide plywood backing behind display. Refer to AVSK-17 for typical flat panel display mounting detail.
- .5 Recessed Electric Screen
 - .1 Provide ceiling mount power connection c/w local disconnect switch on left-hand side of screen, shared with respective projector 15A circuit.
 - .2 Provide ceiling mount single-gang electric screen outlet box mounted on left-hand side of electric screen.
 - .3 Provide wall mount single-gang manual screen control outlet box mounted adjacent to local light switch.
 - .4 Provide 21mm conduit from each outlet box to audio-visual rack back box.
 - .5 If the room does not have a rack, then conduit shall run to the audio-visual control panel outlet box.
- .6 Wall Mount Electric Screen
 - .1 Provide ceiling mount duplex receptacle on left-hand side of screen, shared with respective projector 15A circuit.
 - .2 Provide ceiling mount single-gang electric screen outlet box mounted on left-hand side of electric screen.
 - .3 Provide wall mount single-gang manual screen control outlet box mounted adjacent to local light switch.
 - .4 Provide 21mm conduit from each outlet box to audio-visual rack back box.
 - .5 If the room does not have a rack, then conduit shall run to the audio-visual control panel outlet box.
 - .6 Provide plywood backing at screen anchor points.
- .7 Ceiling Mount HD Camera
 - .1 Provide ceiling mount duplex receptacle.
 - .2 Provide ceiling mount single-gang camera outlet box adjacent to power receptacle.
 - .3 Provide 35mm conduit from camera outlet box to audio-visual rack back box.
- .8 Wall Mount HD Camera
 - .1 Provide wall mount duplex receptacle.

- .2 Provide wall mount single-gang camera outlet box adjacent to power receptacle.
- .3 Provide 35mm conduit from camera outlet box to audio-visual rack back box.
- .9 Ceiling Mount Microphone
 - .1 Provide ceiling mount single-gang microphone outlet box above finished ceiling.
 - .2 Provide 27mm conduit from microphone outlet box to audio-visual rack back box.
 - .3 Multiple microphone outlet boxes can be daisy chained but conduit size may need to be increased to accommodate the additional cabling.
- .10 Wall/Ceiling Mount Antenna
 - .1 Provide ceiling or wall mount single-gang antenna outlet box.
 - .2 Provide 27mm conduit from antenna outlet box to audio-visual rack back box.
- .11 Wall/Ceiling Mount Room Support IP Camera
 - .1 Provide one (1) wall or ceiling mount duplex receptacle.
 - .2 Provide one (1) wall or ceiling mount data outlet box adjacent to power receptacle.
- .12 Ceiling Mount Speaker
 - .1 Provide ceiling mount single-gang outlet box above finished ceiling.
 - .2 Provide 27mm conduit from speaker outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to an additional wall or ceiling mount 2-gang outlet box mounted adjacent to the local display device.
 - .4 Multiple speaker outlet boxes can be daisy chained but conduit size may need to be increased to accommodate the additional cabling.
- .13 Wall Mount Speaker
 - .1 Provide wall mount single-gang speaker outlet box.
 - .2 Provide 21mm conduit from speaker outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to an additional wall or ceiling mount 2-gang outlet box mounted adjacent to the local display device.
 - .4 If required by system design, provide duplex receptacle adjacent to speaker outlet box (to support the use of active speakers).
- .14 Wall Mount Button Control Panel
 - .1 Provide wall mount 3-gang outlet box.
 - .2 Provide 27mm conduit from control panel outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to local display device outlet box.
- .15 Wall Mount Touch Control Panel
 - .1 Provide wall mount 2-gang outlet box.
 - .2 Provide 27mm conduit from control panel outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to local display device outlet box.

- .16 Wall Mount Audio-Visual Input Plate
 - .1 Provide wall mount multi-gang outlet box as defined by system requirements.
 - .2 Provide 41mm conduit from input plate outlet box to audio-visual rack back box.
 - .3 If the room does not have a rack, then conduit shall run to local display device outlet box.
 - .4 Refer to AVSK-02 for AV input plate L-hook installation detail.
 - .5 L-Hook shall be installed with two (2) toggler bolts and (2) 3/16" flat head screw to secure to dry wall.
 - .6 L-Hook shall be installed at 25-3/4" AFF.
- .17 Table Mount Audio-Visual Devices
 - .1 Provide floor box c/w with double duplex receptacle and 41mm conduit from floor box to audio-visual rack back box.
 - .2 If the room does not have a rack, then conduit shall run to local display device outlet box.
- .18 Audio-Visual Equipment Rack (each)
 - .1 Provide wall mount double duplex receptacle on dedicated 20A circuit.
 - .2 Provide wall mount data outlet box adjacent to power receptacle.
 - .3 Provide wall mount 300mm x 300mm rack back box.
 - .4 If the rack is wall mounted, provide plywood backing.
- .19 Fixed Instructor Lectern
 - .1 Provide four (4) double duplex receptacles on two (2) 15A circuits.
 - .2 Provide data outlet box adjacent to each rack power receptacle.
 - .3 Provide data outlet box adjacent to power receptacle in trough.
 - .4 All conduits for power, communications and audio-visual shall stub up below lectern trough. Stubs shall never be installed underneath lectern rack bay locations.
- .20 Mobile Instructor Lectern
 - .1 Provide wall mount duplex receptacle on dedicated 15A circuit.
 - .2 Provide wall mount data outlet box adjacent to duplex receptacle.
 - .3 Provide wall mount 3-gang furniture whip outlet box mounted adjacent to duplex receptacle.
 - .4 Provide 41mm conduit from outlet box to audio-visual rack back box
- .21 Lighting Integration
 - .1 Provide 2-gang outlet box adjacent to the local low-voltage lighting controller.
 - .2 Provide 27mm conduit from lighting integration point outlet box to audio-visual rack back box.
- .22 Electric Window Blind Integration
 - .1 Provide 2-gang outlet box adjacent to the blind controller.
 - .2 Provide 27mm conduit from blind integration point outlet box to audio-visual rack back box.
 - .3 Blind shall have a LAN or RS-232 port for control by a 3rd party controller.

2.5 Typical Room Power, Data and Pathway Requirements

- .1 This section will aid Consultants and Contractors with infrastructure requirements for typical audio-video systems. UBC IT Audio Visual shall be consulted to confirm which system type applies to the given project rooms. UBC IT Audio Visual shall verify final infrastructure requirements prior to finishing design or pricing scope of work.
- .2 Typical Rooms:
 - .1 Bring-Your-Own-Device (BYOD) Projector System
 - .1 **Description:** This system has a single projector and screen and allows for connection of a personal device such as laptop or tablet. Wall mounted speakers flanking the screen drive program audio.
 - .2 Refer to AVSK-08 for typical BYOD projector system riser diagram.
 - .2 Bring-Your-Own-Device (BYOD) Flat Panel Display (FPD) System
 - .1 **Description:** This system has a single flat panel display and allows for connection of a personal device such as laptop or tablet. A sound bar mounted below the display drives program audio.
 - .2 Refer to AVSK-09 for typical BYOD FPD system riser diagram.
 - .3 Single Screen Video Conferencing (VC) System
 - .1 **Description:** This system has a single flat panel display, camera and microphone to allow live, real-time two-way communication between two or more geographically separated parties using a hardware-based endpoint. Presentation material can be transmitted from any personal device such as a laptop or tablet. Program audio is typically driven from the all-in-one camera, sound bar and microphone.
 - .2 Refer to AVSK-10 for typical single screen VC system riser diagram.
 - .4 Dual Screen Video Conferencing (VC) System
 - .1 **Description:** This system has two flat panel displays, a camera and microphones to allow live, real-time two-way communication between two or more geographically separated parties using a hardware-based endpoint. Presentation material can be transmitted from any personal device such as a laptop or tablet. Program audio is typically driven from the all-in-one camera, sound bar and microphone.
 - .2 Consult with UBC IT Audio Visual for system riser diagram.
 - .5 Web Conferencing System
 - .1 **Description:** This system has a single flat panel display, web camera and microphone to allow live, real-time two-way communication between two or more geographically separated parties using a PC running web conferencing software. Presentation material can be loaded to the PC to transmit. Program audio is typically driven from the all-in-one camera, sound bar and microphone.

- .2 Consult with UBC IT Audio Visual for system riser diagram.

.6 Single Screen Projector System

- .1 **Description:** This system has a single projector and screen and allows for connection of a personal device such as laptop or tablet, or presentation from a built-in PC or document camera. Wall mounted speakers flanking the screen drive program audio.
- .2 Consult with UBC IT Audio Visual for system riser diagram.

.7 Dual Screen Projector System

- .1 **Description:** This system has two projectors and screens and allows for presentation from two sources concurrently. Connections can be made from a personal device such as laptop or tablet, or built-in PC or document camera. A lectern provides a work surface and a location to house the audio-video equipment. Wall mounted speakers flanking the screens drive program audio.
- .2 Consult with UBC IT Audio Visual for system riser diagram.

.8 Lecture Theatre System

- .1 **Description:** This system has two projectors installed in a projection booth that allow presentation from two sources concurrently on two screens at the front of room. Connections can be made from a personal device such as laptop or tablet, or built-in PC or document camera. A lectern provides a work surface and a location to house audio-video equipment. The projection booth will house audio-video equipment that is not required at the lectern. Wall mounted line array speakers flanking the screens drive program audio and ceiling mounted speakers drive microphone audio.
- .2 Consult with UBC IT Audio Visual for system riser diagram.

.9 Collaboration Lab System

- .1 **Description:** This system has a flat panel display for the instructor and at each student pod allowing presentation from any single display to all the other displays. The instructor has connections for a personal device such as laptop or tablet, or built-in PC or document camera. Each student pod has connections for a personal device such as laptop or tablet. A lectern provides a work surface and a location to house audio-video equipment. An audio-video equipment closet will house equipment that is not required at the lectern. Ceiling mounted speakers will drive program and microphone audio.
- .2 Consult with UBC IT Audio Visual for system riser diagram.
- .3 Collaboration Lab systems require an audio-video equipment closet to house at minimum one (1) back-end audio-video equipment rack. The closet shall provide acoustic isolation from the lab and adequate ventilation or cooling for the heat generated by the audio-video equipment. Dimensions, power, data and HVAC requirements shall be verified by UBC IT Audio Visual.

.10 Digital Signage System

- .1 **Description:** This system has a flat panel display with digital signage player PC mounted behind the display.
- .2 Consult with UBC IT Audio Visual for system riser diagram.

2.6 Projection Booth Infrastructure Requirements

- .1 Projection booths are required in lecture theatres to house projectors and back-end audio-video equipment racks.
- .2 Projection booths require coordination with architecture, electrical and mechanical to ensure the booth location, dimensions, power, data and HVAC support the needs of the audio-video system.
- .3 Refer to AVSK-11 for an example layout of a typical projection booth with three (3) projectors (left, right and centre), and two (2) audio-video equipment racks.
- .4 Architectural Requirements
 - .1 The projection booth shall be sized at a minimum for two (2) projectors and one (1) full height swing-out audio-video equipment rack. Additional equipment racks and projectors may be required for the audio-video system. Quantities shall be confirmed by UBC IT Audio Visual.
 - .2 The projection booth shall be located such that all projectors are aligned centred to their corresponding projection screen at the front of room. The projection screens can be angled to reduce the width of the projection booth. Angled screen must adhere to the horizontal viewing angle defined in the UBC Learning Space Design Guidelines.
 - .3 The audio-video equipment racks shall have a minimum clearance of 1500mm in front, 1000mm on one side, and 150mm on the other side.
 - .4 The projectors shall have a minimum clearance of 500mm on the back, and both sides from walls or any other audio-video components.
 - .5 The projection booth shall have a minimum depth of 2900mm. Final depth of room shall be confirm by UBC IT Audio Visual to suit the needs of the audio-video system requirements.
 - .6 The projection booth shall be accessible from the entry vestibule or foyer outside the lecture theatre for support staff to be able to access the booth without disrupting a session.
 - .7 The projection booth shall be designed to provide the required structural support for the projectors and should include any required vibration isolation measures to prevent the projectors from shaking. In addition to vibration caused by HVAC, movements in the building such as doors opening and closing shall not cause the projectors to shake. Refer to AVSK-12 for example projector mounting structure.
 - .8 The projection booth shall have a window spanning the full width of all projectors in the booth. The window shall be designed for projection allowing optimal transmission of light, contrast and colour. The window shall be clear, colourless glass with a 2-

sided, multi-layer broadband anti-reflective coating. Transmission rate shall be 95% or better. The window shall be installed on 2 degree angle to minimize ghosting.

.1 Typical product is Abrisa Technologies CPG series.

.5 Electrical Requirements

- .1 Provide one (1) wall mounted double duplex receptacle on dedicated 20A circuit for each audio-video equipment rack.
- .2 Provide one (1) ceiling mounted duplex receptacle on dedicated 20A circuit for each projector.
- .3 Provide one (1) wall mounted data outlet with two (2) data drops for each audio-video equipment rack.
- .4 Provide surface mounted light fixtures in the projection booth. The location of the fixtures shall not affect the location of the racks and projectors as well as the swing of the racks.
- .5 Provide minimum 150mm wide basket tray around the perimeter of the projection booth to support the audio-video cabling to the equipment racks and projectors.
- .6 Provide adequate wall space, unimpeded from audio-video equipment rack location and swing, for lighting controller panel and electrical panel board as required.
- .7 For UBCO provide the following additional data drops:
 - .1 One (1) ceiling mounted data outlet with one (1) data drop for each projector.
 - .2 Four (4) data drops in addition to those required above for each audio-video equipment.

.6 Mechanical Requirements

- .1 Ventilation or cooling shall be provided in the projection booth to manage the heat gain produced by the audio-video equipment and projectors without adversely affecting the functionality of the audio-video system through factors such as condensation and vibration.
- .2 The projection booth shall be kept at a temperature range between 21 and 24 degrees Celsius with a relative humidity level between 30 and 50 percent.
- .3 The total amount of heat gain in the projection booth shall be calculated by allowing 4000 BTU/h per projector and 4000 BTU/h per audio-video equipment rack.

2.7 Stage Lighting

- .1 Stage lighting shall be provided by the audio-visual contractor unless indicated otherwise by UBC IT Audio Visual.
- .2 Stage lighting installation methods include flexible truss mount, flexible pole mount or fixed surface mount.
- .3 The stage lighting installation requires the following infrastructure:

- .1 Pathway from stage light fixtures to audio-visual equipment rack for DMX control cable
- .2 One (1) 20A receptacle on dedicated circuit for every nine (9) fixtures
- .3 Pathway from chain hoists to wall mounted connection point for remote plug station if applicable
- .4 One (1) 20A receptacle on dedicated circuit for each pair of chain hoists if applicable
- .4 Refer to Section 27 41 16.15 for Stage Lighting requirements.

3.0 **EXECUTION**

3.1 **Electric Screen Mounting**

- .1 Electric screen shall be mounted at a height such that the bottom edge of the image is at 1220mm for applications where the viewers are typically seated. The screen may need to be higher if the viewers are standing or the room geometry requires adjustments.
- .2 The following table provides a guide for electric screen case mounting height by typical screen size. The exact mounting height shall be confirmed onsite prior to installation and shall account for non-standard black drop height as indicated in the design.

Image Size			Case Size		Bottom of Image Height Above Finished Floor	Black Drop	Top of Case Height Above Finished Floor
Height	Width	Diagonal	Height	Width			
50"	80"	94"	6"	92"	48"	2"	106"
57.5"	92"	109"	6"	104"	48"	2"	113.5"
60"	96"	113"	6"	108"	48"	2"	116"
65"	104"	123"	6"	116"	48"	2"	121"
69"	110"	130"	6"	122"	48"	2"	125"
72.5"	116"	137"	6"	128"	48"	2"	128.5"
87"	139"	164"	6"	152"	48"	2"	143"
100"	160"	189"	9"	173.5"	48"	2"	159"
110"	176"	208"	9"	189.5"	48"	2"	169"
117.5"	188"	222"	9"	201.5"	48"	2"	176.5"

END OF SECTION

1.0 **GENERAL**

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 General

- .1 UBC IT Audio Visual has certified Biamp and Crestron programmers on staff to manage and maintain the Digital Signal Processors. DSP's must be Biamp or Crestron, unless otherwise specified in this Section, to allow for internal support and maintenance, and include Acoustic Echo Cancellation as required for the specific application.
- .2 All audio equipment, with the exception of microphone inputs, loudspeaker outputs, and consumer (IHF) items in approved usage, is intended to operate at a nominal level of -20 dBm to +4 dBm on balanced floating 600 ohm lines. Provide buildouts, terminations, interstage attenuators and decoupling transformers as required.
- .3 Consumer items are nominally intended to operate at 200 mV on unbalanced high-impedance lines. Provide buildouts, terminations, interstage attenuators and decoupling transformers as required.
- .4 All digital audio equipment should have a minimum sampling rate of 44.1kHz and a bit depth of 16bits.
- .5 Wireless microphone systems shall be designed with an antenna distribution system to provide uninterrupted 100% coverage in the area of usage. To ensure good signal strength, the transmitter should be line of sight to the receiving antenna.

2.2 Performance Criteria

- .1 Sound systems intended for AV playback support must provide a minimum speech intelligibility of 0.56 STI throughout the student seating area.
- .2 Sound systems intended for speech reinforcement must provide a minimum speech intelligibility of 0.67 STI throughout the student seating area.
- .3 Coverage uniformity from 500Hz-2000Hz should be within 6dB (+/- 3dB) in the listening plane throughout the seating area for any sound system in any application. The coverage uniformity below 500Hz should be within 10dB (+/- 5dB) in the listening plane throughout the seating area. The coverage uniformity above 4000Hz should be within 8dB (+/- 4dB) in the listening plane throughout the seating area.
- .4 Sound systems should be calibrated to output at a minimum of 20 dBA over the ambient sound levels of the enclosing space (as measured during typical use), and should be capable of delivering no less than 75dBA sound level at the most distant seat in the classroom.
- .5 When AV playback is provided, the sound system shall provide complete coverage of the seating area. For AV systems with stereo audio, the left channel audio shall be routed to "audience left speaker" and the right channel audio shall be routed to "audience right speaker". For AV systems with summed mono, both left and right audio channels shall be reproduced at equal volume.

- .6 Feedback Stability Margin should be a minimum of 6dB when the classroom acoustics are within the criteria set by the UBC Classroom Acoustical Standards.
- .7 Provide loudspeaker modelling coverage results, and STI predictions, for review with Design Development submission before tendering sound or AV package.
- .8 The audio DSP shall eliminate acoustic echo in a full-duplex video conference. Ensure that the AEC has a strong signal of the incoming audio as a reference. An incoming signal that is weak could cause the AEC to miss elements that should be eliminated from the outgoing signal. The following settings shall assure the acoustic echo cancelling is working properly:
 - .1 The audio used in a reference signal shall be post-process audio. The cancellation reference should be a sample of the signal being sent to the power amplifier.
 - .2 Avoid routing far-end audio through dynamic feedback controllers. This could give a false acoustic picture of the room to the AEC.
 - .3 As the audio signal is acquired from a microphone, assure the AEC function is completed prior to any automatic gain control, noise cancelling, muting, or microphone mixing. Applying any of these functions prior to the AEC activity could cause a false acoustic picture of the room.

2.3 Lavalier Wireless Microphone Systems

- .1 UHF band FM diversity wireless microphone systems, with frequency agile transmitters/receivers.
- .2 Audio Frequency Response 80 to 15,000 Hz, +/-2 dB, with high pass filter.
- .3 Gain Adjustment Range transmitter 0 to 40 dB.
- .4 Modulation +/-15 kHz deviation compressor expander system with pre and de-emphasis.
- .5 RF Power Output 12 mW minimum, 30 mW maximum.
- .6 Dynamic Range >100 dB, A weighted.
- .7 RF Image Rejection 55 dB typical.
- .8 Spurious Rejection 75 dB typical.
- .9 The minimum effective range of the wireless system, receiver to transmitter, must be 75 meters (225 ft.) in its specified use case.
- .10 The receivers will be mounted in the equipment rack with the antennae mounted externally from the rack and extended using 50 ohm coaxial cable.
- .11 Include a lavalier type cardioid condenser microphone with appropriate wireless connector, tie clip mount and windscreen.
- .12 Battery life to be a minimum of 8 hours with AA Lithium Alkaline batteries.
- .13 The wireless system must have a minimum of 100 channels available in their operating band, or more as required by the local operating environment.
- .14 Wireless systems used within the same building must have frequency blocks selected to be compatible.

- .15 Select clear frequencies on site based on RF site survey using wireless receiver.
- .16 Typical manufacturers are:
 - .1 Shure

Shure Band	
Band G50	(470 MHz – 534 MHz)

2.4 Talkback Handheld Wireless Microphone Systems

- .1 UHF band FM diversity wireless microphone systems, with frequency agile transmitters/receivers operating.
- .2 Audio Frequency Response 80 to 15,000 Hz, +/-2 dB, with high pass filter.
- .3 Gain Adjustment Range transmitter 0 to 40 dB.
- .4 Modulation +/-15 kHz deviation compressor expander system with pre and de-emphasis.
- .5 RF Power Output 12 mW minimum, 30 mW maximum.
- .6 Dynamic Range >100 dB, A weighted.
- .7 RF Image Rejection 55 dB typical.
- .8 Spurious Rejection 75 dB typical.
- .9 The minimum effective range of the wireless system, receiver to transmitter, must be 75 meters (225 ft.) in its specified use case.
- .10 The receivers will be mounted in the equipment rack with the antennae mounted externally from the rack and extended using 50 ohm coaxial cable.
- .11 Include a handheld cardioid dynamic microphone integrated into the transmitter.
- .12 Battery life to be a minimum of 8 hours with AA Lithium Alkaline batteries.
- .13 The wireless system must have a minimum of 100 channels available in their operating band, or more as required by the local operating environment.
- .14 Wireless systems used within the same building must have frequency blocks selected to be compatible.
- .15 Select clear frequencies on site based on RF site survey using wireless receiver.
- .16 Typical manufacturers are:
 - .1 Shure

Shure Band	
Band G50	(470 MHz – 534 MHz)

2.5 Gooseneck Microphone

- .1 Fixed microphones mounted on the lectern will be equipped with a flexible gooseneck.
- .2 The microphone will feature an outboard preamplifier.
- .3 The microphone will feature a cardioid condenser microphone capsule with a response of 80Hz to 20,000kHz with high pass filter engaged.
- .4 Minimum output impedance will be 150 ohms balanced, and it will have a minimum open circuit output sensitivity of 10mV/Pa.
- .5 The microphone will be usable with phantom power from 11 to 52V.
- .6 The microphone will have a matte black finish, and will be equipped with a windscreen.
- .7 Gooseneck microphones will be equipped with a fixed mounting to permanently mounted shockmount, removable microphones will not be acceptable.
- .8 Typical manufacturers are:
 - .1 Audio-Technica
 - .2 Shure
 - .3 Beyerdynamic
 - .4 Clock Audio
 - .5 AKG Harman

2.6 Ceiling Condenser Microphones

- .1 Microphones intended for ceiling mounting.
- .2 The microphone will feature a condenser microphone capsule with a response of 100Hz to 10kHz with high pass filter engaged along with all recommended manufacturer filters.
- .3 Minimum output impedance will be 150 ohms balanced, and it will have a minimum open circuit output sensitivity of 37mV/Pa.
- .4 The microphone will be usable with phantom power from 11 to 52V.
- .5 Typical manufacturers are:
 - .1 Audix
 - .2 Audio Technica
 - .3 Biamp
 - .4 Clear One
 - .5 Shure

2.7 Ceiling Tile Microphones

- .1 Microphones intended for mounting in rooms with ceiling tile ceilings.
- .2 The microphone will fit in 2'x2' ceiling tile grids and have a frequency response of 180Hz to 15 kHz with high pass filter engaged along with all recommended manufacturer filters.
- .3 The microphone will have a signal to noise ratio of 83 dB(A) and a minimum dynamic range of 82 dB(A).
- .4 The microphones will be powered via PoE.

- .5 The microphone audio output will be Digital Dante Network Audio.
- .6 Typical manufacturers are:
 - .1 Sennheiser
 - .2 Shure

2.8 Digital Audio Processor (Large Expandable)

- .1 DSP-based software configurable audio processor with a modular input and outputs, with a minimum capacity of 12 dual input or output modules, usable for inputs or outputs.
- .2 Compatible input modules with Acoustic Echo Cancelling must be available.
- .3 The DSP programming will not be limited by a fixed signal flow architecture, but fully configurable using a modular object interface.
- .4 Expandability will utilize an AVB or Dante backbone, allowing input and output expansion and shared DSP resources over an Ethernet network.
- .5 The mixer shall have a: frequency response within +/- 0.5dB between 20Hz-20kHz; signal-to-noise ratio of >80dB; output level of +24dB with less than 0.15%THD.
- .6 The unit will be configured through computer software, but a computer will not be required for operation.
- .7 The unit will be controllable through the AV control system via RS-232 or Ethernet.
- .8 Approved products are:
 - .1 Biamp Tesira

2.9 Digital Audio Processor (Small Expandable)

- .1 DSP-based software configurable audio processor with a fixed input and output configurations, with the option of local connections to other units over a proprietary expansion bus on short multiconductor cables or AVB.
- .2 The DSP programming will not be limited by a fixed signal flow architecture, but fully configurable using a modular object interface.
- .3 The mixer shall have a: frequency response within +/- 0.5dB between 20Hz-20kHz; signal-to-noise ratio of >80dB; output level of +24dB with less than 0.15%THD.
- .4 The unit will be configured through computer software, but a computer will not be required for operation.
- .5 The unit will be controllable through the AV control system via RS-232 or Ethernet.
- .6 Approved products are:
 - .1 Biamp Tesira Forte Series

2.10 Digital Audio Processor Fixed Application

- .1 DSP-based software configurable audio processor with a fixed input and output configurations.
- .2 The DSP programming may have a fixed signal flow architecture.

- .3 The mixer shall have a: frequency response within +/- 0.5dB between 20Hz-20kHz; signal-to-noise ratio of >80dB; output level of +24dB with less than 0.15%THD.
- .4 The unit will be configured through computer software, but a computer will not be required for operation.
- .5 The unit will be controllable through the AV control system via RS-232 or Ethernet.
- .6 Typical products are:
 - .1 Extron DMP series
 - .2 Extron MVC series
 - .3 Biamp Tesira
 - .4 Crestron Avia

2.11 USB Audio Mixer Fixed Application

- .1 The USB mixer shall have microphone and/or line level inputs with +48 volt phantom power, one USB 2.0 and one line level output
- .2 The USB mixer shall have a: frequency response within +/- 0.5dB between 20Hz-20kHz; signal-to-noise ratio of >80dB; output level of +24dB with less than 0.15%THD
- .3 The USB mixer input level and master volume level shall be manually adjustable control.
- .4 The USB mixer USB 2.0 output shall be Windows and Mac compatible.
- .5 Approved product manufacturers are Crestron and Art.

2.12 Power Amplifiers (70V)

- .6 Amplifiers for driving 70V ceiling loudspeakers or other distributed loudspeaker systems.
- .7 Amplifier power should be selected to have at least 2dB of headroom above the calculated load of loudspeaker taps plus insertion loss of speaker transformers, and should have a minimum of 30% more power than the sum total of all loudspeaker taps.
- .8 Amplifiers may have 70V output transformers, or may be a direct coupled constant voltage output. Amplifiers that use 70V transformers must include suitable high pass filtering to prevent output transformer saturation.
- .9 Amplifiers may be single channel or multi-channel, as best suits the particular needs of the project and the power density needed.
- .10 Amplifiers should have a minimum frequency response of 50Hz-15,000Hz including the output transformer.
- .11 Total Harmonic Distortion (THD) should be under 0.5% at full rated power including the output transformer.
- .12 Input connections by terminal strip, Phoenix connector, or XLR connector. ¼" TRS phone jacks are not acceptable.
- .13 Output connections by terminal strip, 5 way binding posts or Neutrik Speak-On.
- .14 Typical manufacturers are:
 - .1 Crestron
 - .2 Crown

- .3 TOA
- .4 Extron
- .5 QSC
- .6 Kramer

2.13 Power Amplifiers 50W and Up (Low Impedance)

- .1 Amplifiers for driving low impedance loudspeakers directly in medium to high power applications (50W or higher).
- .2 Amplifier power should be selected to have at least 3dB of headroom above the maximum expected power demands.
- .3 Amplifiers that are direct coupled low impedance output should have a minimum load impedance below 4 ohms and feature protection against short circuits and overheating.
- .4 Amplifiers may be single channel or multi-channel, as best suits the particular needs of the project and the power density needed.
- .5 Amplifiers should have a minimum frequency response of 50Hz-15,000Hz including the output transformer.
- .6 Total Harmonic Distortion (THD) should be under 0.5% at full rated power including the output transformer.
- .7 Input connections by terminal strip, Phoenix connector, or XLR connector. ¼" TRS phone jacks are not acceptable.
- .8 Output connections by terminal strip, 5 way binding posts or Neutrik Speak-On.
- .9 Typical manufacturers are:
 - .1 Crestron
 - .2 Crown
 - .3 Extron
 - .4 QSC
 - .5 Ashley
 - .6 Kramer

2.14 Power Amplifiers 2W – 50W (Low Impedance)

- .1 Amplifiers for driving low impedance loudspeakers directly in medium to high power applications (2W – 50W).
- .2 Amplifier power can be selected to match the maximum expected power demands.
- .3 Amplifiers that are direct coupled low impedance output should have a minimum load impedance below 4 ohms and feature protection against short circuits and overheating.
- .4 Amplifiers may be single channel or multi-channel, as best suits the particular needs of the project and the power density needed.
- .5 Amplifiers should have a minimum frequency response of 50Hz-15,000Hz including the output transformer.
- .6 Total Harmonic Distortion (THD) should be under 0.5% at full rated power including the output transformer.
- .7 Input connections by terminal strip, Phoenix connector, or XLR connector. ¼" TRS phone jacks are not acceptable.

- .8 Output connections by terminal strip, 5 way binding posts or Neutrik Speak-On.
- .9 Approved manufacturers are:
 - .1 Extron
 - .2 Crestron
 - .3 Stewart
 - .4 Kramer

2.15 Ceiling Loudspeakers for Learning space Speech Reinforcement Systems

- .1 Ceiling loudspeakers used in speech reinforcement systems must exhibit uniform 1/3 octave directivity from 1000Hz - 4000Hz with a nominal directivity index of 6 (+/- 4). The coverage pattern should never be narrower than 90 degree conical in that 1-4kHz bandwidth.
- .2 Speech reinforcement ceiling speakers should be concentric coaxial rather than "tweeter on a post" construction to meet the above directivity requirement.
- .3 Frequency response for ceiling speakers should be 90Hz to 18,000Hz +/- 3dB.
- .4 Ceiling speakers should include 70V transformers with a minimum of a 9dB range of taps. Wattage taps to be verified prior to install.
- .5 Ceiling speakers should have a minimum sensitivity of 85dB @ 1W @1 m.
- .6 Ceiling speakers must be seismically restrained in suspended ceilings.
- .7 Typical manufacturers are:
 - .1 Crestron
 - .2 Tannoy
 - .3 Community
 - .4 JBL
 - .5 Soundtube
 - .6 Kramer

2.16 Ceiling Loudspeakers for General Purpose Use

- .1 Ceiling loudspeakers used in general purpose paging systems must have a frequency response of 90Hz to 15,000Hz +/- 5dB.
- .2 Ceiling speakers should include 70V transformers with a minimum of a 12dB range of taps. Wattage taps to be verified prior to install
- .3 Ceiling speakers should have a minimum sensitivity of 85dB @ 1W @1 m.
- .4 Ceiling speakers must be seismically restrained in suspended ceilings.
- .5 Typical manufacturers are:
 - .1 [Community](#)
 - .2 [Tannoy](#)
 - .3 Crestron
 - .4 JBL
 - .5 Extron
 - .6 Kramer

2.17 AV Playback Loudspeakers for Small Learning spaces

- .1 AV playback speakers for use in learning spaces under 50 seats.

- .2 Playback speakers should be able to provide a sound level of 75dBA in the most distant seats in the classroom, and should have a wide enough coverage that all students can hear both stereo channels.
- .3 Loudspeakers should have a frequency response of 90Hz to 18,000Hz +/- 5dB.
- .4 Loudspeakers should have a minimum sensitivity of 85dB @ 1W @1 m.
- .5 Typical manufacturers are:
 - .1 Crestron
 - .2 JBL Control series
 - .3 Tannoy
 - .4 Kramer

2.18 AV Playback Loudspeakers for Large Learning spaces

- .1 AV playback speakers for use in learning spaces over 50 seats.
- .2 Loudspeakers for use in learning spaces and lecture theatres over 50 seats should be chosen based on the coverage uniformity results of a loudspeaker modelling package to provide performance as outlined in section 2.2
- .3 Playback speakers should be able to provide a sound level of 75dBA in the most distant seats in the learning spaces, and should have a wide enough coverage that all students can hear both stereo channels.
- .4 Loudspeakers should have a frequency response of 60Hz to 18,000Hz +/- 5dB.
- .5 Loudspeakers should have a minimum sensitivity of 85dB @ 1W @1 m.
- .6 Typical manufacturers are:
 - .1 Crestron
 - .2 Community
 - .3 JBL Pro
 - .4 Tannoy
 - .5 Bose
 - .6 TOA

3.0 EXECUTION

3.1 Mounting, Rigging and Seismic Restraint

- .1 Where the Sound Contractor uses loudspeaker enclosures or systems that are factory equipped with rigging or mounting points, the rigging or mounting hardware and the attachment to the building or support structure must be certified. Component mounting in the enclosures must make use of bolts and threaded inserts or locknuts. Self-threading wood or sheet metal screws are not acceptable for driver mounting to the baffle. Loudspeaker mounting clamps that grip the edge of the loudspeaker frame, and are put in compression by a through bolt are not acceptable. All loudspeakers must be mounted by bolts through mounting holes in the frame.
- .2 Loudspeaker components such as moulded fibreglass horns, cast or injection moulded plastic speaker enclosures or horns, etc. must never be supported by a system using the drilled or moulded holes through the plastic material. All mounting holes or attachment points must have aluminium or steel reinforcement to prevent breakaway or tear-out of the

material surrounding the holes.

- .3 All loudspeakers installed in acoustic ceiling tile grids must use appropriate tile bridge hardware, and be seismically restrained to building structure.

3.2 Wiring

- .1 Route microphone cables in separate conduit or raceways and maintain separation of all other cables in tray system and equipment racks by level and function: microphone circuits, line level circuits, foldback circuits, loudspeaker circuits, intercom circuits, video circuits, control circuits and 120 volt AC power circuits.
- .2 All connections using shielded pair audio cable should include cable dressing as follows.
 - .1 The shield, or drain wire should have a clear Teflon, or green PVC, or heatshrink sleeve covering exposed conductor between the connector, or termination and the cable jacket.
 - .2 A heat shrink boot, or Hellerman sleeve should be used on any cable that uses a braided shield or spiral wrap shield where the cable is dressed for termination.
- .3 All audio circuits, unless otherwise specified, shall be balanced, floating and shielded two wire circuits with the red or white wire hot (connected to pin 2 of XLR3 connectors and to the Tip of phone connectors) and the black wire cold (connected to pin 3 of XLR3 connectors and to the Ring of phone connectors).
- .4 Make input connections to power amplifiers with XLR3 connectors, or with spade lugs on barrier terminal strips, or Phoenix connectors. Do not make input connections with 1/4 inch phone plugs.
- .5 Use ring lugs or high current locking connectors, such as Neutrik Speakons for connections to enclosed loudspeaker systems.

3.3 Grounding and Shielding

- .1 Connect all racks containing sound system equipment to only the dedicated sound system ground point.
- .2 For microphone cables, provide continuous shield from microphone receptacle to microphone mixer input. Ground only at mixer.
- .3 Pin 1 on XLR type connectors must not be connected to the connector barrel or shell.

3.4 Testing

- .1 Conduct tests to demonstrate that the sound system is properly functional:
 - .1 After installation, measure and document the sum of the harmonic distortion, noise floor and gain for a typical path from microphone level input to amplifier output.
 - .2 Measure and document gain structure through the signal path from input to output for each typical signal level. Repeat with sine wave sweep from 50 Hz to 15kHz to record any additional adjustments required by equalization. Repeat with full bandwidth pink

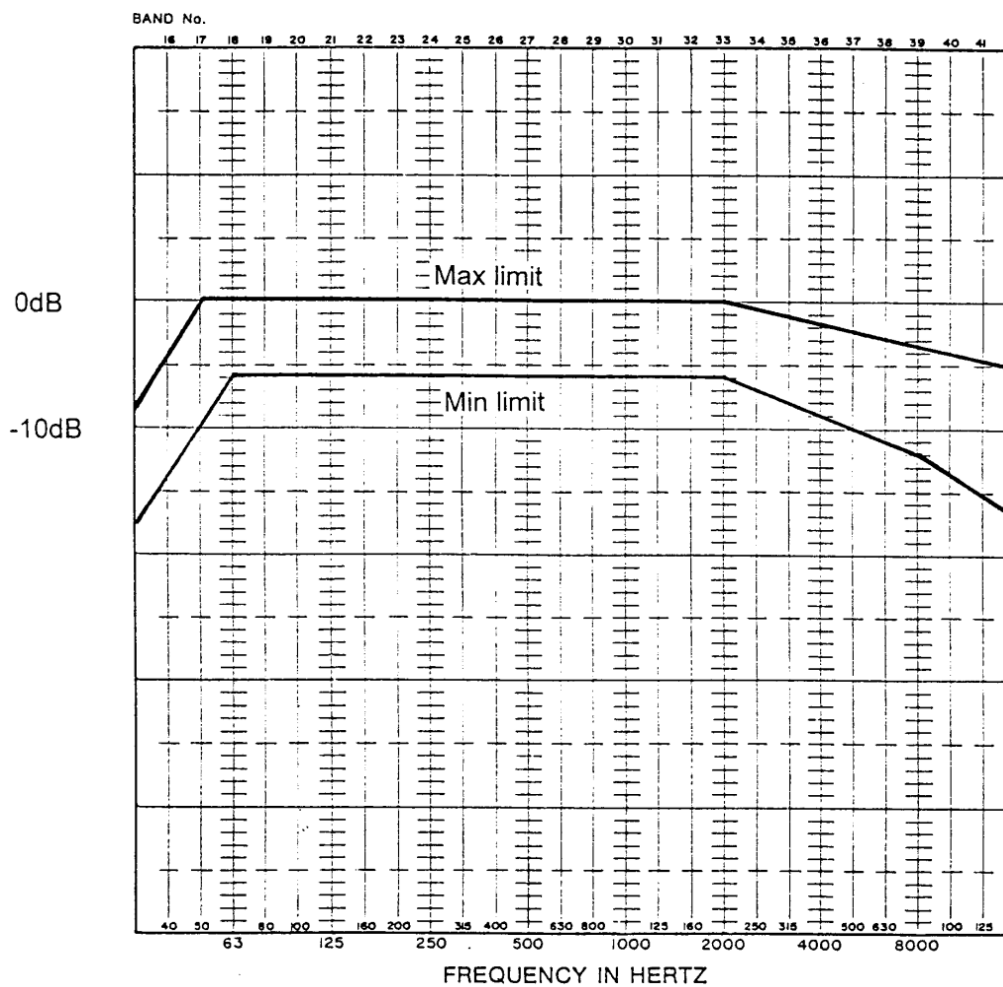
noise signal, or swept test signal to record equalizer wide-band gain.

- .3 Ensure that system is free of spurious oscillation and RF noise up to 5 MHz.
- .4 Test polarity of microphones, microphone cables, and signal wiring: pin 1 = shield, pin 2 = hot, pin 3 = cold. Test polarity of connector plate plugs and jacks: sleeve = shield, ring = cold, tip = hot. Test polarity of signal equipment and amplifiers. Test polarity of loudspeaker wiring: red = (+), black = (-). Drive all loudspeakers in polarity, and in absolute polarity. Test absolute polarity of the voice and playback systems, input to output, and ensure that the sum of all signal paths is in polarity. If it is necessary to invert signal polarity at any stage or interconnect point to preserve system polarity, document that polarity change on as-built drawings.
- .5 Measure uncorrected direct sound response of the loudspeakers at no less than three (3) positions representative of the middle and edges of the seating. Adjust equalization to shape house response. Measured response after equalization shall fall within the limits defined on Figure #1.
- .6 With pink noise input, record maximum sound pressure level after equalization.

3.5 Test Equipment

- .1 Provide the following audio test equipment on site during check-out where necessary to measure and document the system performance outlined in section 3.8:
 - .1 Time domain measurement system (**TEF** or JBL/EAW Smaart or EASERA) for setting of direct sound equalization.
 - .2 Sound level meter with linear response and 1/2 inch free field microphone.
 - .3 Audio test set with low distortion signal generator, true RMS meter, and facility to measure THD. (Audio Precision, Neutrik, HP, etc.)
 - .4 5 MHz oscilloscope.
 - .5 Pink noise generator.
 - .6 All cables, connectors and adaptors necessary to interface with the sound system.
- .2 Provide test equipment of professional quality and in good working order. Substandard equipment will be cause for rejection. The Owner, or their designated Consultant reserves the right to demand proof of equipment accuracy.

Figure # 1 Sound System Response Limits



*** END OF SECTION***

1.0 **GENERAL**

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 Design Criteria

- .1 All video outputs to display devices shall be digital outputs, with scaling capability provided either by the display device itself or by an external scaler located immediately prior to the display device input. The scalers must be able to maintain the original signal aspect ratio (4:3, 16:10 or 16:9), and should support HDTV and 4K resolutions (720P, 1080i, 1080P, Ultra HD, 4K DCI).
- .2 All digital video sink equipment will be HDCP compliant, communicate EDID status and accept signals with a minimum bit depth of 24bits at a resolution of 1920 x1080 pixels @60Hz or 1080P. Equipment that is not HDCP compliant, such as a video conferencing codec or lecture capture recorder, shall be reviewed with UBC IT Audio Visual for approval.
- .3 Video switching infrastructure will be required to support TMDS digital inputs (DVI-D/HDMI) with minimum resolution of 4K. The digital signal input, switching and distribution system must be HDCP compliant (minimum of HDCP2.2).
- .4 Video projection systems must be designed to deliver a minimum of 60 Lumens/sq.ft in typical learning spaces with multiple zone lighting and typical blind systems. In very large lecture theatres with screens over 14m² image areas, and complete ambient lighting control to a full blackout, special project by project allowances may be considered to reduce that requirement to balance projector cost versus performance.
- .5 The following table provides a guide for selecting a laser projector brightness in lumens by typical screen size. As per ANSI/INFOCOMM 3M-2011, the contrast ratio is minimum 15:1 for classroom content and a constant light output percentage of 80%. The ambient light Lux values are the approximate sunlight and artificial light shining on the projection surface. These brightness values are suggestions for high-level discussions and design – the AV designer shall validate brightness requirements for each application.

Image Size			Projector Lumens by Ambient Light					
			Good 0 – 50 Lux		Better 51 – 65 Lux		Best > 65 Lux	
Height	Width	Diagonal	Lm	Lm/Ft ²	Lm	Lm/Ft ²	Lm	Lm/Ft ²
50"	80"	94"	5,000	144.0	5,000	144.0	5,000	144.0
57.5"	92"	109"	5,000	108.9	5,000	108.9	5,000	108.9
60"	96"	113"	5,000	100.0	5,000	100.0	5,500	110.0
65"	104"	123"	5,000	85.2	5,000	85.2	6,500	110.8
69"	110"	130"	5,000	75.9	5,500	83.5	7,000	106.2
72.5"	116"	137"	5,000	68.5	6,500	89.0	9,000	123.3
87"	139"	164"	7,000	66.7	9,000	85.7	12,000	114.3
100"	160"	189"	9,000	64.8	12,000	86.4	15,000	108.0
110"	176"	208"	10,000	59.5	15,000	89.3	20,000	119.0
117.5"	188"	222"	12,000	62.6	15,000	78.2	20,000	104.3

- .6 Video projectors must be mounted to minimize risk of vibration or shake, either initiated by mechanical systems or from wall movement caused by doors closing or people walking on the floors above the projector mounts. Structural rigidity should be raised with project structural engineer, especially where lightweight construction methods are being employed.
- .7 Projectors and displays will be equipped with 4-digit combination padlocks, and anti-theft fittings and hardware.
- .8 Projection booth glazing and projection ports must have glass with anti-reflective coating on both sides. Use angled glass to prevent a reflected image from being sent back into the projector lens. A seven degree outward tilt from the perpendicular plane of the projector is recommended.

2.2 Video Source Equipment

.1 Robotic Video Camera

- .1 Where robotic PTZ cameras are used in classrooms for lecture capture, overflow connectivity, or remote audiences the cameras will have HD resolution to 1080P, and the output will be available on a suitable TMDS connector (HDMI/DVI-D).
- .2 The units should use a VISCA RS-232/RS-485 or Ethernet control protocol and should feature at least 6 internal presets that include PTZ settings and focus.
- .3 The units should feature an adequately large optical zoom range so that the widest to narrowest shots required can be achieved without using digital zoom.
- .4 The cameras should be usable when mounted upright or inverted.
- .5 Approved manufacturers are:
 - .1 Panasonic
 - .2 Sony
 - .3 Vaddio
 - .4 Clearone
 - .5 AVer

.2 Robotic Tracking Video Camera

- .1 Where robotic tracking PTZ cameras are used in classrooms for lecture capture, overflow connectivity, or remote audiences the cameras will have HD resolution to 1080P, and the output will be available on a suitable TMDS connector (HDMI/USB/RJ-45).
- .2 The units should use a VISCA RS-232/RS-485 or Ethernet control protocol and should feature at least 6 internal presets that include PTZ settings and focus.
- .3 The units should feature an adequately large optical zoom range so that the widest to narrowest shots required can be achieved without using digital zoom.
- .4 The cameras should be usable when mounted upright or inverted.
- .5 The cameras should have multiple tracking modes including People Tracking, Zone Tracking, Voice tracking and Hybrid mode that switches between People & Zone tracking modes.

- .6 Approved manufacturer is Aver.

.3 Document Camera

- .1 Table top mounted document cameras will have a collapsible camera arm and will have integrated top lighting for the object table.
- .2 Document cameras will have a minimum resolution capability of 1280x720 on [HDBaseT](#) or HDMI outputs. The output signal should not be HDCP protected.
- .3 The document camera must include secure table top mounting brackets to reduce risk of theft.
- .4 Approved manufacturers are:
 - .1 Elmo
 - .2 Epson (additional UBCO option)

.4 Computer Inputs

- .1 Input panels mounted on walls, in racks, in lectern troughs, in meeting room tables and any other location must use industry standard Extron modular input plates, in either MAAP or AAP format.
- .2 Digital inputs will use panel mounted HDMI connectors, mounted face up or at 90 degrees, and in such a fashion as to relieve stress on HDMI connector when the cable is inserted.
- .3 HDMI inputs must include highly flexible connection cables between plates and laptops. Overly rigid, thick, or otherwise difficult to manage cable types will be rejected.
- .4 Laptop cables must include a strain relief and a cable locking system to keep cables attached to AV input plates. When input plates are wall mounted, wall mounted J-hooks will be installed for cable storage. These hooks are to be mounted securely, adjacent the input plate, at a distance of approximately 18" apart. Hooks should be mounted at a comfortable height that is easily accessible, and in such a way that cable loops do not drape over/impede access to either the AV input plate, or nearby power or data outlets.

.5 Wireless Presentation Gateway

- .1 The presentation gateway shall provide Ethernet to HDMI conversion of audio and video signals. Portable devices shall be able to connect to the gateway through the local Wi-Fi network.
- .2 The presentation gateway shall support up to ten (10) user connections.
- .3 The presentation gateway shall support the following operating systems:
 - .1 Windows 10
 - .2 Mac OS X (v10.10 or higher)
 - .3 Apple iOS
 - .4 Android
- .4 The presentation gateway shall support Apple AirPlay mirroring.

- .5 The presentation gateway shall support USB web conferencing peripherals such as soundbars, & cameras. USB connection to be USB2.0 type A or USB3.0 type A. Must be compatible with Microsoft Teams and Zoom software.
- .6 Video Output Resolution, 1280x720@60Hz (720p60), 1280x800@60Hz, 1280x1024@60Hz, 1366x768@60Hz, 1440x900@60Hz, 1600x1200@60Hz, 1600x900@60Hz, 1680x1050@60Hz, 1920x1080@60Hz (1080p60), 3840x2160@30Hz (2160p30), 3840x2160@60Hz (2160p60).
- .7 Audio Standards:
 - .1 PCM 2-channel
- .8 Audio/Video Connector:
 - .1 One (1) female 19-pin Type A HDMI
 - .2 One (1) HD15 female
 - .3 One (1) 3.5 mm TRS mini phone jack
- .9 Network Interface:
 - .1 One (1) LAN/Ethernet, RJ-45, 10/100/1000 Mbit
- .10 Power supply:
 - .1 Local DC power source.
- .11 Mounting:
 - .1 Freestanding.
 - .2 Surface mount.
 - .3 Built-in to DigitalMedia Presentation System.
- .12 Product shall be the following or Approved Equal:
 - .1 Crestron AM-3200
 - .2 Crestron DMPS3-4K-250-C
 - .3 Crestron DMPS3-4K-350-C

2.3 Networked Audio-Video over IP Switching and Distribution Equipment

.1 Basic Function

- .1 The system shall be able to facilitate audio and video distribution over a standard 1 gigabit network. The system components shall include support for real-time signal up to 4K60.
- .2 The system shall be composed of endpoints (hardware encoders and decoders) and network switches.
- .3 The system shall be capable of supporting an unlimited number of endpoints.
- .4 The maximum bandwidth requirement per endpoint stream shall be 1 gigabit.

.2 Transmission

- .1 1 gigabit transmission of video over Ethernet with support for resolutions up to 4K60.
- .2 The endpoints shall support automatic bit rate adjustment set by the resolution of the stream.

.3 Network Requirements

- .1 The system shall operate on Category 5e or better infrastructure.
- .2 The system shall utilize standard 1 gigabit Ethernet.
- .3 The system shall support unicast or multicast traffic to distribute streams across a network.
- .4 The system shall not require proprietary network management software or hardware, Ethernet switches or network protocol.
- .5 All switches must be non-blocking and configured in such a way to meet all AV-over-IP protocol requirements including but not limited to IGMP, Multicast, PIM-SM and QoS.
- .6 Approved Audio-Video over IP switches are Cisco and Netgear.

.4 System Integration

- .1 The system shall support integration with a single software management platform to provide complete system monitoring, management and control.
- .2 The management platform shall support the following functions:
 - .1 Automatic device configuration including firmware updates, security patches, and device settings
 - .2 Manage feature licences

.5 Audio-Video over IP Endpoints

- .1 Endpoints shall allow encoding or decoding of up to 4K60 video signal and stereo audio signal.
- .2 Endpoints shall require a maximum bandwidth of 1 gigabit.
- .3 Endpoints shall support web-based control and management.
- .4 Endpoints shall have the following video features:
 - .1 One (1) HDMI video connection
- .5 Endpoints shall have the following audio features:
 - .1 Two-channel Dante network audio, Two-channel AES67 network audio or two-channel balanced analog audio
- .6 Endpoints shall have the following control features:
 - .1 One (1) 1000-BASE-T Ethernet port for stream connection
 - .2 One (1) 100-BASE-T or faster Ethernet port or one (1) RS-232 port for device control
- .7 Endpoints shall support local or remote DC power source and PoE+ via network switch or power injector.

- .8 Approved manufacturers are:
 - .1 Crestron NVX, Kramer KDS-7 Series, and Atlona Omnistream

2.4 Point-to-Point Video Switching and Distribution Equipment

.1 Fiber Optic HDMI Extender Transmitter

- .1 Fiber optic HDMI input extenders will have at least one HDMI input connector, an HDMI loop thru connector for a local display, a stereo audio input, and a set of multi-mode fiber output connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for EDID management or emulation at the transmitter.
- .3 Crestron fiber optic distribution does not support 4K resolution. Fiber optic video distribution shall only be implemented when transmission distance is more than 100m or integrating with an existing fiber optic system, and 4K resolution is not an essential system requirement.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series
 - .3 Kramer Ultra-Reach

.2 Fiber Optic HDMI Extender Receiver

- .1 Fiber optic HDMI output extenders will have at least one HDMI output connector, a stereo audio output, and a set of multi-mode fiber input connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for HDCP key management.
- .3 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series
 - .3 Kramer Ultra-Reach

.3 Fiber Optic HDMI Extender Scaler Receiver

- .1 Fiber optic HDMI output extenders will have at least one HDMI output connector, a stereo audio output, and a set of multi-mode fiber input connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for HDCP key management.
- .3 The receiver will have a built in scaler to allow resolutions of different display devices to be matched to the system resolution. The scaler must provide an option to maintain the original source aspect ratio.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series

.4 Fiber Optic Digital Video Matrix Switcher

- .1 Fiber optic digital video switcher will accept multi-mode fiber inputs and provide multi-mode fiber outputs. Matrix sizing will depend on system complexity, and should be sized to allow for future expansion.
- .2 The unit will switch TMDS video signals and be HDCP compliant.
- .3 The switcher frame will include power supplies and necessary fiber input and output cards.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series

.5 Hybrid Digital Video Matrix Switcher

- .1 Hybrid switchers may combine fiber optic digital video multi-mode fiber inputs and provide multi-mode fiber outputs with copper Shielded Twisted Pair digital video inputs and outputs in the same chassis. Matrix sizing will depend on system complexity, and should be sized to allow for future expansion.
- .2 The unit will switch TDMS video signals and will be HDCP compliant.
- .3 The switcher frame will include power supplies and necessary fiber or copper input and output cards.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series

.6 Copper Shielded Twisted Pair Digital Video Matrix Switcher

- .1 Switchers using STP copper digital video inputs and outputs. Matrix sizing will depend on system complexity, typically 8x8 to 32x32.
- .2 The unit will switch TDMS video signals and will be HDCP compliant.
- .3 The switcher frame will include power supplies and necessary fiber or copper input and output cards.
- .4 Approved manufacturers are:
 - .1 Crestron Digital Media 8G+
 - .2 Extron Fox Series

.7 UTP HDMI Extender Transmitter

- .1 UTP HDMI input extenders will have at least one HDMI input connector, an HDMI loop thru connector for a local display, a stereo audio input, and UTP output connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for EDID management or emulation at the transmitter.

- .3 The extender transmitter will require only one UTP cable, and must support signal transmission over distances of up to 100 meters.
- .4 The extender transmitter must support a minimum resolution of 4k at 60hz
- .5 Approved manufacturers are:
 - .1 Crestron Digital Media
 - .2 Extron
 - .3 Kramer

.8 UTP HDMI Extender Receiver

- .1 UTP HDMI output extenders will have at least one HDMI output connector, a stereo audio output, and a UTP input connectors. Must be at least HDMI 2.0 compatible.
- .2 The unit must be HDCP 2.2 compliant and have the option for HDCP key management.
- .3 The extender receiver will require only one UTP cable, and must support signal transmission over distances of up to 100 meters.
- .4 The extender receiver must support a minimum resolution of 4k at 60hz.
- .5 Approved manufacturers are:
 - .1 Crestron Digital Media
 - .2 Extron
 - .3 Kramer

2.5 Laser Projectors

- .1 The projector must have at least one (1) HDCP compliant digital input, preferably HDMI 2.0. Displays should be specified with adequate input counts for the application.
- .2 The projector must have at least one (1) HDMI input, one (1) HDBaseT input, [one \(1\) LAN control port](#) and one (1) RS-232 port.
- .3 The projector must have a minimum of 1920 x 1200 native resolution, and support all HDTV resolutions plus standard computer resolutions.
- .4 DLP based projectors are preferred, but LCD and other technologies will be considered, as long as they are field serviceable by UBC.
- .5 The projectors light source shall be laser diode with an expected half luminance life of 10,000 hours when running in normal mode. The projector shall be minimum 5,000 ANSI lumens.
- .6 The projectors will have the ability to have custom UBC logo start-up/no-signal screens loaded by users in the field.
- .7 The projectors will have interchangeable lens, and be equipped with horizontal and vertical lens shift as required.
- .8 The projectors used in learning spaces must have a noise level of less than 35dBA.
- .9 The projectors must be controllable via 3rd party control systems using RS-232, Ethernet or HDBaseT. Crestron Connected products are preferred.

- .10 The projectors must have a minimum of a 3 year warranty.
- .11 Approved manufacturers:
 - .1 Panasonic
 - .2 Sony

2.6 Flat Panel Displays

- .1 The flat panel displays must have at least the following:
 - .1 One (1) HDCP compliant digital input, preferably HDMI 2.0.
 - .2 One (1) variable audio output.
- .2 Displays should be specified with adequate input counts for the application.
- .3 The digital inputs must be HDCP compliant
- .4 The flat panel displays must have a minimum of 1920 x 1080 native resolution, and support all HDTV resolutions plus standard computer resolutions.
- .5 The display brightness should be a minimum of 400 Nits at full white.
- .6 The displays should be LED array backlit LCD display
- .7 The display must be controllable via 3rd party control systems, such as Crestron. Crestron Connected products are preferred. RS-232 or Ethernet is accepted as a control interface.
- .8 Professional displays must have a minimum of a 3 year warranty, and consumer or pro-consumer displays must have a minimum of 1 year warranty.
- .9 Typical manufacturers are:
 - .1 Panasonic
 - .2 Sharp
 - .3 NEC
 - .4 LG
 - .5 Sony

2.7 Manual Projection Screens

- .1 Manual projection screens should only be used for screen widths less than 96" or 2450mm wide.
- .2 Manual screens of any size must have a controlled spring return option included.
- .3 Manual screens must have a matte white fibreglass screen with a black backside.
- .4 For screen sizing calculations refer to the UBC Classroom Design Guidelines.
- .5 Typical manufacturers are:
 - .1 Da-Lite

2.8 Motorized Projection Screens

- .1 Motorized projection screens must be used for screen widths over 96" or 2450mm wide.

- .2 Motorized screens that will be integrated into an AV system with a control system must include LV control, integrated with a standard electrical plug. In the case of very large screens that do not allow this option, a power disconnect switch must be installed between the LVC and building power.
- .3 Motorized screens must have a matte white fibreglass screen with a black backside.
- .4 Screens that are recessed within a finished ceiling must include appropriate trim kit or recessed housing, to allow servicing and replacement from below, without a requirement to modify or damage ceiling.
- .5 For screen sizing calculations refer to the UBC Classroom Design Guidelines.
- .6 Typical manufacturers are:
 - .1 Da-Lite

2.9 Soft Codec Endpoints

- .1 The Soft Codec Endpoint PC shall be a Windows 11 based PC with minimum two Digital Video (HDMI/DP/USB-C) outputs, two USB-A 2.0, two USB-A 3.0, 3.5mm audio jack and one network port
- .2 The Soft Codec Endpoint PC shall have as a minimum spec Intel Core i5-14500T Processor, Windows 11 Pro 64, 8 GB RAM, 256 GB SSD Hard drive, Integrated Graphic Card and Integrated Gigabit Ethernet Port
- .3 The Soft Codec Endpoint PC shall be compatible with Microsoft Teams and Zoom conferencing software and capable of either single or dual screen conferencing
- .4 Approved product is Lenovo Thinkcentre Tiny (Intel) Desktop

2.10 Interactive Display System

- .1 The interactive display must have at least one (1) HDCP compliant digital input, preferably HDMI 2.0. Display should be specified with adequate input counts for the application.
- .2 The interactive display must have a minimum of 1920 x 1080 native resolution, and support all HDTV resolutions plus standard computer resolutions.
- .3 The interactive display should have an average brightness of 300 cd/m2.
- .4 The interactive display should be LED array backlit LCD display.
- .5 The interactive display system shall have 10-point capacitive multi-touch.
- .6 The writing surface shall have fingerprint and scratch resistance.
- .7 The interactive display must be controllable via 3rd party control systems using Ethernet or RS-232.
- .8 The interactive display must have a minimum of a 3-year warranty.
- .9 The interactive display size shall be minimum of 65" diagonal.
- .10 The interactive display shall be mounted using an appropriate wall mount tilt bracket or motorized mount if size makes top edge unreachable for user. The product manufacturer for the mount shall be Chief, LOFT or Jiro Pro-Lift.

- .11 Product shall be [ViewSonic IFP](#), LOFT D3xx or Approved Equal.

3.0 **EXECUTION**

3.1 **Wiring**

- .1 Isolate all BNC video connectors from building ground on all panels, plates and bulkheads.
- .2 Install video cable in a manner that will prevent sharp bends or kinks. Use right angle BNC connectors where necessary to prevent cable kinking in shallow electrical boxes.

3.2 **Test Equipment**

- .1 Provide video test equipment on site during check-out where necessary to measure and document the system performance outlined in section 3.8:
- .1 800 MHz oscilloscope
 - .2 Video test generator with digital video signal resolutions up to 1920x1200 pixels, as well as 720P and 1080P HDTV signals
- .2 Provide the following fiber optics test equipment on site during check-out where necessary to measure and document the system performance outlined in section 3.8:
- .1 Optical meter, optical sources, two test jumpers & adapters, for 850nm & 1310nm multimode & single mode fiber optical systems testing
 - .2 Optical Time Domain reflectometer (OTDR) and test fiber box for 850nm & 1310nm multimode & single mode fiber optical systems testing
 - .3 Fiber termination microscope
- .3 Provide test equipment of professional quality and in good working order. Substandard equipment will be cause for rejection. The Owner, or their designated Consultant reserves the right to demand proof of equipment accuracy.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 [UBC Learning Space Design Guidelines](#)
- .2 UBC Technical Guidelines Interior Building Lighting Section 26 51 00

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **General**

- .1 UBC IT Audio Visual has trained Crestron programmers on staff to manage and maintain the learning space AV control systems. All control systems must be Crestron to allow internal support and maintenance
- .2 UBC IT Audio Visual has a campus wide learning space AV monitoring desk. All control systems must be connected to the building network and must be remotely accessible from the monitoring desk.
- .3 UBC IT Audio Visual has standardized GUI style guides and examples for standard touch panels that will be provided to the Crestron programmer. These standards and templates will form the basis of most projects, however any additional graphical elements or alternate GUI types required for unique situations will be considered within the control system programming scope of work. In cases where faculties provide their own GUI spec, the faculty GUI spec will be implemented in place of the UBC IT AV GUI standard.
- .4 UBC IT Audio Visual has a comprehensive Crestron programming guideline that indicates how systems operate, and how features are to be implemented in programming. These must be followed for any control system.
- .5 UBC IT Audio Visual will coordinate all UBC network configuration and IP address assignment for all control systems. Non-UBC network configurations will be coordinated with faculty network staff, or directly with third party network owners.
- .6 UBC IT Audio Visual employs a team of dedicated in house AV control system programmers, and wherever feasible the utilization of these internal UBC resources for AV control system programming functions is preferred.
- .7 Prior to final acceptance, UBC IT Audio Visual shall be consulted and have the opportunity to comment as well as perform quality control testing on any and all control system programming and user interfaces implemented at UBC.
- .8 The UBC Point Grey campus implements the following virtual local area networks (VLANs) for audio-video systems:
 - .1 AV Control (trunkable on network switch)
 - .2 Video Conferencing (trunkable network switch)
 - .3 Media Capture (trunkable network switch)
 - .4 Room PC (requires dedicated data port)
 - .5 Digital Signage (requires dedicated data port)
- .9 The UBC Okanagan campus implements the following VLANs for audio-video systems:

- .1 AV Control (requires dedicated data port, per-building subnets)
- .2 Video Conferencing (requires dedicated data port)
- .3 Room PC (requires dedicated data port)
- .4 Digital Signage (requires dedicated data port)

2.2 Intellectual Property

- .1 It is understood that the machine language or high level programming language will remain the property of the particular audio, video or control system product manufacturer, and the University of British Columbia will have the use and benefit of this hardware/software for as long as they own this equipment.
- .2 The University of British Columbia will become the outright owner of all value-added intellectual property in the form of all audio, video or control system programming (including objects, modules and macros) to adapt and configure the equipment for the specific functions and performance required by this specification, whether performed by the Audio-Visual Contractor or the product manufacturer. No password protection or other locking mechanism is permitted for all control code, modules, or macros. Supply one copy of the compiled and uncompiled source code for all the audio, video and control system value-added programming. All subsequent revisions of control code must be provided under the same guidelines as described above. Any raw graphics, custom themes, and other graphical elements implemented within the control system shall be provided, under the same stipulations as above.

2.3 Control System Processor

- .1 Each control processor will have suitable control ports and connections for the scale of the project or ethernet control field devices.
- .2 Every control processor will have Ethernet connectivity for connection to campus AV control LAN. Rooms implemented off campus will be evaluated on a room by room basis considering available infrastructure.
- .3 Include Cresnet Distribution Blocks as required to avoid stacking Cresnet cables in terminal blocks.
- .4 Virtual Control Processor shall have the following features:
 - .1 Server-based control platform for enterprise applications that can be used in place of hardware-based Crestron control systems. The platform runs programs to control multiple rooms over the network from a single, centralized location.
 - .2 Access to XiO Cloud to validate its licenses.
 - .3 Network connected devices to be controlled and integrated into a pre-programmed system.
 - .4 Single server shall be capable of controlling up to 500 rooms.
 - .5 Software shall run on the following platforms:
 - .1 Red Hat Enterprise Linux 8.2 software (64-bit version) or greater;
 - .2 AlmaLinux OS 8.2 software (64-bit version) or greater;
 - .3 Rocky Linux OS 8.2 software (64-bit version) or greater.

- .5 The control software shall support the following programming languages:
 - .1 C#
 - .2 SIMPL
 - .3 SIMPL#PRO
- .6 All control processors shall be minimum 4-series.
- .7 Approved manufacturer is:
 - .1 Crestron

2.4 Touchscreen Panel

- .1 All wired touch screen shall be 10" diagonal in size, colour display, installed [with](#) locking system or suitable cable lock restraint. [Minimum](#) 15" diagonal size touch screens shall be provided for Collaboration Labs. 7" diagonal size touch screens can be used for basic AV systems with approval from UBC IT Audio Visual.
- .2 The unit will have video preview capability, either via dedicated video input or via H.264 streaming [when used in conjunction with HDMI output type pan-tilt-zoom camera controls](#).
- .3 Provide all required video interface hardware when required.
- .4 Provide Ethernet interconnection between the touch panel and control central processor and suitable power supply or PoE Injector as conditions require.
- .5 Provide programming to implement the touch panel layouts in the UBC Touch panel programming guidelines or applicable faculty GUI requirements.
- .6 Approved manufacturers are:
 - .1 Crestron
 - .2 [Neat](#)
 - .3 ELO touchscreen with embedded windows running executable GUI
 - .4 ELO touchscreen with Crestron DGE graphics engine

2.5 Integrated Button Control Processor

- .1 Small room wall mount applications typically use wired button panel with integrated control processor for RS-232 or Ethernet control of single display device (and motorized screen where needed).
- .2 Provide Ethernet interconnection to the button panel control central processor and suitable power supply as conditions require.
- .3 Provide programming to implement the functions in the UBC programming guidelines.
- .4 All control processors shall be 3-series or higher.
- .5 Approved manufacturers for UBC Point Grey are:
 - .1 Crestron
 - .2 AMX
 - .3 Biamp
- .6 Approved manufacturers for UBC Okanagan are:
 - .1 Crestron

2.6 Remote Button Control Panel

- .1 Wired button panels without integrated control processors may be paired with a separate control processor, to act as either a primary or secondary control interface.
- .2 Provide wired interconnection to the central processor and suitable power supply as conditions require.
- .3 Provide programming to implement the functions in the UBC programming guidelines.
- .4 Approved manufacturers are:
 - .1 Crestron

2.7 Wireless Tablet Control Panel

- .1 Wireless tablet control panels may be paired with a separate control processor, to act as either a primary or secondary control interface.
- .2 Wireless tablet must be configurable to operate on UBC wireless network, including password authentication.
- .3 Wireless tablet control must be configured to run current xPnael. 3rd party apps are not permitted.
- .4 Provide programming to implement the functions in the UBC programming guidelines.
- .5 Provide compatible docking station for storage and charged, in either wall mounted or table top mounted form.
- .6 Approved manufacturers are:
 - .1 Microsoft Surface

2.8 Low-Voltage Projection Screen Controls

- .1 Where LV projection screen controls are included in a project, include connections between AV control system LV control and the screen LV controls so that the screens may be operated from wall mounted screen button panel or the AV control system.

2.9 AVB/Dante/AV-Over-IP Network Switch

- .1 The network switch shall provide 1000 Mbps ports for high-speed network connectivity.
- .2 The network switch shall provide 10 Gbps ports where interconnecting network switches.
- .3 The network switch shall automatically identify and determine the correct transmission speed and duplex mode of the attached devices.
- .4 The network switch shall be managed providing non-blocking switch fabric and wire-speed throughput with minimum of 56 Gbps.
- .5 The network switch shall support IEEE AVB standards to enable reliable real-time audio-video transmissions over Ethernet.

- .6 The network switch will remain isolated from all other networks unless required to connect to an additional audio switch in support of the system design.
- .7 Product shall be Biamp TesiraConnect or Netgear M4250 Series.

2.10 Network Switch

- .1 The network switch shall provide 10/100/1000 Mbps ports for high-speed network connectivity.
- .2 The network switch shall be fully managed with layer 2 and layer 3 features.
- .3 The network switch shall have per-port broadcast, multicast and unicast storm control, and VLAN trunking protocol.
- .4 The network switch shall automatically identify and determine the correct transmission speed and duplex mode of the attached devices.
- .5 The network switch shall have Power-over-Ethernet 802.3at (PoE+) support.
- .6 The network switch shall be connected and configured to use the last port for the trunk.
- .7 The network switch shall have one (1) unused port configured to the AV Control VLAN used by the service team to connect a field laptop for troubleshooting the AV system.
- .8 Product shall be Cisco, or Approved Equal.

2.11 Ethernet Control Field Devices

- .1 The ethernet control field device shall provide RS-232, relay closures or IR to control devices.
- .2 The ethernet control field device shall be used for the following applications:
 - .1 Systems need to be expanded or upgraded with minimal cost or infrastructure coordination.
 - .2 Dedicated control device requires additional functionality.
 - .3 Infrastructure and/or space constraints necessitate deploying a networked device with a single cable.
 - .4 Control processor does not have built-in control ports.
- .3 Approved Manufacturers are Crestron and Global Cache

END OF SECTION

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 [UBC Learning Space Design Guidelines](#)

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **General**

- .1 All materials, equipment, devices, components, wire and cable provided under this contract shall be new CSA approved and listed with ULC as required by AHJ.
- .2 Contractor shall provide secondary seismic restraint for devices, and racks as required by code and as directed by Consultant.

2.2 **Lectern Rack**

- .1 The lectern rack shall be slide-out rotating type.
- .2 The rack shall provide front and rear access using minimal floor space.
- .3 The rack shall have the following minimum characteristics:
 - .1 EIA compliant 19-inch panel width
 - .2 14 useable rack spaces (14U)
 - .3 19-1/4" useable depth
 - .4 250 lb. weight capacity
 - .5 Front and rear rack rails:
 - .1 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing.
 - .2 Black coated finished
 - .3 Rack spaces marked
 - .6 Cooling fan for active ventilation
 - .7 Provide all rack accessories as required for a complete racking solution.
- .4 Product shall be Middle Atlantic SRSR series or Approved Alternative.

2.3 **Half Height Wall Mounted Rack**

- .1 The pivoting rack enclosure shall be a wall mount type.
- .2 The rack shall have the following minimum characteristics:
 - .1 EIA compliant 19-inch panel width
 - .2 Useable rack spaces shall be sized to ensure adequate spacing between devices and air flow for ventilation
 - .3 Useable depth shall be sized to allow adequate space behind the devices for cabling and connectors
 - .4 Minimum weight capacity of 200 lbs
 - .5 *Front and rear* rack rails:
 - .1 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing.

- .2 Black coated finished
 - .3 Rack spaces marked
- .6 Cooling fans for active ventilation as required
- .3 Provide all rack accessories as required for a complete racking solution.
- .4 Product shall be Middle Atlantic DWR series or Approved Alternative.

2.4 Low-Profile Wall Mounted Rack

- .1 The low-profile vertical rack enclosure shall be a wall mount type.
- .2 The rack shall have the following minimum characteristics:
 - .1 EIA compliant 19-inch panel width
 - .2 Useable rack spaces shall be sized to ensure adequate spacing between devices and air flow for ventilation.
 - .3 Useable depth shall be sized to allow adequate space behind the devices for cabling and connectors.
 - .4 Minimum weight capacity of 150 lbs
 - .5 Rack rail: 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing.
 - .6 Cooling fans for active ventilation as required.
 - .7 Lockable front door for access to front and back of equipment.
- .3 Provide all rack accessories as required for a complete racking solution.
- .4 Product shall be Tripp-Lite SRWF series or Approved Alternative.

2.5 Full Height Wall Mounted Rack

- .1 The pivoting rack enclosure shall be a wall mount type.
- .2 The rack shall have the following minimum characteristics:
 - .1 EIA compliant 19-inch panel width
 - .2 Useable rack spaces shall be sized to ensure adequate spacing between devices and air flow for ventilation
 - .3 Useable depth shall be sized to allow adequate space behind the devices for cabling and connectors
 - .4 Minimum weight capacity of 500 lbs
 - .5 Rack rail:
 - .1 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing.
 - .2 Black coated finished
 - .3 Rack spaces marked
 - .6 Cooling fans for active ventilation as required
- .3 Provide all rack accessories as required for a complete racking solution.
- .4 Product shall be Middle Atlantic SR series or Approved Alternative.

2.6 Cabinet/Credenza

- .1 The audio visual cabinet or credenza shall be free-standing on casters.

- .2 The cabinet or credenza shall be functionally and aesthetically incorporated into spaces while maintaining proper ventilation, sound isolation, and serviceability.
- .3 The cabinet or credenza shall have the following features:
 - .1 EIA compliant, threaded rack rails, 10-32 screws
 - .2 Front door with ability to lock
 - .3 Rear access panel or door
 - .4 Useable rack spaces shall be sized to ensure adequate spacing between devices and air flow for ventilation
 - .5 Useable depth shall be sized to allow adequate space behind the devices for cabling and connectors
 - .6 Variety of finish options to suit application
 - .7 Cooling fans for active ventilation as required
- .4 Provide all rack accessories as required for a complete racking solution.
- .5 Product shall be one of the following manufacturers:
 - .1 Middle Atlantic
 - .2 AVFI

2.7 Rack Accessories

- .1 All racks shall have blank plates, vent plates, shelves, drawers and all accessories as required for a complete racking solution.
- .2 Fine perforation security covers shall be installed for all equipment not intended for user access
- .3 **Security Covers:** Middle Atlantic SF series.
- .4 **Blanks:** Middle Atlantic EB series.
- .5 **Vents:** Middle Atlantic VT1.
- .6 **Shelves:** Middle Atlantic U1V.
- .7 **Drawers:** Middle Atlantic D2.
- .8 **Fans:** Middle Atlantic CAB-COOL series.

2.8 Mobile Instructor Station

- .1 The mobile instructor station shall have built-in rack and sufficient work surface area for presentation equipment such as document cameras, laptops, touch panels, keyboards, mice and preview monitors.
- .2 The mobile instructor station shall have the following features:
 - .1 Modesty panel with cable management system
 - .2 Resilient thermowrap working surface available in a variety of colours

.3 Casters

.3 Finish colour shall be confirmed with UBC IT Audio Visual.

.4 Product shall be KI All Terrain Mobile Instructors' Desk or Approved Alternative.

2.9 Height Adjustable Instructor Table

.1 The height adjustable instructor table shall be ADA compliant and have sufficient work surface area for presentation equipment such as document cameras, laptops, touch panels, keyboards, mice and preview monitors.

.2 The height adjustable instructor table shall have the following features:

.1 Electric actuators with push button for height adjustment

.2 Modesty panel with cable management system

.3 Resilient thermowrap working surface available in a variety of colours

.3 Finish colour shall be confirmed with UBC IT Audio Visual.

.4 Product shall be AVFI DS6330-LFT or Approved Alternative.

2.10 Fixed Lectern

.1 UBC IT Audio Visual implements a custom millwork solution for classroom fixed lecterns.

.2 The lectern shall have a single bay or dual bay configuration for the audio visual racks as required by the system design.

.3 The work surface shall have sufficient work surface area for presentation equipment such as document cameras, laptops, touch panels, keyboards, mice and preview monitors. The lectern will have two (2) width options for a single or dual document camera system.

.4 The raised podium unit with touch panel location, either stage left or right, shall be confirmed with UBC IT Audio Visual.

.5 The height adjustable instructor table shall be ADA compliant using electric actuators with push button.

.6 Conduit stub ups for power, data and audio visual cabling shall align with the rear section behind the bays and/or underneath the trough. The conduit stubs shall not be located beneath the bay rack locations or work surface.

.7 Lectern shall have at minimum two (2) dedicated 15A circuits for AV rack and convenience power receptacles.

.8 Refer to Section 27 40 00 for fixed lectern infrastructure requirements.

.9 Refer to AVSK-14 and AVSK-15 for lectern millwork sketches.

2.11 Confidence Monitor Shroud

- .1 The confidence monitor shroud shall provide a means to mount a confidence monitor on the front side of the first row of seating. The shroud shall offer protection from inadvertent liquid spills.
- .2 The shroud shall have the following features:
 - .1 6mm thick aluminium plate
 - .2 Clear, colourless satin anodized finish
- .3 The shroud shall be sized to accommodate the confidence monitor size in the system design and shall be confirmed by UBC IT Audio Visual.
- .4 Refer to AVSK-16 for an example 43" confidence monitor shroud

2.12 Display Slide-Out Shelf

- .1 Audio visual systems may require installation of equipment behind flat panel displays. Equipment should be accessible to support staff and slide-out shelf provided as required.
- .2 Approved slide-out shelf products are as follows:
 - .1 B-Tech BT7885 – screen size 49" - 86"
 - .2 B-Tech BT7883 – screen size 46" - 75"
 - .3 Chief CSSMP15X0

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

- .1 All materials, equipment, devices, components, wire and cable provided under this contract shall be new CSA approved and listed with ULC as required by AHJ.

2.2 DMX Ethernet Gateway

- .1 The gateway shall provide an Ethernet interface to an isolated DMX/RDM universe.
- .2 The gateway shall be compatible with Art-Net, sACN and ESP DMX over Ethernet protocols.
- .3 The gateway shall be powered via PoE 802.3af standard and DC power supply.
- .4 The gateway shall have the following features:
 - .1 Output type: one (1) 5-pin XLR DMX
 - .2 DMX universes: 1 (512 channels)
 - .3 Input type: one (1) RJ-45 Ethernet connection
- .5 Product shall be Enttec 70406 ODE MK2 POE or Approved Alternative.

2.3 DMX Splitter

- .1 The splitter shall provide four (4) isolated DMX/RDM ports for distribution.
- .2 The splitter shall have the following features:
 - .1 Input: one (1) DMX input on 3-pole screw connector
 - .2 Output: four (4) DMX output each on 3-pole screw connector
 - .3 Power: provide external DC power supply as required
- .3 Product shall be Enttec 71004 DIN-RDS4 or Approved Alternative.

2.4 DMX LED Profile Fixture

- .1 The fixture shall be a colour-mixing high-intensity LED illuminator with DMX control of intensity and colour.
- .2 The fixture shall be UL 1573 listed for stage and studio use
- .3 The fixture shall comply with the USITT DMX-512A standard
- .4 Fixture Physical Features:

- .1 The unit shall be constructed of rugged, die cast aluminium, free of burrs and pits, finished in white.
 - .2 Lens secured with silicone shock mounts
 - .3 Shutter assembly shall allow for +/-25 degree rotation
 - .4 20 gauge stainless steel shutters
 - .5 Interchangeable lens tubes for different field angles with Teflon guides for smooth tube movement
 - .6 Safety cable mounted to anchor on fixture shall be provided
- .5 Fixture Optical Features:
 - .1 The light beam should have a 2-to-1 centre-to-edge drop-off ratio
 - .2 Sharp imaging through a three-plane shutter design
 - .3 Sharp shutter cuts without halation
 - .4 Shutter warping and burnout in normal use shall be unacceptable
 - .5 Adjustable hard and soft beam edges
 - .6 19, 26, 36, and 50 degree units shall have optional lens tubes available for precision, high-contrast imaging.
- .6 Fixture Thermal Features:
 - .1 Fixture shall be equipped with a cooling fan.
 - .2 Fan speed control via a DMX channel shall be possible.
 - .3 Fan speed software shall permit the fixture to override DMX fan speed setting to prevent heat damage to the fixture.
 - .4 The fixture shall utilize thermal management to maintain LED life to an average of 70% intensity after 50,000 hours of use.
 - .5 The fixture shall operate in an ambient temperature range of 0°C minimum, to 40° C maximum ambient temperature.
- .7 Fixture Electrical Features:
 - .1 The fixture shall be equipped with a 120V, 60Hz internal power supply.
 - .2 The fixture shall support power in and thru operation with Neutrik PowerCon connectors.
 - .3 Power supply outputs shall have self-resetting current-limiting protection.
 - .4 Power supply shall have power factor correction.
- .8 Fixture LED Emitter Features:
 - .1 The fixture shall contain a minimum of five different LED colours.
 - .2 All LEDs used in the fixture shall be high brightness.
 - .3 LED emitters should be rated for nominal 50,000-hour LED life to 70% intensity.
 - .4 All LED fixtures shall undergo a minimum eight-hour burn-in test during manufacturing.
- .9 Fixture Colour Features:
 - .1 The fixture shall utilize a minimum of 60 LED emitters.
 - .2 The fixture shall have an LED array with red, amber, green, cyan, blue, indigo and white LED for broad spectrum colour, light tints, and variable whites.
 - .3 Measured brightness of the LED array shall be greater than 4,000 field lumens

- .10 Fixture Dimming Features:
 - .1 The LED system shall have high-resolution dimming.
 - .2 The fixture shall have the following dimming curve options: incandescent, standard, linear, quick.
- .11 Fixture Control and User Interface Features:
 - .1 The fixture shall be USITT DMX 512A-compatible via In and Thru 5-pin XLR connectors.
 - .2 The fixture shall be compatible with the ANSI RDM E1.20 standard.
 - .3 The fixture shall be equipped with multi-line LCD display for easy-to-read status reports and configuration changes.
 - .4 The fixture shall be equipped with a button user-interface.
 - .5 The fixture shall offer multiple DMX input profile options to include:
 - .1 RGB - control of all individual LED colours via a three-channel profile
 - .2 HSI – control of all individual LED colours via a three-channel profile
 - .3 HSIC – control of all LED colours via a four-channel profile
 - .4 Colour point provides variable colour temperature settings
 - .5 Direct – control of each individual colour channel via an independent channel
 - .6 Studio – Control of the fixture in a white-light 3 channel profile
 - .7 Variable-rate strobe channel shall be provided
- .12 Product shall be ETC Source Four LED Series or Approved Alternative.

2.5 DMX LED Wash Fixture

- .1 The fixture shall be a colour-mixing high-intensity LED illuminator with DMX control of intensity and colour.
- .2 The fixture shall be UL 1573 listed for stage and studio use
- .3 The fixture shall comply with the USITT DMX-512A standard
- .4 Fixture Physical Features:
 - .1 The fixture shall be contained in a rugged all-metal die-cast housing, free of burrs and pits, finished in white.
- .5 Fixture Thermal Features:
 - .1 The fixture shall be cooled with a variable speed fan.
 - .2 The fixture shall utilize thermal management to maintain LED life to an average of 70% intensity after 20,000 hours of use.
 - .3 The fixture shall operate in an ambient temperature range of 0°C minimum, to 40° C maximum ambient temperature.
 - .4 Safety cable mounted to anchor on fixture shall be provided
- .6 Fixture Electrical Features:
 - .1 The fixture shall be equipped with a 120V, 60Hz internal power supply.
 - .2 The fixture shall support power in and thru operation with Neutrik PowerCon connectors.

- .3 Power supply outputs shall have self-resetting current-limiting protection.
- .4 Power supply shall have power factor correction.
- .7 Fixture LED Emitter Features:
 - .1 The fixture shall contain a minimum of four different LED colours.
 - .2 All LEDs used in the fixture shall be high brightness.
 - .3 LED emitters should be rated for nominal 20,000 hour LED life to 70% intensity.
 - .4 All LED fixtures shall undergo a minimum three-hour burn-in test during manufacturing.
- .8 Fixture Colour Features:
 - .1 The fixture shall utilize a minimum of 40 LED emitters.
 - .2 These emitters shall be made up of Red, Green, Blue and Lime.
- .9 Fixture Dimming Features:
 - .1 The LED system shall have high-resolution dimming.
 - .2 The dimming curve shall be optimized for smooth dimming over longer timed fades.
- .10 Fixture Control and User Interface Features:
 - .1 The fixture shall be USITT DMX 512A-compatible via In and Thru 5-pin XLR connectors.
 - .2 The fixture shall be compatible with the ANSI RDM E1.20 standard.
 - .3 The fixture shall be equipped with a 7-segment display for easy-to-read status and control.
 - .4 The fixture shall be equipped with a button user-interface.
- .11 Product shall be ETC ColorSource Par or Approved Alternative.

2.6 Stage Lighting Rig

- .1 The stage lighting rig shall be a complete standalone system that shall allow servicing of stage light fixtures at any time. The contractor shall be responsible for the installation of all aspects of the motorized stage rigging equipment.
- .2 The truss shall have the following features:
 - .1 The truss shall be easily connected together to create a structure to allow light fixtures to be mounted freely at any position.
 - .2 Material: aluminium 6061-T6 extrusions
 - .3 Main chords: 2" outer diameter
 - .4 Attachment: spigot and pin
 - .5 Finish: shall be coordinated with UBC IT Audio Visual
- .3 The electric chain hoist shall have the following features:
 - .1 The chain hoist shall allow hoisting of the rigging equipment.
 - .2 Capacity: 500kg
 - .3 Lift: 35ft
 - .4 Brake: double braking system
 - .5 Speed: up to 8ft/min

- .6 Chain size: 4 x 12mm
 - .7 Control: direct control, external limit switch, positioning encoder
 - .8 Accessories: chain bag
- .4 The cable reel shall have the following features:
- .1 The cable reel shall provide neat and reliable cable management for power and data cabling.
 - .2 The cable reel shall be spring driven without the need to be motorized.
 - .3 Power Reel: 12 AWG multi-conductor cable with 19-pin connector.
 - .4 DMX Reel: 24 AWG multi-conductor cable with DMX connector.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

1.2 Coordination Requirements

- .1 Audio-Video system design shall be coordinated with Architectural, Structural, Interior Design, Electrical and Mechanical to provide a safe and functional operation.

1.3 Description

- .1 General requirements for Sections 27 41 16 to 27 41 52.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

- .1 With few exceptions, all Audio Visual systems installed on UBC campuses are owned and supported by the UBC IT Audio Visual team (UBC Vancouver) or the IT, Media, and Classroom Services teams (UBC Okanagan).
- .2 Any significant design and implementation decisions relating to AV systems at UBC Campuses requires approval from relevant AV support team.
- .3 Any and all proposed changes to these Guidelines/Specifications shall be subject to approval in writing from UBC IT Audio Visual representative prior to implementation.
- .4 UBC IT Audio Visual will be engaged by the project team to develop the approach to AV system design for all new projects. In many cases, UBC IT Audio Visual will play the role of the AV consultant within the project, and provide the AV designs and coordination directly. In cases where capacity, expertise or other considerations warrant the engagement of external AV design consultants, this decision shall be made in collaboration with UBC IT Audio Visual. Any external AV design consultants engaged by the project shall be a consultant in good standing with a proven history of recent, relevant, and comparable experience in AV design within a higher education context. Avixa CTS and Crestron CTI-CSD shall be considered minimum certifications for potential AV system designers, with other certifications such as Avixa CTS-D and P.Eng considered favorably. UBC IT Audio Visual will be engaged in the selection process for any and all proposed AV system design consultants, and will have the opportunity to formally review and provide feedback on their credentials, experience, and proposed services.
- .5 UBC IT Audio Visual will review and approve AV tender packages inclusive of final specifications provided by any external AV design consultant prior to release to the market. The project team will allow a minimum of two weeks for this review, and will notify UBC IT Audio Visual of the requested review period at least four weeks in advance.
- .6 A copy of any and all AV Tender responses will be provided to UBC IT Audio Visual for review and feedback, with a minimum of 1 week review period. UBC IT Audio Visual should be notified of requested review period no later than the date of tender issue.

- .7 Provide only new equipment and material approved for the installation and suitable for continuous operation. Where the guidelines do not describe a required item, furnish equipment or material consistent with the quality of other specified products, and best suited to the purpose required. Submit these products for review by UBC IT Audio Visual.
- .8 The terms “Approved Products” and “Approved Manufacturers” indicate that products/manufacturers described are the UBC standard, and any alternate products must be reviewed and approved in writing by UBC IT Audio Visual.
- .9 The terms “Typical Products” and “Typical Manufacturers” indicate that the products/manufacturers described are commonly used at UBC, but are not necessarily an enforced standard. Alternate products may be used, provide they are of equal or greater quality and approved by UBC IT Audio Visual.
- .10 User accessible rack mount equipment will be fitted with security covers and tamper proof rack screws to prevent tampering

2.2 Contractor Qualifications

- .1 This section describes minimum and preferred qualifications, experience, and credentials for any AV contractor bidding on and being awarded UBC AV integration opportunities.
- .2 Please note that UBC IT Audio Visual maintains a list of pre-qualified integrators who have already demonstrated their ability to meet the below criteria through a competitive process, and require no further project qualification. The current list of pre-approved AV contractors can be found at the following location: <https://finance.ubc.ca/procure-pay/list-suppliers/categories-and-suppliers/it-hardware-software-and-services/audio-visual>
- .3 Prior to award of any AV systems integration opportunities at UBC to any parties not already on the pre-qualified list, UBC IT Audio Visual will have the opportunity to review documentation and supporting evidence of their ability to satisfy the below qualification criteria.
- .4 CTS certification from Avixa and/or PMP certification from the Project Management Institute is strongly favored for the role of Project Manager.
- .5 Avixa CTS certification is strongly favored for on-site technicians
- .6 Avixa CTS-I or CTS-D is strongly favored for engineer and lead technician roles
- .7 The person(s) in the role of Lead Programmer MUST be Crestron Certified and Crestron Digital Media Certified (DMC-E), Crestron NVX certified and Biamp Tesira certified.
- .8 For AV contractors not on the pre-qualified list, at a minimum the below evidence of qualifications shall be submitted to UBC IT Audio Visual for review and approval prior to award.
 - .1 Submit with proposals resumes/work profiles for at a minimum the positions of Account Manager, Project Manager, Lead Programmer, and Lead Site Technician. Include relevant work history details, past project experience, certifications/education, and any other qualifications relevant to this scope of work.
 - .2 Provide a minimum of three (3) to a maximum of five (5) client references for projects of similar size, scope, and complexity completed within the last 3 years.

- .3 Certificate or letter from control system manufacturer stating official stocking dealer status.
- .4 Certificate or letter from audio processor manufacturer stating official stocking dealer status.
- .5 Comprehensive list of all product brands and lines stocked and available through the dealer, including projectors, flat panel displays, video switching equipment, video conference solutions, technical furniture and racking equipment, and audio reinforcement equipment.
- .6 Provide a comprehensive overview of project quality controls and process.
- .9 Provide examples of AV project documentation, including at least one example of each of the following: Audio system schematic, video system schematic, control system schematic, equipment list, IP log, simplified user manual.

2.3 Energy Efficiency

- .1 The University of British Columbia pursues energy efficiency in audio and video equipment where ever possible. Audio and video products that offer the performance described in these technical guidelines with greater energy efficiency will be of interest, and should be submitted to UBC IT Audio Visual for technical review.
- .2 AV systems should incorporate energy conservation measures so that the display equipment in the systems are not left in an operational state when the rooms are unoccupied. An end of day shutdown shall be implemented in the AV system code to ensure equipment is not unnecessarily running after business hours.
- .3 Provide Energy Star compliant equipment were available, and where the Energy Star power management feature does not compromise the function of the AV systems.
- .4 LEED Gold, when applied to a project, will require the AV systems operation to be included in Whole Building Energy Usage Data gathering.

2.4 Shop Drawings

- .1 Submit prints of the following drawings for review by the Owner, or their designated Consultant before proceeding with the work:
 - .1 Manufacturer's specification cuts and quantity schedule for all items furnished under the contract.
 - .2 Detailed schematic diagram showing all specified components including manufacturers, model numbers, signal types, wiring types, rack elevations, and connector panel drawings.
 - .3 Cable logs showing destinations at both ends and cable identifiers.
 - .4 IP Network design and list of equipment requiring IP address on UBC LAN.
 - .5 Drawings for all custom fabricated equipment indicating dimensions, hardware, labelling and finish.

- .6 Suspension details for all suspended equipment, with relevant engineering stamps.
 - .7 Details for all mounting and equipment integration that interfaces with base building structures, as requested by the consultant team.
 - .8 Manufacturer's catalogue/specification cut-sheets indicating the part number, accessories and options pertinent to the project.
 - .9 Where UBC IT Audio Visual is not programming, example programming files including GUI samples, verbiage and program flow/function map. All requested programming revisions prior to final approval of the programming example files will be considered the responsibility of the winning bidder, and must be undertaken at no additional cost.
- .2 Coordinate documents of related divisions when joint submissions are required.

2.5 Project Record Drawing Requirements

- .1 Instruct the Contractor to mark in red ink on one set of white prints any changes, additions, and omissions not contained in the original documents, and any other pertinent information affecting future work. Maintain the record set on site at all times.
- .2 Within 30 days of Substantial Performance, the contractor to submit a clean set of marked up As-Built prints. Instruct them to certify with signature and turn them over to the Owner, or their designated Consultant, one (1) set of white prints so revised. Instruct the contractor to include in each operating and maintenance manual one set of white prints so revised.

2.6 AV Operation and Maintenance Manuals

- .1 Provide an electronic copy of the manual, formatted as follows:
 - .1 List of equipment provided in each room, with recorded serial numbers (including any AV equipment supplied by UBC or other trades. UBC IT Audio Visual will provide an itemized inventory to the Audio-Visual Contractor).
 - .2 Simplified Operating Instructions
 - .3 As-Built and Reviewed Shop Drawings
 - .4 Performance Measurements
 - .5 Service and Adjustment Instructions
 - .6 Provide list of Rooms, IP addresses used, and CCT port connection numbers and locations for equipment connected to any VLAN.
 - .7 Identify power source locations of any devices powered via remote power supplies.
 - .8 Return all product remote controls, rack keys, cables, and any other miscellaneous accessories not permanently installed on site to UBC IT Audio Visual. Loose items left on site will be considered lost, and subject to replacement at integrator's expense.
 - .9 Digital copies of all product configuration software, and configuration files, along with compiled and uncompiled Crestron code and VTP files.

- .10 Provide a schedule of terminations, cross-referenced to test results.

2.7 Audio Visual Cabling and Connectors

.1 Duplex Multimode Fiber Optic 50/125 Cables

- .1 For all 8 Gbps duplex multimode fiber optics connections, provide 50 micron core, 125 micron cladding multimode duplex fiber optics cable with an overall diameter of 3mm. the cable jacket shall be PVC in orange colour. Insertion loss shall be smaller than 0.5dB and have a ferrule end face radius of less than 30mm. operating temperature shall be 02 to plus 70 degrees.
- .2 Typical products are:
 - .1 Corning Premium
 - .2 Crestron DM fiber
 - .3 Extron OM4 MM P

.2 Duplex Multimode duplex Fiber Optics Patch Cables

- .1 For all 8 Gbps duplex multimode fiber optics connections provide 50 micron core, 125 micron cladding multimode duplex fiber optics cable with an overall diameter of 3mm. Insertion loss shall be smaller than 0.5dB and have a ferrule end face radius of less than 30mm. operating temperature shall be 02 to plus 70 degrees. The patch cable shall be equipped with 2 multimode LC connectors at each end. The patch cables shall be in the following overall length: 1m, 2m, 3m, 5m or 10m.
- .2 Typical products are:
 - .1 Corning Premium
 - .2 Crestron DM fiber
 - .3 Extron 2LC OM4 MM P

.3 Fiber Optics Connector Modules

- .1 Systems using fiber optic cables must have the fiber trunks be terminated in fiber optic patch bays or modular connector termination boxes in the AV racks and in the lectern.
- .2 Extenders, transmitters, receivers and switchers will be connected to the patch bays or termination boxes using pre-fabricated fiber-optic patch cables.
- .3 Typical: Corning Pretium Plug & Play Classic CCH-CP24-D3 series.

.4 CAT6 Shielded Twisted Pair Video Cable

- .1 Must be certified to minimum CAT6 specifications, 250 MHz bandwidth
- .2 Must include end to end foil shield with 100% coverage
- .3 Must include 4 pairs of 23 or 24 AWG solid copper conductors
- .4 Maximum overall cable diameter is 0.260"
- .5 Jacket colour:
 - .1 White for HDBaseT link;
 - .2 Purple for Video-over-IP network.

- .6 Must be available in both plenum and non-plenum rated versions
- .7 Typical manufacturers are:
 - .1 Belden
 - .2 Crestron
- .5 Video RJ45 Connector
 - .1 The data connector shall meet or exceed all requirements of TIA/EIA-568-B.1 & B.2 & B.2-1 for Category 6 shielded.
 - .2 The connector shall have the following features:
 - .1 8P/8W modular female connectors at both ends of video cabling.
 - .2 T568A wiring.
 - .3 Snap-in type at both ends.
 - .4 Connector colour:
 - .1 White for HDBaseT link;
 - .2 Purple for Video-over-IP network.
 - .3 Product manufacturer shall be Leviton, Belden or Approved Alternative.
- .6 Video RJ45 Patch Panel
 - .1 The patch panel shall be rack mounted with standard 19" rack compatibility. Placement of the patch panels to be approved from Drawings submitted to the Consultant by the Contractor. Layout will be expected to optimize rack space and proximity to active components.
 - .2 The patch panel port quantity shall match corresponding network switch port count.
 - .3 The patch panel shall have the following features:
 - .1 Category 6, shielded twisted pair, STP
 - .2 Colour: black
 - .3 T568A wiring
 - .4 14-gauge steel
 - .5 Terminates 26-22 gauge solid conductors
 - .4 Product manufacturer shall be Leviton, Belden or Approved Alternative.
- .7 HDMI Cables
 - .1 Must be minimum HDMI 2.0 certified
 - .2 Must support minimum data transfer rate of 10.2 Gbps, and minimum 48 bit colour depth
 - .3 Cables shorter than 15' in length must support a minimum resolution of 2160p/4K UHD at 30hz
 - .4 Cables greater in length than 15' must support a minimum resolution of 1080p/Full HD at 60 hz

- .5 Must support a minimum of 8 high bandwidth, uncompressed multichannel audio streams
- .6 Must include high quality, gold plated connectors
- .7 Must be highly flexible. Overly rigid, thick, or otherwise difficult to manage cable types will be rejected.
- .8 Where cable runs are longer than those attainable with standard HDMI cabling, appropriate transmitter/receiver extender sets, HD-BaseT extenders, or signal boosters should be specified.
- .9 Cables should include factory manufactured ends. Modular cables (Rapid Run, etc.) will be rejected.
- .10 Typical manufacturers:
 - .1 Kramer
 - .2 Crestron
 - .3 Extron
- .8 Data Cabling
 - .1 The data cabling shall meet or exceed all requirements of TIA/EIA-568-B.2 for Category 5e cabling and components.
 - .2 The cabling shall have the following features:
 - .1 Category 5e unshielded twisted pair, UTP
 - .2 Four pair, 22 AWG to 24 AWG, 100 ohm, solid copper.
 - .3 FT6 rated
 - .4 Jacket colour:
 - .1 Green for AVB network;
 - .2 Green for Dante network;
 - .3 Black for Control network;
 - .4 Red for UBC IT AV trunk;
 - .3 Product manufacturer shall be Leviton, Belden or Approved Alternative.
- .9 Data Connector
 - .1 The data connector shall meet or exceed all requirements of TIA/EIA-568-B.1 & B.2 & B.2-1 for Category 5e.
 - .2 The connector shall have the following features:
 - .1 8P/8W modular female connectors at both ends of data cabling.
 - .2 T568A wiring.
 - .3 Snap-in type at both ends.
 - .4 Connector colour:
 - .1 Green for AVB network;
 - .2 Green for Dante network;
 - .3 Black for Control network;
 - .4 Red for UBC IT AV trunk;
 - .3 Product manufacturer shall be Leviton, Belden or Approved Alternative.

.10 Data Patch Panel

- .1 The patch panel shall be rack mounted with standard 19" rack compatibility. Placement of the patch panels to be approved from Drawings submitted to the Consultant by the Contractor. Layout will be expected to optimize rack space and proximity to active components.
- .2 The patch panel port quantity shall match corresponding network switch port count.
- .3 The patch panel shall have the following features:
 - .1 Category 5e, unshielded twisted pair, UTP
 - .2 Colour: black
 - .3 T568A wiring
 - .4 14-gauge steel
 - .5 Terminates 26-22 gauge solid conductors
 - .6 Product manufacturer shall be Leviton, Belden or Approved Alternative.

3.0 **EXECUTION**

3.1 **Installation**

- .1 Secure all equipment, except portable equipment, in place with a safety factor of at least five (calculate mounting based on object weight x 5). Adequately ventilate all equipment for worst case power dissipation. No item of equipment shall produce residual noise in excess of NC-30 when measured from the centre of the enclosing room.
- .2 Install all equipment in such a manner as to present no safety hazard to operating personnel.

3.2 **Mounting, Rigging and Seismic Restraint**

- .1 All overhead mounting or rigging installations of video projectors and flat panel display equipment must have received the approval of a Professional Engineer registered in British Columbia, at the shop drawing stage prior to installation.
- .2 Rigid and fixed mounting systems (brackets, tube and clamp, frames etc.) used for any piece of suspended equipment must have a safety cable attached between the suspended device and the superstructure used to support the mounting system. The size and construction of the safety cable, and attachment points must be suitable to support the weight of the equipment being restrained.
- .3 Flexible rigging systems (chain and aircraft cable) must be installed by a Certified Rigger. Flexible mounting systems must have suitable seismic restraint sway bracing provided. Seismic restraint systems must be approved by a Professional Engineer registered in British Columbia.
- .4 All free standing equipment racks, trolley or caster equipped racks intended for permanent locations, free standing or platform mounted loudspeakers, video projectors, and other equipment with significant mass and freedom of movement must be equipped with a seismic restraint system that can be disconnected for servicing the equipment.

3.3 Wiring

- .1 Neatly arrange cables with Velcro cable wraps. Avoid tight bundling, and twist cable bundles into a spiral configuration before installing cable ties. Allow a minimum of a 1 metre spiral bound slack service loop when entering racks or panels. Exercise care to avoid damage to wiring or equipment.
- .2 Make all signal connections within systems with rosin-core solder or approved mechanical connectors. Untidy or cold solder joints will be rejected. Use proper crimping tools for mechanical connectors.
- .3 Do not splice cables except with permission of the Owner, or their designated Consultant
- .4 All RJ-45 connections shall be terminated in accordance with this TIA/EIA-568B standard.
- .5 Refer to AVSK-05, AVSK-06 and AVSK-07 for AV wiring details.
- .6 For AV equipment racks with more than three (3) wall wart power supplies of the same voltage, provide DC power distribution system. Distribution system shall include a DIN rail power supply and DIN rail termination block. Refer to AVSK-04 for DC power distribution detail. DC power supply shall have the following features:
 - .1 DIN rail mountable
 - .2 Isolation class II
 - .3 Input voltage: 120 VAC
 - .4 Output voltage: as required by AV equipment
 - .5 Protections: short circuit, overload, over voltage and over temperature
 - .6 Cooling: free-air convection

3.4 Grounding and Shielding

- .1 Isolate all racks containing sound system equipment from the building and electrical grounds. Bond adjacent equipment racks with #6 AWG insulated ground cable.
- .2 Conduit and tray systems containing audio, video and control wiring will be permanently connected to the electrical ground.
- .3 Do the utmost to prevent ground loops of any type, including use of ground isolators when necessary.
- .4 Isolate the shields of all shielded cables from both the conduit system and any other shielded cables.
- .5 Provide continuous shield from source to input point, with shields lifted at the source and grounded at the input point.

3.5 Marking

- .1 Mark all wiring with PVC or neoprene slip-on sleeves, or with tape type markers with a clear heat shrink boot, indicating approved circuit number. All labels must be machine printed. Hand written labels will be rejected.
- .2 Mark all remote or outboard power supplies with permanent labels to indicate which devices they power, and mark all power cables at the U-GND connector where plugged in to the

power outlets to indicate which devices they power.

- .3 Log IP address and other relevant network info of all network enabled devices, and include IP table of all system IP info with as-built documentation.
- .4 Record circuit numbers and wire destinations on as-built drawings and schedules. List spare circuits.

3.6 Nameplates

- .1 Dymo labels are not acceptable. Decal type labels (Brother P-touch) are not acceptable in high traffic or high wear applications. All nameplates shall be printed on a black background, with white text.
- .2 Identify all racks and panels as specifically noted on the drawings.
- .3 Submit all nomenclature to the Owner, or their designated Consultant for approval prior to installation.
- .4 All blank rack panels shall be solid black, and include no logos or company advertising. Integrator(s) may not install custom logos, decals, stickers, or electronic images on any equipment, and will remove any such items at their own expense

3.7 Finishes

- .1 Finish all components exposed to the public with colours and finishes approved by the Owner, or their designated Consultant.

3.8 Lamacoid Labelling

- .1 Engraved lamacoid labels shall be used to identify audio visual equipment accessible to end-users for the purpose of training and supporting.
- .2 Numbering scheme shall start with '1' at stage left (from the point of view of the presenter facing the audience) and ascend in order by increments of one until stage right is reached.
- .3 Each lamacoid number shall correspond to its respective control tab on the touch panel GUI.
- .4 In spaces where there is a single, central projector in addition to dual content projectors, the central projector shall be assigned the last number in the sequence.

3.9 Testing Copper Category Cable Installation

- .1 All copper Category cables shall be tested in conformance with the current ANSI/TIA/EIA-568-C Standard. Testing shall be accomplished [certified tester](#) with appropriate permanent link adapters. Testing shall be performed for at least the minimum copper Category type including, but not limited to the following:
 - .1 HDBaseT, F/UTP Category 6
 - .2 AVoIP, UTP Category 5e
 - .3 Control, UTP Category 5e
 - .4 Dante, UTP Category 5e
- .2 All links must attain a "PASS" certification as required by the standards defined above,

- unless otherwise released from this requirement by the UBC IT Audio Visual representative.
- .3 All copper Category cable links shall be tested for permanent link performance and the following parameters:
 - .1 Length;
 - .2 Wire Map;
 - .3 Insertion Loss;
 - .4 Near-End Crosstalk (NEXT) Loss;
 - .5 Attenuation to Crosstalk Ratio, Far-end (ACR-F);
 - .6 Propagation delay and delay skew;
 - .7 Return Loss;
 - .8 Power Sum Near-End Crosstalk (PSNEXT);
 - .9 Power Sum Attenuation to Crosstalk Ratio, Far-end (PSACR-F).
 - .4 Trained technicians who have successfully attended an appropriate training program and have obtained a certificate, as proof thereof shall execute the tests.
 - .5 The testing equipment shall be within the calibration period recommended by the equipment manufacturer in order to achieve the vendor-specified measurement accuracy.
 - .6 All shielded Category cable test results must show continuity of shield from end-to-end.
 - .7 Random testing of copper Category cables shall be done by UBC IT Audio Visual representative. Where any portion of the end-to-end system does not meet the specifications, the Contractor shall correct the deviation and repeat all applicable testing at no additional cost.
 - .8 Supply a complete set of electronic test results for all copper Category cable tests performed in PDF format with the Operation and Maintenance Manuals.
 - .9 Supply test results for all copper Category cable tests performed for each space as it is handover to the AV Programmer.

3.10 Testing Fibre Optic Cabling Installation

- .1 Measure, verify, and document proper operation of the fibre optic based video system performance in accordance to the TIA/EIA-568-B.3 standards:
 - .1 Test and document end-to-end attenuation for each simplex and duplex multimode fibre optics link to determine optical power loss between each cable termination point.
 - .2 Measure and document fibre optics cable systems insertion loss for each connectorized cable link, using a stabilized optical source and an optical power meter to compare the difference in optical power levels in dBm, by measuring how much light is put into the near end and how much light is exiting the far end. Use factory approved 50/125 core test jumpers only. Perform this procedure in accordance to the TIA/EIA OFSTP-14A multi-mode fibre testing specifications.
 - .3 To prevent high order modes from invalidating the power loss testing they must be attenuated during the referencing step to obtain a valid measure of the optical power travelling along the fibre core using the mandrel wrapping method. Use a mandrel diameter of 22mm for the multimode 3.0mm jacketed 50/125 core fibre optics cabling system.

- .4 For all fibre optics cable runs longer than 100m (300feet) conduct and document a signature trace using an optical time domain reflectometer (OTDR) to locate fibre events and measure losses attributable to cable, connectors & splicing.
- .5 For all Crestron Digital Media systems, provide a complete Digital Media test report
- .2 Forward to the Owner, or their designated Consultant a complete report detailing test results obtained above, accompanied by a letter certifying that all video components meet manufacturer's specifications and that the system is complete and ready for inspection.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 [UBC Learning Space Design Guidelines](#)

1.2 Co-ordination Requirements

- .1 UBC IT Audio Visual

1.3 Description

- .1 UBC offers two (2) solutions for media capture:
 - .1 PC with video capture card or USB device, or
 - .2 Video/web conferencing record feature.
- .2 The media capture solution shall be compatible with Kaltura and Panopto.
- .3 UBC IT Audio Visual will provide the room PC c/w video capture device to be integrated into the AV systems.
- .4 Installation and testing of the PC will be included in the AV system installation scope. Installation and testing execution is described in the applicable sections of the technical guidelines
- .5 The media capture solution shall be able to broadcast a minimum of two (2) sources such as camera and content feeds outside the UBC network.
- .6 The programming and configuration instructions for the media capture recorder functions are described in the UBC IT Audio Visual Graphical User Interface Standards Document.
- .7 The recorder shall have one (1) video input for cameras and one (1) video input for each content source being presented. For example, a dual content system shall have at minimum three (3) video inputs.
- .8 The recorder shall have an LED recording status light visible to presenter.

2.0 PRODUCTS

2.1 PC Video Capture Card

- .1 The capture card shall have a minimum of two (2) HDMI inputs.
- .2 The capture card shall have embedded HDMI audio inputs.
- .3 The capture card shall support a resolution up to 1080p.
- .4 The capture card shall support Windows 10 operating system
- .5 The capture card shall be a PCIe format card.

2.2 PC Video Capture USB Device

- .1 The capture card shall have one (1) HDMI input.
- .2 The capture card shall have embedded HDMI audio inputs.
- .3 The capture card shall support a resolution up to 1080p.
- .4 The capture card shall support Windows 10 operating system or later.
- .5 The capture card shall be a PCIe format card.

3.0 EXECUTION

3.1 Data Infrastructure

- .1 Provide one (1) data drop for each media capture appliance and configure to media capture VLAN.
- .2 Where AV system has managed network switch, media capture recorder may be connected to managed network switch if media capture VLAN is configurable.

3.2 AV Connectivity

- .1 Where a media capture appliance or PC w/ video capture device is not installed in an AV space with 80 seats or more, provide one (1) content HDMI output, one (1) camera HDMI output, and one (1) balanced stereo audio XLRM output on a rack plate in the AV rack where a future media capture appliance would be installed.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 [UBC Learning Space Design Guidelines](#)

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Design Criteria**

- .1 A listen assist system shall be installed in teaching spaces of 100 net square meters (NSM) or greater or as required by the BC Building Code, whichever has the more stringent requirements. The coverage shall achieve 100% of the seating area. Where 100% coverage cannot be achieved, UBC IT Audio Visual shall be consulted to determine an approved solution.
- .2 LAN or Radio Frequency (RF) listen assist solutions are acceptable options with preference for LAN.
- .3 Where multiple classrooms are served by one set of receivers, the minimum receiver count should be based on 5% of the largest classroom seat count.

2.2 **Listening Assistance Equipment and Materials**

.1 RF-Based Listen Assist Systems

- .1 UBC utilizes two types of RF-based listen assist systems: 72 MHz and 2.4 GHz.
- .2 **72 MHz Listen Assist Systems**
 - .1 72 MHz FM Transmitter
 - .1 The FM transmitters will operate in the designated FM listening assistance band of 72 MHz.
 - .2 The transmitters will have selectable broadcast frequencies in the 72 MHz band allowing 16 operating channels to be selected. These frequencies will be on industry standard centres so that any brand of FM listening assistance receiver could be used on any system.
 - .3 The transmitters should have both line and microphone levels inputs, and the input should have an integral audio compressor with peak stop limiter to prevent high peak levels.
 - .4 The transmitters should be rack mounted with the AV equipment and the antenna should be mounted outside the rack, extended using 50 Ohm coaxial cable.
 - .5 Where multiple classrooms are grouped in a single building, each room should have a dedicated transmitter with a visually conspicuous decal indicating the transmitting channel.
 - .6 Approved manufacturer is Listen Technologies.

.2 72 MHz FM Receiver

- .1 The FM receiver will operate in the 72 MHz FM band.
- .2 The receiver will have selectable channels amongst the 16 available, with a visual display to indicate channel selected.
- .3 The receiver will have an easily accessible volume control and a 3.5mm headphone connector.
- .4 The receiver will be equipped with rechargeable batteries.
- .5 Each receiver should be supplied with a walkman type circumaural headphone, with 10 extra ear cushion sets for each receiver.
- .6 Each receiver should be supplied with an induction neck loop.
- .7 Where there are multiple classrooms equipped with listening assist systems in a single building, one set of receivers may be used for the group of classrooms.
- .8 Approved manufacturer is Listen Technologies

.3 FM Receiver Battery Charger /Case

- .1 Each listening assistance system FM receiver set should have a combination carrying/storage case and battery charger.
- .2 Each charger should be able to charge all the available receivers simultaneously.
- .3 Approved manufacturer is Listen Technologies

.3 **2.4 GHz Listen Assist Systems**

.1 2.4 GHz FM Transmitter

- .1 The transmitter shall operate in the band of 2.402 – 2.480 GHz.
- .2 The transmitter shall support an audio bandwidth of 100 Hz – 7200 Hz.
- .3 The transmitter shall be mounted near the entry door to allow users to pair their receiver to the transmitter upon entering the space.
- .4 The transmitter shall have a balanced line level XLR input as its primary signal input.
- .5 The transmitter shall have minimum of two (2) year warranty.
- .6 Laminated pairing instruction sheet shall be placed on the wall near the transmitter.
- .7 Approved manufacturer is Phonak Roger Base Station.

.2 2.4 GHz Receiver

- .1 The receiver shall operate in the band of 2.402 – 2.480 GHz.
- .2 The receiver shall provide USB port for connection to third party devices and charging.
- .3 The receiver shall include lanyards that can provide t-coil induction loop.
- .4 The receiver shall pair transmitter upon button press at transmitter.
- .5 Approved manufacturer is Phonak Roger Neck Loop.

.4 LAN Based Listen Assist Systems

.1 LAN Transmitter

- .1 The transmitter shall have latency no greater than 60 ms.
- .2 The transmitter shall have an audio frequency response of 40Hz – 20KHz.
- .3 The transmitter shall have a balanced XLR input.
- .4 The transmitter shall have a Dante input.
- .5 The transmitter shall support PoE power or 110V wall power.
- .6 The transmitter shall be able to broadcast audio signal over building network and Wi-Fi infrastructure.
- .7 The transmitter shall be able to support up to 100 client per devices.
- .8 Approved manufacturer is Sennheiser MobileConnect Station.

.2 LAN Receiver

- .1 The receiver is a mobile device such as Android or iPhone phones.
- .2 The receiver application shall be compatible on Android and iOS.
- .3 The receiver shall be able to pair with the transmitter by pin code or QR code.

3.0 **EXECUTION**

3.1 **Induction Loop Listen Assist Systems**

.1 Wiring

- .1 All audio circuits, unless otherwise specified, shall be balanced, floating and shielded two wire circuits with the red or white wire hot (connected to pin 2 of XLR3 connectors and to the Tip of phone connectors) and the black wire cold (connected to pin 3 of XLR3 connectors and to the Ring of phone connectors).
- .2 Install ribbon cables (if used) flat on floor and tape with floor tape. Turns will be facilitated by folding the ribbon cable once at the angle required to achieve the turn (eg: 90 degree turn is a single fold of 45 degrees).
- .3 Loop wire must be twisted together for at least 1' prior to being connected to the induction loop amp. Twisted portion of loop wire will be soldered to ribbon cables as required for floor installs. Twisted portion of induction loop wire shall not exceed 30'.

.2 Grounding and Shielding

- .1 Isolate the shields of all shielded cables from both the conduit system and any other shielded cables. Provide continuous shield from source to input point, with shields lifted at the source and grounded at the input point. Properly serve all unconnected shielding. Pin 1 on XLR type connectors must not be connected to the connector barrel or shell.

.3 Testing

- .1 System testing will be conducted with a Fosmeter Pro (FPRO):
 - .1 If the integrator does not own a Fosmeter Pro, one will be purchased by the integrator at no cost to the owner.
 - .2 Results will be recorded in the BS EN 60118-4 compliance checklist.
 - .3 Results will be within required parameters to meet BS EN 60118-4 compliance.
 - .4 An inductive loop receiver will also be used to validate acoustical performance of induction loop system
 - .5 Limiters and or compressors will be tuned during commissioning to prevent amp cutoff triggering when audio signals fluctuate from normal levels.

3.2 **RF-Based Listen Assist Systems**

.1 Wiring

- .1 All audio circuits, unless otherwise specified, shall be balanced, floating and shielded two wire circuits with the red or white wire hot (connected to pin 2 of XLR3 connectors

and to the Tip of phone connectors) and the black wire cold (connected to pin 3 of XLR3 connectors and to the Ring of phone connectors).

- .2 Install coax cable in a manner that will prevent sharp bends or kinks. Use right angle coax connectors where necessary to prevent cable kinking in shallow electrical boxes.

.2 Grounding and Shielding

- .1 Isolate the shields of all shielded cables from both the conduit system and any other shielded cables. Provide continuous shield from source to input point, with shields lifted at the source and grounded at the input point. Properly serve all unconnected shielding. Pin 1 on XLR type connectors must not be connected to the connector barrel or shell.

.3 Testing

- .1 Conduct tests to demonstrate that the Listening Assistance system is properly functional:
 - .1 With speech program at nominal levels in the room, verify that the transmitter is able to function without clipping or overload.
 - .2 Ensure that the receivers are able to receive the signal at all seats in the room. Adjust the transmitter antenna if necessary to ensure complete coverage.
 - .3 Ensure that the receiver signal in the headphones is free of audible distortion with the speech test signal.

Appendix A

Test Certificate for AFILS in accordance with BS EN 60118-4		
This test certificate is used to log the results detailed in the Fosmeter Pro (FPRO) Instruction (Doc. No. DCM0004006).		
Tested to BS EN 60118-4 at any point within the useable volume.		
1	Background Noise Acceptable: <-42 to <-22 dB L	Is background noise acceptable? Yes ☐ No ☐ If No _____ dB L
	System Noise Acceptable: <-42 to <-22 dB L	Is system noise acceptable? Yes ☐ No ☐ If No _____ dB L
2	Magnetic Field Strength using a pulsed 1 kHz signal Acceptable: 400 mA/m (0 dB L)	Is field strength acceptable? Yes ☐ No ☐ If No _____ dB L
3	Frequency Response Acceptable: signal @ 1 kHz +/-3 dB L, 100 Hz to 5 kHz	Is frequency response acceptable? Yes ☐ No ☐ If No _____ dB L
Was a metal compensation test performed? Yes ☐ No ☐		
Was an overspill test performed? Yes ☐ No ☐		
Was a subjective audio test performed? Yes ☐ No ☐		
Please note, a plan showing the loop location is required by BS EN 60118-4. Attach a plan to this document (this can be a building drawing or a simple sketch).		
Customer: _____ Site/Location: _____ Install Company: _____ Installer: _____ Equipment Used: _____ Serial Nos.: _____ Installer Comments:		
The system has been tested in accordance with BS EN 60118-4.		
Signed: _____ Date: _____		

END OF SECTION

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Guidelines / Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:

- 1.0 GENERAL
- 1.1 DOCUMENTS
- 1.2 SUMMARY
- 1.3 INTRODUCTION
- 1.4 OVERVIEW
- 1.5 CONSULTANT CO-ORDINATION
- 1.6 CONTACTS – INFORMATION TECHNOLOGY
- 1.7 CONTRACTOR QUALIFICATIONS
- 1.8 APPROVED CONTRACTORS

1.3 INTRODUCTION

- .1 The University of British Columbia owns and Information Technology operates most of the Communications systems and facilities on campus. With few exceptions UBC owns all cabling on campus.
- .2 The intent of this document is to assist Consultants and installing contractors to provide standard specifications to ensure the continued implementation and maintenance of the cabling infra-structure system on the UBC Campus. This document is the property of Information Technology.

1.4 OVERVIEW

- .1 This document must be read, interpreted and coordinated with all other related UBC Technical Guidelines to deliver a complete Communications infrastructure system.
- .2 These Guidelines / Specifications prescribe mandatory requirements for Telecommunications infra-structure systems within academic and residential buildings, up to and including the Communications outlet, and between buildings to the extent of a campus wide environment.
- .3 A structured approach is specified which will ensure a flexible distribution system that will minimize the future costs of moves, additions and changes.
- .4 The Contractor will supply, furnish, and install all material, labour, apparatus, tools, equipment and services required for construction and put into regular operation the complete Communications system as shown on the Communications drawings, described in the specifications, and any attached appendices.
- .5 Renovations in existing buildings shall always reflect the intent of these Guidelines / Specifications. This includes, but is not limited to:
 - .1 Outlet upgrades with new conduit, outlet boxes, cable faceplates, or jacks.
 - .2 Cable tray in hallways, J-hook spurs, and or zone conduit.

- .3 Communications room design placement shall provide maximum 90-meter, 360-degree coverage for the most cost-effective network equipment deployment and utilization where possible. The intent is to minimize communications rooms with active network equipment.
- .6 Any and all proposed changes to these Guidelines / Specifications shall be subject to approval in writing to the UBC Information Technology Representative prior to implementation.

1.5 **CONSULTANT COORDINATION**

- .1 Information Technology Mandatory Process
 - .1 The Consulting Engineer shall be an RCDD in good standing who has performed recent Communications design. Certifications and references to be forwarded to the Information Technology Representative for approval. The RCDD will approve and stamp all prints relating to the communications infrastructure including all rooms, closets, riser diagrams, work area outlets and logical designs.
 - .2 Provide design based on Communications service requirements signed off by end user and provided by UBC Information Technology Representative.
 - .3 Conceptual design shall include proposed Communication rooms location and layout, square footage of room, outlet locations, communications bonding riser, fibre and copper backbone riser layouts, and horizontal 1-line diagram. The Design shall be based on current UBC Information Technology Communications Design Guidelines / Specifications, and shall be reviewed by Information Technology Representative.
 - .4 95% design review prior to release to tender, inclusive of final tender specifications and UBC Information Technology Representative sign off on final number of Communication outlets. The Contractor shall supply soft copies of all drawings for review.
 - .5 Permit submissions to UBC regulatory as required. The Contractor shall pay all required permit fees.
 - .6 A copy of all Tender responses shall be submitted to Information Technology Representative for review.
 - .7 Random site inspections, testing of copper and or fibre will be done at the discretion of the UBC Information Technology Representative to ensure standards are being met.

NOTE:
This will not remove the responsibility of the Consulting Engineer to ensure these standards and all Contractors' Quality Control and Quality Assurance processes are met. The UBC Information Technology Representative may also request to be present during active testing by the Contractor.
 - .8 All final AutoCAD infrastructure drawing submissions shall comply with Information Technology AutoCAD drawing format and symbol standards. Drawings not meeting the standards will be rejected and revised to meet required standards at no cost to UBC.

1.6 **CONTACTS - INFORMATION TECHNOLOGY**

Sarah Gardner sarah.gardner@ubc.ca	Project Manager 604-827-5242 bus	Connectivity Infrastructure
Stephen McKenzie stephen.mckenzie@ubc.ca	Project Manager 604-822-0535 bus	Connectivity Infrastructure
Tom Ziemlanski tom.ziemlanski@ubc.ca	IT Plant Coordinator 604-822-8659 bus	Connectivity Infrastructure
Blake Bridgewater blake.bridgewater@ubc.ca	Manager 604-827-3663 bus	Connectivity Infrastructure
Eric Bourdon eric.bourdon@ubc.ca	Senior Manager UBCNetwork and Infrastructure Facilities 604-822-0832 bus.	

1.7 **CONTRACTORS QUALIFICATIONS**

Certified Personnel

- .1 The Contractor shall be an authorized "CommScope Partner" cabling system Installer.
- .2 All Technicians performing cable system installation work shall be current ACT 1 & 2 certified. All Technician certification cards shall be checked prior to work start up. Technicians must be current employees of the Communications Contractor.
- .3 The Communications Contractor shall assign a Supervisor with current RCDD certification to provide Quality Control based on UBC Information Technology Guideline Specifications, and to provide weekly report to Information Technology Representative.
- .4 The Contractor shall have worked satisfactorily for a minimum of five (5) years on systems of this type and size.
- .5 The UBC Information Technology Representative will pre-approve contractors for performing communications work at the University of British Columbia.

1.8 **APPROVED COMMUNICATIONS CONTRACTORS**

- .1 The following Contractors have been pre-approved by UBC Information Technology and are eligible to perform Inside Communications infrastructure work at the University of British Columbia, Point Grey campus:

BKS Cablecom Systems Ltd.

4th Utility Inc.

Houle Electric

Paladin Technologies
- .2 The following Contractors have been pre-approved by UBC Information Technology and are eligible to perform Inside Communications Infrastructure work at the University of British Columbia, Okanagan Campus:

Houle Electric

Impact MEP Services Group

Paladin Technologies

END OF SECTION 27 05 00

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 REFERENCED CODES AND STANDARDS
 - 1.4 CONTRACTOR RESPONSIBILITIES
 - 1.5 MATERIALS
 - 1.6 DRAWINGS
 - 1.7 ACCEPTANCE CONDITIONS
 - 1.8 PRE-INSTALLATION SITE SURVEY

1.3 REFERENCED CODES AND STANDARDS

- .1 The contractors must comply with the latest British Columbia Building Code, and Canadian Electrical Code, including all Provincial and other amendments, any local by-laws or rules and regulations requirements of UBC Land & Building Services regulating the installation of Communication facilities.
- .2 Materials shall bear the approval of the Canadian Standards Association and where applicable, the Underwriters Laboratories of Canada or alternately shall bear local approval from the Electrical Inspection Department having jurisdiction. [All costs associated with obtaining local approvals are to be borne by the contractor.](#)
- .3 If there is a conflict between the Drawings and Specifications and the above noted codes, by-laws, rule and orders, the codes, by-laws, rules and orders shall govern. In no instance, however shall the standards established by the Contract Documents be reduced by any of these codes or regulations.
- .4 Install and test telecommunications cabling networks per the latest manufacturer requirements and in accordance with the following standards:

NOTE:

Only the greater titles are referenced in this document but all current details and specifications that appear in each of the standards are relevant and apply to installations covered by this document. Please contact UBC IT – Connectivity Infrastructure if any clarification is required about the codes and standards that apply to any work done under these guidelines.

- .1 The Canadian Electrical Code (CEC)
- .2 BC Amendments to the CEC and associated bulletins.

- .3 ANSI/TIA/EIA Telecommunication Standards.
- .4 IEEE Ethernet Standards.
- .5 IEEE Wireless Standards.
- .6 ISO Telecommunications Standards.
- .7 BICSI Standards.
- .5 If the Contractor should note items in the drawings or in the specifications, or on the construction site, which would result in a code violation, promptly bring them to the attention of the Consulting Engineer and Information Technology Representative in writing. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.
- .6 Conform to current safety and security standards, codes, and practices in effect at UBC including, but not limited to:
 - .1 Technical Safety BC
 - .2 BC Electrical Safety Act.
 - .3 The BC Building Code with Amendments.
- .7 Any other reference material must be approved by UBC before work commences.

1.4 CONTRACTOR RESPONSIBILITIES

- .1 The Communications guideline specifications generally describe the work of the Sub-Contractors, but does not intend to define the responsibility between the General Contractor and his/her Sub-Contractors.
- .2 The complete scope of all work is fully described in Division 27 drawings and technical specifications described herein.
- .3 The words “provide”, “supply”, “furnish”, and “install” shall imply that the applicable Contractor shall provide all necessary labour, materials, and equipment to complete the installation and where applicable, performance test same to the approval of the Consultant and or the UBC IT representative.
- .4 Unless otherwise noted or specified, the Contractor shall provide all equipment and / or materials shown on the drawings and defined in the specifications.
- .5 Any apparatus, appliances, materials, or work not shown on the drawings, but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished, delivered, and installed by the Contractor, without additional expense to UBC IT.
- .6 Establishment and verification of dimensions, elevations, grades, boundaries shown on drawings and, reporting of any errors or inconsistencies to the Communications Consultant before starting Work. Starting Work shall imply that the Contractor has verified all items and found them to be correct. Additional costs arising out of any subsequent rectifications

shall be borne by the Contractor.

- .7 The Contractor will maintain a consistent approach and general orderliness to the progress of the Project.
- .8 The Contractor will maintain coordination of work with all trades in an efficient manner and on a continuous basis.
- .9 For the protection of all existing work, including buildings, finishing's, fixtures, paving, landscaping and other property against damage of any kind arising out of the Work and, reinstatement of anything spoiled or damaged, as directed. Special attention to be given by protecting elevators with plywood and the carpets with material sufficient to avoid staining and damage.
- .10 The coordination of patching, furring, re-finishing, including painting as required for performance of the Work.
- .11 To take measures to maintain security and prevent unauthorized access to existing Communication rooms, Classrooms, Offices, Study Rooms and Lecture Theatres.
- .12 To take steps throughout the Construction process, to prevent dust from escaping the immediate Construction zone and from settling on or contaminating existing Communications equipment terminal hardware, or classroom, and office furniture and equipment.
- .13 The availability and maintenance of one complete set of prints to be used exclusively for purposes of recording changes, deviations and revisions from the original contract. Care shall be taken by directing particular attention to the location of pipes, conduits etc..
- .14 Scheduling the Work in a manner acceptable to the Consulting Engineer and Information Technology Representative.
- .15 The Contractor has the responsibility to ensure that all provisions of these Standards are met and to specifically advise the Information Technology Representative in writing of any contemplated exceptions and obtain approval in writing for these changes.

1.5 MATERIALS

- 1. Materials shall be delivered on site in original containers and packages with labels and seals intact. Use in strict accordance with manufacturer's latest printed directions and instructions unless otherwise specified. Materials not approved or not conforming to the Contract Documents will be rejected. Contractor to order materials with long delivery times immediately upon award of Contract and with concurrence of Information Technology Representative.
- 2. Material deliveries to site shall be the responsibility of the Contractor. Post-delivery, the Contractor shall take responsibility to protect material during storage and handling to prevent damage and theft. Do not store equipment or materials where conditions fall outside manufacturer's recommendations for environmental conditions. Do not install damaged material or equipment. Material or equipment damaged during installation, shall be replaced at no cost to the University.

1.6.1 DRAWINGS

- .1 The location of various items indicated in IT drawings, are approximate except where specifically mentioned.
- .2 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work.
- .3 The Contractor is responsible to take field measurements where equipment and material dimensions are dependent upon building dimensions.
- .4 The Contractor shall coordinate with General, Mechanical and Electrical trades as well as Furniture Layout Designer for final User outlet locations.
- .5 If any discrepancies or omissions are found in the drawings, or if the intent is not clear, the Contractor shall obtain clarification from the Consulting Engineer or UBC IT representative.

1.7 ACCEPTANCE CONDITIONS

- .1 The installed system will be deemed acceptable when the Contractor delivers the documentation as specified in Section 27 08 00 and 27 05 09 to the UBC Information Technology Representative.
- .2 The Consulting Engineer must supply completed IT Infrastructure as-built drawings.

1.8 PRE-INSTALLATION SITE SURVEY

- .1 Prior to start of systems installation, the Contractor shall meet at the project site with the UBC Information Technology Representative and Representatives of trades performing related work to co-ordinate efforts.
- .2 The Contractor shall review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with other trades shall be necessary to meet critical deadlines for completion of Communications Rooms and Closets.
- .3 Examine areas and conditions under which the system is to be installed. Do not proceed with the work until satisfactory conditions have been achieved.

END OF SECTION 27 05 01

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 CONTRACTOR'S FOREMAN
 - 1.4 PROJECT MEETINGS
 - 1.5 COORDINATION ON SITE
 - 1.6 SEQUENCE AND SCHEDULING
 - 1.7 PRICING
 - 1.8 PERMITS, FEES, TAXES, AND INSPECTIONS
 - 1.9 COORDINATION, CLARIFICATION AND ADDENDA
 - 1.10 INSPECTIONS
 - 2.0 SUBMITTALS
 - 2.1 INFORMATION TECHNOLOGY REVIEW AND APPROVAL
 - 2.2 FIBRE SUBMITTALS
 - 2.3 DRAWINGS AND SPECIFICATIONS
 - 2.4 CONSTRUCTION DOCUMENTS
 - 2.5 SUBSTANTIAL PERFORMANCE
 - 2.6 FIELD QUALITY CONTROL
 - 2.7 CERTIFICATE OF A COMMUNICATION SYSTEM

1.3 CONTRACTOR'S FOREMAN

- .1 The Contractor shall designate a Foreman to remain on the job site from the time construction commences until final completion and acceptance of the Work
- .2 The Foreman shall not be changed unless satisfactory reasons are given in writing to UBC Information Technology Representative.

1.4 PROJECT MEETINGS

- .1 The Foreman shall attend all meetings with the General, Mechanical, and Electrical Contractors as requested, as well as meetings that may be requested by the Project Manager, Consulting Engineer, or UBC Information Technology Representative.

1.5 COORDINATION ON SITE

- .1 The Contractor shall coordinate their work with the General, Mechanical, and Electrical Contractors to ensure that all required supporting structures such as (conduits and trays) are in place prior to commencing work.
- .2 Any conduit, outlet boxes, or cable trays that are installed at locations that contradict instructions on the drawings, or in the specifications, shall be immediately identified and reported to the Consulting Engineer and UBC Information Technology Representative.
- .3 The Contractor shall promptly advise the Consulting Engineer and UBC Information Technology Representative of any specific equipment, materials or installation that are

non-conforming with or in violation of laws, by-laws or regulations of authorities having jurisdiction.

1.6 SEQUENCE AND SCHEDULING

- .1 The Contractor shall meet the Construction Schedule as laid out by General Contractor for the installation of the structured cabling system and associated equipment. When no site schedule exists, the contractor will work with UBC IT to achieve the desired schedule outcome.
- .2 The contractor will ensure that all reasonable efforts will be undertaken to achieve the identified construction schedule at no additional cost to UBC IT.
- .3 The Contractor shall submit a separate time schedule with applicable cut-overs in areas where live services are in place.

1.7 PRICING

- .1 The Contractor will provide pricing as per the UBC IT RFQ process unless otherwise specified by UBC IT.

1.8 PERMITS, FEES, TAXES, AND INSPECTIONS

- .1 Contractor is fully responsible for compliance with Federal, Provincial and Municipal laws and regulations.
- .2 The Contractor is responsible to obtain low voltage installation permit and, at the end of project, submit request for final inspection to the appropriate Inspection Authority.
- .3 Technical Safety BC is responsible for issuing electrical permits at the University of British Columbia.
- .4 The Contractor shall pay all associated permitting and inspection fees and any taxes.
- .5 The Contractor shall be responsible and pay for any additional time and expense occurred if re-inspections are required for deficiencies which have not been corrected to the Owner's satisfaction.
- .6 Contractor shall obtain and pay for all necessary key deposits, permits and licenses.
- .7 Upon substantial performance and before final payment, the Contractor shall submit a confirmation copy of acceptance for all work by Technical Safety BC, to the consulting engineer and UBC Information Technology Representative.

1.9 COORDINATION, CLARIFICATION AND ADDENDA

- .1 Questions about the meaning and intent of this document that may require clarification shall be submitted to the UBC Information Technology Representative.

1.10 INSPECTIONS

- .1 The Contractor shall request, and coordinate representation from the Consulting Engineer and UBC Information Technology Representative for inspection of cabling system during, but not limited to the following stages of construction:

- .1 Cable rough-in
- .2 Communications room construction
- .3 Testing
- .4 Completion.

2.0 **SUBMITTALS**

- .1 The Contractor shall submit the following items to the UBC Information Technology Representative:
 - .1 Immediately identify any long lead-time items that might jeopardize the construction schedule.
 - .2 Complete test results of all structured cabling elements, UTP/STP cables, fibre optic horizontal and backbone cables. Test methodology and result formats are noted in 27-08-00.
 - .3 Completed electronic UBC IT CCT spreadsheet as per sample provided.

2.1 **INFORMATION TECHNOLOGY REVIEW AND APPROVAL**

- .1 The UBC Information Technology Representative's approval of the Contractor's shop drawings, product data, and samples submitted shall not relieve the Contractor of responsibility for errors, omissions, or deviations from requirements of the Contract Documents, unless the Contractor has specifically informed the UBC Information Technology Representative in writing of such deviation at time of submittal, and the UBC Information Technology Representative has given written approval of the specific deviation.
- .2 The UBC Information Technology Representative's review and approval, of shop drawings, product data, and samples, is for the limited purpose of checking for conformance with information given and design concept expressed in the Contract Documents.
- .3 The UBC Information Technology Representative's review of Contractor's submittals is not conducted for the purpose of determining accuracy and completeness of details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor.
- .4 The UBC Information Technology Representative's review shall not constitute approval of safety precautions or of construction means, methods techniques, sequences or procedures.
- .5 The UBC Information Technology Representative's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

2.2 **DRAWINGS AND SPECIFICATIONS**

- .1 The Contract drawings and specifications form an integral part of the contract documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the

- drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided.
- .2 Misinterpretation of any requirements on drawings, or specifications shall not relieve the Contractor of his, or her responsibility of properly completing the Contract.
 - .3 Where conflict exists between drawings and specifications, the Contractor shall make allowance for provision of the component, system, or installation process in a manner which will provide UBC with the highest monetary cost components, systems, or installation process.
 - .4 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of the Work. The Contractor shall not scale the drawings, but rather take field measurements in existing buildings particularly where equipment and material dimensions are dependent on building dimensions.
 - .5 The Contractor shall obtain information from the Consultant and or UBC IT where exact locations are not indicated.
 - .6 The UBC Information Technology Representative has the option of changing the location of Electrical and Communication outlets to within 1 m of designed location prior to rough-in stage at no extra cost to UBC.

2.3 **CONSTRUCTION DOCUMENTATION**

- .1 The Contractor shall submit to the UBC Information Technology Representative for approval:
 - .1 Product data (including cut sheets and catalogue information) for products not on the approved product list
 - .2 Samples required by the Contract Documents
- .2 All above submittals must be forwarded promptly and, in such sequence, as to cause no delay in the work or in the activities of the other trades.
- .3 The UBC Information Technology Representative shall indicate approval of product data, and samples submitted in writing.
- .4 Submittals shall be signed by the Contractor, imprinted with the date submitted, and shall bear the Contractor's legitimate Company name.
- .5 By submitting product data, and samples, the Contractor signifies that he, or she has carefully reviewed and verified materials, quantities, field measurements, and related field construction criteria. It also signifies the Contractor has checked, coordinated, and verified that all information contained with product data, and samples conforms to the requirements of the Work and of the Contract Documents.
- .6 The Contractor shall perform no portion of the Work requiring submittal and review of product data, or samples until the UBC Information Technology Representative has approved the respective submittal.

- .7 The Consultant shall submit the following to the UBC Information Technology Representative at the conclusion of the project and within (2) weeks of forwarding notification that Substantial Performance has been achieved:
 - .1 (1) electronic set of As-Built drawings to UBC Information Technology Representative
 - .2 (1) full size set of As-Built drawings to Campus & Community Planning

NOTE:

- .1 As-Built drawings shall confirm location and identification of all:
 - .1 Communication Outlets
 - .2 Communication Rooms
 - .3 Backbone Cable Runs
 - .4 Critical Zone pathways transition points e.g. – riser pipes that are not located in a comm room
- .2 As-Built drawings shall be drawn utilizing industry standard platforms such as AutoCAD (preferred), and be in an editable format for future updates by UBC IT.

2.4 SUBSTANTIAL PERFORMANCE

- .1 The Contractor shall advise the UBC Information Technology Representative in writing when Substantial Performance has been achieved and shall request at the same time a Deficiencies Inspection be made.
- .2 The UBC Information Technology Representative may request to be present during actual live testing of the cable system.
- .3 The Contractor shall not issue a Substantial Performance Deficiencies Inspection request until the following work has been completed and specified documentation forwarded to the UBC Information Technology Representative:
 - .1 Verification of new fire alarm demarcation jack has been completed.
 - .2 All deficiencies noted during job inspection have been completed.
 - .3 Warranty certificates have been provided.
 - .4 All systems have been tested and passed and are ready for operation.
 - .5 Completed test results for the structured cabling system have been provided in a readily readable format such as PDF. Cable tester manufacturer proprietary file formats are not acceptable for submission to UBC IT.
 - .6 Site cleanup is finished and all contractor surplus materials and equipment has been removed from site.

- .7 All inspection certificates have been furnished including final low voltage and or electrical inspection certificates.

2.5 FIELD QUALITY CONTROL

- .1 Fire-stop installation shall be performed as per Fire-stop Section 27 05 07.
- .2 Manufacturer's certificate or letter shall be provided to confirm that the entire installation is installed according to manufacturer's instructions.
- .3 At UBC IT's option, tests shall be carried out in presence of UBC Information Technology Representative.
- .4 Instruments, meters, equipment and personnel shall be provided to conduct tests during and at conclusion of the project.
- .5 Test results shall be submitted to for UBC Information Technology Representatives for review.

2.6 CERTIFICATION OF A COMMUNICATIONS SYSTEM

- .1 The Contractor shall ensure that the cabling system installed and the Contractor's Employees working on this project are Certified and Warranted by the Cable Manufacturer.
- .2 The Contractor shall only use Certified Personnel who are trained and equipped to properly install a structured cabling system, including but not limited to supporting pathways, cable, termination hardware, bonding and grounding systems, equipment cabinets or equivalent, and associated Communications equipment, in order to obtain system acceptance.

END OF SECTION 27 05 02

1.0 **GENERAL**

1.1 **DOCUMENTS**

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 **SUMMARY**

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 USE OF PREMISIS
 - 1.4 SITE EXAMINATION
 - 1.5 NOISE ABATEMENT
 - 1.6 CORING AND DRILLING
 - 1.7 FINAL CLEAN-UP
 - 1.8 REMOVAL OF ABANDONED CABLES
 - 1.9 DELIVERY, STORAGE, AND HANDLING

1.3 **USE OF PREMISIS**

- .1 The Contractor must abide by UBC's requirements regarding protection and security of UBC's property during construction.
- .2 The Contractor must confine construction activities relevant to the work to immediate areas and within the bounds established by UBC.
- .3 The Contractor and his employees and subcontractors employed on the project shall comply with applicable Provincial Government Regulations, Work Safe BC Regulations and the Canada Employment Insurance Commission.
- .4 UBC reserves the right to take possession of and have use of completed or partially completed portions of the work, regardless of the time of completion of the entire work, provided it does not interfere with the contractor's work. Such possession or use of the building or part thereof shall not be construed as final acceptance, or an acknowledgement of fulfilment of the contract.
- .5 The key deposit fee does not relieve the Contractor of paying re-keying costs should any keys be lost.

1.4 **SITE EXAMINATION**

- .1 The Contractor shall examine the site and become familiar with all characteristics affecting the work prior to submitting the price.
- .2 No additional compensation will be given for extra work due to conditions that the site examination should have disclosed.
- .3 Construction trailer(s) must be located in UBC approved location(s).
- .4 All expenses for trailer services and installation (power or telephone) will be the contractor's responsibility.

- .5 Parking of all vehicles (personal or business) must be in UBC approved locations. Failure to do so will subject the vehicle to parking violations.
- .6 Keys for access must be obtained from appropriate UBC authority. A key deposit may be required. In sensitive areas, UBC Security may be required to be in attendance and a schedule for those locations may be required of the Contractor.

1.5 NOISE ABATEMENT

- .1 The Contractor shall comply with the requirements of UBC and with Provincial and Municipal bylaws regarding noise abatement and shall take all the necessary steps to ensure that noise and vibration that are found objectionable, be corrected to the satisfaction of UBC.

1.6 CORING AND DRILLING

- .1 Should coring or drilling be required, the work shall be performed by qualified company or personnel trained and familiar with the procedure. Any extra costs for coring out the Coring and Drilling will be paid for by the contractor.
- .2 The Contractor shall confirm that the company or personnel who will carry out the Coring and Drilling work, must conduct an X-Ray or Radar investigation prior to any coring or drilling

1.7 FINAL CLEAN-UP

- .1 Upon substantial completion of work, the General Contractor shall remove all surplus materials and thoroughly clean all communications rooms and spaces.
- .2 Upon completion, each communications space will be inspected by UBC IT ensuring an acceptable level of cleanliness prior to equipment installation.

1.8 REMOVAL OF ABANDONED CABLES

- .1 As part of the contract, the Contractor shall remove all unused and abandoned telecommunications cables. This includes all temporary telecommunications cables, as well as telecommunications cables that become redundant after cutover. All Category cables of level 5 and lower are considered to be obsolete and will be removed during the course of any renovation or IT project regardless of size. These obsolete cables are not to be re-installed or reused once they have been changed or moved from their current installed location.

1.9 DELIVERY, STORAGE, AND HANDLING

- .1 Material pickup or delivery to site shall be the responsibility of the Contractor. After delivery, the Contractor shall take responsibility to protect materials during storage and handling to prevent damage and theft.
- .2 The Contractor shall co-ordinate with the UBC Information Technology Representative for secure storage of equipment and materials.
- .3 The Contractor shall not store equipment or materials in conditions that fall outside manufacturer's recommendations for permissible environmental conditions.
- .4 The Contractor shall not install damaged materials, remove them from site and arrange replacement without causing delay to other trades or to the project schedule.

- .5 UBC shall not be held responsible for any damage or disappearance of any materials during construction and before substantial performance review and sign off.

END OF SECTION 27 05 03

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 OVERVIEW

1.3 OVERVIEW

- .1 The responsibility for safety on construction sites rests with the Contractor. The regulations of Work Safe BC (WSBC) and the British Columbia Building Code apply.
- .2 All Contractors and Subcontractors must be a registered employer with Work Safe BC and must conform to all WSBC requirements for construction safety.
- .3 All Site Safety Regulations as laid out and under the direction of the General Contractor will apply to the UBC IT contractors and must be observed.

END OF SECTION 27 05 04

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 COMMUNICATION ROOM DETERMINATION
 - 1.4 COMMUNICATION ROOM RESTRICTIONS
 - 1.5 COMMUNICATION ROOM LAYOUT
 - 2.0 DOORS
 - 2.1 KEYING
 - 2.2 FLOORING
 - 2.3 PAINTING AND FINISHING SCHEDULE
 - 2.4 SIGNAGE
 - 2.5 SMOKE DETECTOR, HEAT DETECTOR, SPRINKLER SYSTEM
 - 2.6 BACK-UP POWER AND POWER OUTLETS
 - 2.7 FIRE-RATED DOOR GRILLS
 - 2.8 EQUIPMENT CABINETS
 - 2.9 HORIZONTAL CABLE
 - 2.10 LABELING
 - 2.11 ENTRANCE CABLE PROTECTORS

1.3 COMMUNICATION ROOM DETERMINATION

- .1 A Communications room is a service room designed to safely and securely house telecommunications equipment, and mounting and terminating of approved voice and data cables and their associated terminating and distribution equipment. A Communications room will not be used to house, or as a pass-through for, any components or systems that are not specifically related to the function of the communications room or stated as acceptable by UBC IT. This restriction includes, but is not limited to, electrical conduits and junction boxes, mechanical ducts and lines, plumbing connections and lines.
- .2 Number of and placement of Communication rooms will be based on the use of the 90-meter rule in a 360-degree coverage pattern where it allows the concentration of horizontal cable runs to common locations. This provides for cost effective network equipment utilization. A UBC Information Technology Representative will review the proposed placement at the conceptual design phase for approval. Minimizing the quantity of communications rooms and consolidating the network equipment are essential.
- .3 Communications designers are to draw a scaled circle on all electrical building floor plans indicating the 90-meter point from the serving communications room, taking in to account any riser distance needed for communications rooms that are not on the same floor. The intent is quickly identifying any outlets that exceed the 90-meter distance limitation.

- .4 Each Campus building will contain one Main Communications Room (MCR) and, as determined by the size of the building, may also contain one or more Local Communications Rooms (LCR).
- .5 The MCR will be used to mount UBC IT telecommunications equipment and terminations common to the entire building. Usually, the MCR room also provides as a floor serving facility for mounting and terminating of UBC IT Communications cabling and hardware. This room requires a minimum one-hour fire rating and is usually located in the basement..
- .6 LCRs serve a floor or several floors and are used to mount and terminate approved Communications cabling, hardware and equipment.
- .7 Installation details of a given communication system in a Communications room shall be verified with the UBC Information Technology Representative on site prior to time of installation.
- .8 Each Communications room shall have some form of environmental control provided regardless of whether the building as a whole is so equipped.
- .9 All Communications rooms shall be designed and placed so that direct access is from a common or non-secure area. Communications rooms are not to be placed behind other rooms that might have specialized or secure locks installed, for example a janitors' room or electrical room.

1.4 **COMMUNICATION ROOM RESTRICTIONS**

- .1 The minimum size of a communications room is determined by the expected cabinet quantity and associated cabinet clearances. The preferred shape of a communications room is square. For example, a room expecting to house a single cabinet would respect the 1.5m cabinet clearance front and 1m cabinet clearance rear to arrive at a depth of approximately 3.5m. As the preferred shape is square the resulting room will be 3.5m x 3.5m or 12.25m². Additional cabinets will require additional space. Any architectural or mechanical assets located inside a communications room must not subtract or disrupt the intent of the clear working space of the communications room. See section 2.8 of this document. A Communications room will not be used to house, or as a pass-through for, any components or systems that are not specifically related to the function of the communications room or stated as acceptable by UBC IT. This restriction includes, but is not limited to, electrical conduits and junction boxes, mechanical ducts and lines, plumbing connections and lines.
- .2 Communications rooms shall only contain Communications wiring, terminations and distribution equipment. UBC Information Technology must approve all security equipment installations before design. All other building systems equipment is not approved for installation in Communications rooms, for example AV equipment, BMS equipment, Clock equipment, Fire Alarm panels, Cellular systems.
- .3 Occupants or end users of the building are not allowed to install or house any equipment in the communications rooms.
- .4 Other utilities shall not use the Communications Room space for pathways of ducts and pipes, other than those needed directly for environmental control of the Communication room. Creating a drywall box around utilities to affect a separation to the communications room is not acceptable. Other utilities will not pass through communications rooms space as measured from slab to slab for floor to ceiling and not within the perimeter walls of the room.

- .5 All supporting infrastructure (i.e.- electrical conduits) will be routed following building lines and utilize the corners of the room for vertical travel. This will allow for the largest uninterrupted space on the plywood back board walls, which is integral to the communications installation.
- .6 Communications rooms should not be located below rooms that are designed for wet usage i.e. – laundry, washroom, kitchen. If this is unavoidable, then a waterproof membrane system with floor drain must be utilized to prevent water escape to the comm room below.

1.5 **COMMUNICATION ROOM LAYOUT**

- .1 Penetrations through walls, floors and ceilings shall be fire-stopped using products as outlined in the UBC Guidelines Section 27 05 07 Fire-Stopping if applicable.
- .2 All walls shall be lined with rigidly installed 20 mm (3/4"), G1S (good one side) plywood, with the good side facing out. The plywood must be painted with two coats of light-colored Intumescent paint applied to all sides. If Treated Fire Rated Plywood is used, then the paint is not required to be intumescent. The full 8' length of plywood shall extend up from approximately 150mm height AFF. The plywood shall be professionally installed and fitted to the walls of the room. A poor-quality fitting and installation will not be accepted. Piecemeal installation of plywood will not be accepted, full length pieces must be used where they can. All plywood edges will be installed flush to each other to avoid ridges where the sheets meet. "Smash pins" are not an acceptable method of attachment as they are not flush with the finished plywood surface.
- .3 Install a drip tray(s) for any fluid carrying piping or sprinkler heads that are located above equipment racks.
- .4 The only access from adjacent ceiling spaces shall be by cable tray or conduit to allow connection to the horizontal and backbone pathways, HVAC supply lines and condensate drains specifically for conditioning of the communications room, sprinkler supply lines for protection of the communications room.
- .5 All power receptacles shall be centered at 300 mm AFF, or match mounting height of existing receptacles.
- .6 The lighting fixtures shall be mounted a minimum of 2900 mm AFF and positioned so that the majority of the light emitted falls on the front and rear of the equipment cabinets/ racks. Avoid placing the lights directly above the equipment cabinet / rack row.
- .7 Unless specified to the contrary, a minimum of one equipment cabinet shall be supplied and installed in each active Communications room (not required for designated pass thru rooms). Exact placement and proposed layout of the equipment racks and required cable mangers shall be reviewed by UBC Information Technology Representative and must observe the required clearances around the cabinet.
- .8 UBC Information Technology Representatives will consult with the contractor regarding the final location of UTP/STP, coax, and fibre optic, terminating and distribution equipment at the time of installation.

- .9 A Flex or basket type cable tray shall be provided around the perimeter of the room and shall be attached to the Communications cable tray infrastructure as per standard drawing ITSTD-05. The tray shall be mounted @~2700 mm AFF. When used, wall-mounted tray brackets shall be securely bolted through the plywood into the wall structure behind it.
- .10 All conduit terminating in the ceiling space shall protrude into Communications rooms between a distance of 25 mm to 100 mm. The conduit stubs must be higher than the cable tray. Preferably installed with a small downward kick bend to assist in the waterfall of the cables in to the cable tray. *Any conduit protrusions that are more than 600mm above the cable tray must have additional cable supports installed, either additional plywood or cable tray. Adding a 90 deg bend and extending the conduit down to the cable tray should be avoided, however extending conduits straight down without bends to the tray level is acceptable.*
- .11 All conduit entry in to communications rooms will be above or below the installed plywood sheathing. Conduits should not penetrate directly through the plywood sheathing unless approved by UBC Information Technology.
- .12 The use of a pull pit in the Main Communications Room is not acceptable.
- .13 Communications rooms should not have drop ceilings or finished ceilings installed. The room is intended to be open / unfinished ceiling for easy access to pathways.

2.0 **DOORS**

- .1 The supply of finish hardware on all new doors and frames are indicated on Architectural drawings and schedules. Retrofit existing hardware where directed on drawings. As a minimum, all existing doors shall be fitted with new accessible locksets.
- .2 Provide pressed steel frames and hollow metal doors C/W fire-rated door grilles.

2.1 **KEYING**

- .1 All Communication Rooms shall be “storehouse” keyed to the restricted access, ABLOY lock & key assemblies, as supplied and installed by the UBC Locksmith. The Contractor shall coordinate and arrange for installation of Communication Room locksets, prior to the installation of network equipment.

2.2 **FLOORING**

- .1 New Communication Room floor coverings shall be linoleum composite sheeting i.e. “Marmolium” as noted on drawings. Vinyl tiles are not acceptable. Sealed concrete is not acceptable. Epoxy seal floor finish is acceptable in a gray colour.
- .2 Re-use of existing flooring where applicable, shall be at the discretion of the UBC Information Technology Representative.

2.3 **PAINTING AND FINISHING SCHEDULE**

- .1 All plywood wall sheathing shall be treated with Intumescent paint if fire resistant plywood is not installed. Refer to MPI #64 listing and reference INT. 6.4S.

2.4 **SIGNAGE**

- .1 Provide room signage for all new or renovated Communications Rooms, closets or ancillary rooms created as part of the Communications infrastructure where these are accessed from a public corridor or where necessary to facilitate way-finding as per

current Campus Community Planning Standards.

- .2 Remove and replace existing signage where this can be incorporated in the new work.
- .3 Communications spaces must not be referred to as Electrical rooms as this implies a different level of safety requirements and access controls.

2.5 **SMOKE DETECTOR, HEAT DETECTOR, SPRINKLER SYSTEM**

- .1 Sprinkler heads shall be high temperature type. For existing sprinkler system inside communications room area, replace existing sprinkler head with high temperature type.
- .2 Provide cage to sprinkler heads for mechanical protection.
- .3 Install a drip tray(s) for any fluid carrying piping or sprinkler heads that are located above equipment racks.

2.6 **BACK-UP POWER AND POWER OUTLETS**

- .1 The Contractor shall provide power to MCR and LCR from both stand-by generator power supply panel, if the building is so equipped, and standard building power.
- .2 The Contractor shall provide a minimum of (1) 30A 120 V AC circuit (non-switchable) outlet. This circuit is to appear in (1) double gang simplex electrical outlet located on the wall directly behind or beside the IT equipment cabinet in the MCR and each LCR. (Refer to Drawing ITSTD-4 & 11) The outlet receptacle is to be a NEMA L5-30R twist lock. If standby generator exists in the building, then a second 30A 120V AC circuit (non switchable) outlet will be installed beside the above indicated outlet using the same format box/ plug combination and location. The intent is to have (2) L5-30R outlets in the room near the equipment rack, one on generator, one on standard building power. This requirement repeats for each active network equipment rack in the room, for example if a room has 2 active network equipment racks then there will be (2) sets of (2) L5-30R outlets. Each L5-30R outlet will be labelled to indicate if it is supplied by Generator or regular power including the breaker panel and breaker position.
- .3 The Contractor shall provide (2) dedicated 15A, 120V AC (non-switchable) circuits. These circuits are to appear in double gang duplex convenience outlets located at not more than 2000mm intervals around perimeter walls of MCR and each LCR. Convenience outlets shall be identified and marked. These outlets are to be supplied from standard building power. (Refer to Drawing ITSTD-04 & 11) These outlets must be labelled with the breaker panel and breaker position. [Conduit routing for these outlets must not vertically cross the plywood backboards except in the corners of the rooms.](#)

2.7 **FIRE-RATED DOOR GRILLS**

- .1 Only when requested by UBC IT.

2.8 **EQUIPMENT CABINETS**

- .1 Equipment cabinets will be per approved manufacturers and associated part numbers supplied and detailed in Section 27 05 08.
- .2 Each equipment cabinet shall be plumbed and leveled, and solidly bolted to the floor with bolts, washers and brackets. Bonding of rack to ground per Section 27 05 26
- .3 Equipment cabinets shall be seismically restrained, as shown on ITSTD-36 and per UBC Campus Community Planning Standards.

- .4 Where two or more cabinets are mounted side by side; the racks shall be bolted together with the indicated vertical wire managers between the racks (if requested) or as directed by UBC IT. Provide side panels, front and rear doors, and cabinet top only when requested by UBC IT. See ITSTD-15.
- .5 Provide 1.5 meters access clearance in the front and 1-meter access clearance in the rear and one side of an equipment cabinet. Where several rows of racks are located side by side, the row spacing shall be a minimum of 1.5 meters. A minimum clearance of 150 mm shall be maintained between one side of an equipment cabinets and the wall. [See ITSTD-4.](#)
- .6 Typical equipment cabinet data port capacity is 432 horizontal cables when the UPS is installed in the same cabinet. If the UPS is not present then the typical data port capacity is 576 horizontal cables.

2.9 **HORIZONTAL CABLE**

- .1 In a communications room, horizontal cables shall be bundled separately from entrance and riser cables.
- .2 A minimum of 5 meters slack shall be left on all unterminated cables in the communication room.

2.10 **LABELING**

- .1 Each MCR and LCR is identified with a unique terminal room number supplied by the UBC Information Technology Representative. (Refer to Section 27 05 53 and ITSTD32)

2.11 **ENTRANCE CABLE PROTECTORS**

- .1 Always leave space for location of entrance facility terminations and protectors in the main communications room of a building as per drawing ITSTD-06 and always co-ordinate this layout with the UBC Information Technology Representative. (Refer to Section 27 05 06)

2.12 **COMMUNICATIONS ROOM VENTILATION**

- .1 Each MCR and LCR is to be provided with a means of ventilation (heat abatement) sufficient to maintain an average ambient air temperature range of 20 C to 23 C, as measured at the midpoint of the front face of the installed equipment racks. This temperature range is to be maintained on a 24 hour a day by 365 day per year basis. Modulation of the communications room temperature or ventilation airflow (supply/exhaust) via in-building BMS systems is not allowed.
- .2 Where a centralized source of chilled water/fluid exists or will be provided within the building, each MCR/LCR should be provided with its own ceiling-mounted fan-coil unit, with wall-mounted thermostat for full local temperature control.
- .3 If no centralized source of chilled/fluid exists, a package precision-cooling chiller unit such as those from American Power Conversion (Network Air CM series or equivalent) or Liebert (Datamate, Minimate or equivalent) should be provided. [Split systems are acceptable however each condensate drain must be professionally planned and installed.](#)
- .4 If there is mechanical room space available adjacent to the communications room, it is preferable to mount fan-coil or package chiller units within the mechanical room (and duct the supply and return thru wall penetrations) to avoid running water/glycol pipes within the communications room envelope.

- .5 Wherever possible, ventilation system supply/return air ducting is to be placed such that chilled supply air is directed to the front of installed equipment racks, and return/exhaust intakes are above the rear of the equipment racks. Ducting must be routed so as not to interfere with access to cable tray and equipment racks or any other installed communications infrastructure within the room.
- .6 Power supply to communications room ventilation systems should be provided with redundant power feed sourced from standby power systems where available.
- .7 Humidity inside the communications room must be maintained within the range of 20 % RH to 80% RH. Tighter control is not required unless specifically requested for by Information Technology, or where special circumstances mandate it.
- .8 Air filtration is to be provided at all air handling and mechanical ventilation plants servicing the communications room. Dry, replaceable type filter media is required.

2.13 **LIGHTING**

- .1 Each MCR and LCR is to be provided with energy efficient direct [source LED type, daylight temperature](#) lighting, so as to illuminate both the front and back areas of all equipment racks as well as interior walls where equipment is mounted.
- .2 Illumination levels are to be according to WSBC or similar Industry standards for safety and comfort.
- .3 On/off control of the lighting within the room must be dedicated for that room and located within the room.

END OF SECTION 27 05 05

1.0 **GENERAL**

1.1 **DOCUMENTS**

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 **SUMMARY**

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 INTER-BUILDING FACILITIES - OVERVIEW
 - 1.4 COORDINATION WITH UBC UTILITIES
 - 1.5 COORDINATION WITH UBC INFORMATION TECHNOLOGY
 - 1.6 DUCT SELECTION
 - 1.7 CONTRACTOR SUPERVISION
 - 1.8 APPROVED CONTRACTOR LIST – OP FIBRE
 - 1.9 LABELING
 - 1.10 RECORD DRAWINGS
 - 1.11 ENTRANCE CABLE PROTECTORS

1.3 **INTER-BUILDING FACILITIES - OVERVIEW**

- .1 When installing cable in empty ducts, the installation of sub-ducting, as directed by the Engineer of Record, is optional. A pull rope shall be installed in each sub-duct or main duct. All pull ropes used when installing cables must be replaced with same or better strength and quality of pull rope.
- .2 Provide all necessary record drawings and permits as required by UBC Utilities.
- .3 Provide all required Engineering reports to Information Technology Representative and copy of permits as required.

1.4 **COORDINATION WITH UBC UTILITIES**

- .1 [Stan Takenaka](#)

[Manager - Electrical Utilities, Engineering & Utilities](#)
[Energy and Water Services](#)

[Building Operations – UBC Utilities](#)

[Phone-604-822-4943](#)
[Cell--604-916-0631](#)
stan@utilities.ubc.ca

1.5 COORDINATION WITH UBC INFORMATION TECHNOLOGY

Sarah Gardner sarah.gardner@ubc.ca	Project Manager 604-827-5242 bus	Connectivity Infrastructure
Stephen McKenzie stephen.mckenzie@ubc.ca	Project Manager 604-822-0535 bus	Connectivity Infrastructure
Tom Ziemlanski tom.ziemlanski@ubc.ca	IT Plant Coordinator 604-822-8659 bus	Connectivity Infrastructure
Blake Bridgewater blake.bridgewater@ubc.ca	Manager 604-827-3663 bus	Connectivity Infrastructure
Eric Bourdon eric.bourdon@ubc.ca	Senior Manager UBCNETwork and Infrastructure Facilities 604-822-0832 bus.	

1.6 DUCT SELECTION

- .1 UBC Utilities shall provide duct assignments in conjunction with the Information Technologies representative and the Engineer of Record.

1.7 CONTRACTOR SUPERVISION

- .1 Engineer of Record shall be responsible for all up to date certification, code and UBC standard compliances.
- .2 Engineer of Record shall provide manhole verifications and installation contractor supervision as required.

1.8 APPROVED CONTRACTOR LIST – Outside Plant

- .1 The following Contractors have been pre-approved by UBC Information Technology and are eligible to perform Outside Plant Communications Infrastructure work at the University of British Columbia – Point Grey campus:
 1. West Net Communications Inc
 2. Dixon Networks Corp

1.9 LABELING

- .1 UTP Cable: After terminating, the cable shall be identified at each termination on BIX connector labels (Green).
 - i.e. HA-6 represents Henry Angus Hub-site, Cable #6
- .2 Individual pairs are identified with a sequential number in increments of 25.
 - i.e. 501-525.526-550, etc.
- .3 Fibre Optic Cable: After terminating, the cable shall be identified at the fibre distribution panel with three groups of characters. The first group represents the originating hub-site.

The second represents the cable type. The third represents the cables sequential appearance on the originating hub-site frame.

i.e. SSW-FO-01 represents School of Social Work Hub-site, fibre optic cable, #1.

.4 Individual fibres strands are further identified indicating type and sequence.

i.e. SM-01, SM-02 indicating single mode fibre strand # 1 and strand #2.

Strand numbering will re-start for each discreet cable.

1.10 RECORD DRAWINGS

.1 Provide routing and associated Manhole detailed drawings as required. These record drawings must be in the standard UBC Utilities format.

.2 Provide hard and soft copies to Information Technology Representative.

1.11 ENTRANCE CABLE PROTECTION

.1 Location of entrance facility terminations and protectors in the Main Communications room of a building shall be coordinated with the Information Technology Representative.
(Refer to Standard Drawings ITSTD-04, ITSTD-06)

END OF SECTION 27 05 06

1.0 **GENERAL**

1.1 **DOCUMENTS**

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 **SUMMARY**

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 FORWARD
 - 1.4 REFERENCES
 - 2.0 PRODUCTS
 - 2.1 REQUIREMENTS
 - 2.2 MATERIALS
 - 3.0 EXECUTION
 - 3.1 INSTALLATION
 - 3.2 EXISTING PENETRATIONS
 - 3.3 MASONRY POINTING PATTERN
 - 3.4 INSPECTING AUTHORITIES
 - 4.0 TRAINING

1.3 **FORWARD**

- .1 Fire-stop systems installed by the Contractor shall meet the requirements of all applicable codes and ULC standards.
- .2 The Contractor shall fire-stop new Communication pathway and / or cable penetrations of building fire barriers with an approved fire-stop system.
- .3 The Contractor shall fire-stop with an approved fire-stop system, any holes created by the Work of this Contract.
- .4 The Contractor shall coordinate all Work with Division 26 and applicable Inspection departments.
- .5 The Contractor shall obtain inspection approval from the applicable Permits and Inspections department and shall be responsible for all associated costs.
- .6 The Contractor shall provide equipment, materials, labour, and services not specifically mentioned or shown which may be necessary to complete or perfect all parts of this installation and in compliance with requirements stated or reasonably inferred by the Contract Documents.
- .7 The intent of the section is to address the firestopping requirements of penetrations where:
 - .1 Telecommunications cables are physically involved in or are part of the penetration
 - .2 the interior dimension of a telecommunications designated pathway allow for air exchange across a fire rated barrier

- .8 This section does not attempt to address and should not be used to address fire barrier penetrations that are applicable to Div 26.

1.4 **REFERENCES**

- .1 BICSI – Current Edition, *Telecommunications Distribution Methods Manual (TDMM)*
- .2 Current Canadian Electrical Code
- .3 Current BC Building Code
- .4 CAN/ULC-S115-11

2.0 **PRODUCTS**

2.1 **REQUIREMENTS**

- .1 The Contractor shall submit to the UBC Information Technology Representative for approval, the following items relating to the fire-stop system if requested:
 - .1 Hilti manufacturer technical data for each product intended to be used on site including product description, specifications and storage requirements.
 - .2 Fire-stop design documentation shall include:
 - .1 Schedule indicating:
 - .1 Number of fire-stop locations
 - .2 Type of penetration
 - .3 Type of building construction at point of penetration
 - .4 Hourly fire-rating of floors and walls
 - .5 Fire-stop device or system proposed.
 - .3 Applicable fire-stop design drawings.
 - .4 Installation Procedures and Material Safety Data Sheets shall be included with products delivered to the job site.
 - .5 Maintenance manuals and maintenance data that may be published by Manufacturer.

2.2 **MATERIALS**

- .1 Only Hilti fire-stop products are approved for fire-stopping Communications infrastructure penetrations of fire barriers at UBC.
- .2 Hilti fire-stop products may be in the form of speed sleeves, traditional sleeves, modular sleeves, caulk, putty, strips, blocks, plugs, or sheet material. The choice of fire-stop products depends on the type of penetration to fill such as holes, spaces, and voids, or

cavities and whether the penetration has or will have cable passing through it. Hilti speed sleeves and modular sleeves are the preferred products and every effort should be made to use these products over other possible solutions.

- .3 The Contractor shall use fire-stop materials that have no irritating or objectionable odors, when fire-stopping occupied areas of existing buildings.
- .4 Fire-stop products used in cross-sectional areas of the pathway such as inside sleeves, or cable tray penetrations of fire barriers shall be re-enterable type to enable future Moves, Adds, or Changes.
- .5 Fire-stopping materials shall provide adhesion to substrates, and maintain fire and smoke seal under normal expected movements of substrates, conduits, and cables.
- .6 The preferred Hilti Fire stop system for new installations is the Gang plate/ Speed sleeve system. CFS-SL GP and CP 653 and modular sleeve CFS-MSL.

3.0 **EXECUTION**

1. Division 27 contractors are responsible for Firestopping the interior air space of all pathways that are designated for UBC IT Telecommunications and networking cables where firestopping is required.

3.1 **INSTALLATION**

- .1 The Contractor must receive training from the manufacturer on the proper installation of the fire stop system. The Contractor shall follow the manufactures instructions and guidelines for installation of the chosen fire stop system

3.2 **EXISTING PENETRATIONS**

- .1 In existing buildings, the Contractor shall fire-stop any gaps or cavities between penetrating cable tray, ducts, or sleeves and surrounding surface area
- .2 The Contractor shall fire-stop with an approved fire-stop system, the following existing penetrations of building fire barriers:
 - .1 Existing Communication pathway, cables, or holes that are not fire-stopped and are within 1m (3') of new Communication pathway, or cable penetrations of fire barriers.
 - .2 Existing Communication cables abandoned by the Work of this Contract.

3.3 **MASONRY POINTING PATTERN**

- .1 Where fire-stop systems penetrate masonry barriers, the Contractor shall make good surrounding area by replicating original pointing pattern and matching in quality of workmanship.

3.4 **INSPECTING AUTHORITIES**

- .1 The Contractor shall remove and expose fire-stop systems to the extent directed by Inspecting Authority for the purpose of carrying out the inspection.

- .2 The Contractor shall re-install fire-stop system and restore any affected building components removed for inspection, at no cost to the Owner.

4.0 TRAINING

- .1 The Contractor must receive training from Hilti and possess current Hilti certification prior to installing Hilti fire-stop products.

END OF SECTION 27 05 07

1.0 **GENERAL**

1.1 **DOCUMENTS**

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 **SUMMARY**

- .1 Section Includes:

- 1.0 GENERAL
- 1.1 DOCUMENTS
- 1.2 SUMMARY
- 1.3 OVERVIEW
- 1.4 DESCRIPTION OF SYSTEM
- 1.5 OTHERS IN INFORMATION TECHNOLOGY PATHWAY
- 2.0 PRODUCTS
- 2.1 MANUFACTURERS
- 2.2 MATERIAL
- 2.3 HANDLING AND PROTECTION OF EQUIPMENT AND MATERIALS
- 3.0 EXECUTION
- 3.1 PROTECTION OF OWNER'S FACILITIES
- 3.2 PRE-INSTALLATION SITE SURVEY
- 3.3 INSTALLATION - GENERAL
- 3.4 COMMUNICATIONS CABLE – GENERAL
- 3.5 UTP/STP INSTALLATION
- 3.6 MISCELLANEOUS CABLES
- 3.7 CABLE SUPPORT
- 3.8 BIX CONNECTORS
- 3.9 FIBRE OPTIC INSTALLATION
- 3.10 TERMINATIONS
- 3.11 TESTING

1.3 **OVERVIEW**

- .1 This Section includes equipment, materials, labour and services to provide telephone and data distribution systems including, but not limited to:
 - .1 Installation, termination, testing and labeling of horizontal and backbone [UTP/FTP](#), Coaxial CATV and Fibre Optic cabling.
 - .2 Disconnection and removal of existing voice or data cables.
 - .3 Equipment cabinet and or rack installation.
 - .4 System testing and labeling
 - .5 Documentation and submissions.
- .2 Contractors shall provide all equipment, consumable materials, labour and services, not specifically mentioned or shown, which may be necessary to complete or perfect all parts of the installation. Contractors shall ensure that they are compliant with requirements stated or reasonably inferred by the contract documents.

1.4 DESCRIPTION OF SYSTEM

- .1 The Number of voice and data jacks in work areas is not typical and is based on information supplied by the end user and the UBC Information Technology Representative.
- .2 The determination of typical communication outlet cable counts will be in consultation with UBC Information Technology during the design phase of each building or renovation. It is not to be assumed that one cable is sufficient for typical installations. A detailed needs assessment could be carried out by the UBC Information Technology Representative to determine the customer's requirements, which will affect the design.
- .3 When it is determined that a typical work area outlet will consist of only one (1) four-pair FTP Category 6A cable, this cable will be dedicated to the Data network by default. Typically, four-pair FTP Category 6A cables dedicated to Voice use will be quantified during the detailed design process and added as required. Terminate data cables on wall/rack mounted modular patch panels located in the appropriate LCR / MCR. Terminate the voice cables on GigaBIX termination blocks located in the same LCR / MCR. ITSTD-32
- .4 Each Wireless Access Point (AP) outlet shall consist of a minimum of two (2) four-pair FTP Category 6A cables, installed from the indicated AP outlet location to the zone Local Communication Room (LCR) unless otherwise specified. ITSTD-50-54
- .5 Voice backbone cabling shall consist of multiples of 25 pair Category 3 unshielded twisted pair cables and shall be installed from the Main Communication Room (MCR) to each Local Communication Room (LCR.) ITSTD-13, 32, 64
- .6 Fibre Data backbone cabling consisting of a minimum of 24 strands of OS2 single mode optical cable shall be installed from MCR to each zone LCR. Required strand count to be determined as needed per installation. All connections will be SC, UPC form factor. ITSTD-32, 56, 63
- .7 All FTP Category 6A horizontal cable lengths shall not exceed 90 meters. All FTP Category 6A cables will be bonded to ground at the local consolidation point, for example a communications room or cabinet. All FTP Category 6A patch panels must be bonded to the cabinet or room bonding point at the time of installation of the panel. ITSTD-32
- .8 Local Lighting Controller Systems – A minimum of (1) FTP Category 6A cable for data connection shall be installed from the MCR or LCR to any local lighting controller that is intended to be controlled by the integrated AV system of that room. This connection is in addition to, and independent of, any BMS requirements for lighting controllers (see section 26 51 00 for AV integration).
- .9 BMS Systems - A minimum of (2) FTP Category 6A cables for data connection shall be installed from MCR or LCR to specified demarcation locations for centralized BMS panels. There may be more than one location per building. ITSTD-22
- .10 Security Systems– System specific cables for Security shall be installed as per UBC Access Control drawings and specifications and are not addressed in this document. Typical Communications cable installations for the Security system to communicate with the Network will consist of a minimum of one (1) FTP Category 6A cable for data communications installed within 300mm of designated security panels in a surface mounted outlet. Typically, there will be more than one location per building, and common locations are: a - on the communications room wall behind entrance door, b – in elevator machine rooms, c – above Proxsafe key lock boxes. However, it is possible for Secure Access to request any location in any given building. ITSTD-22,23,24,25

- .11 Fire Alarm System - Communications cables for the Fire Alarm system to communicate with the Network or remote location are to be a minimum of (1) FTP Category 6A cable for data communications and (1) FTP Category 6A cable for voice communications. These cables shall be installed from MCR, or LCR to the specified demarcation location for the central fire alarm panel. Typically, there will be only one location per building. ITSTD-22
- .12 Clock/ Bell System - System specific cables for Clock Bell system shall be installed by others and are not addressed in this document. Communications cables for the purposes of delivering a synchronous correction signal to the clock system of a building will consist of a minimum of (1) FTP Category 6A cable for voice communications. The cable shall be installed from the MCR, or LCR to specified demarcation location for the central Clock / Bell panel. Regardless of the intention for the system to use wireless synchronization, this demarcation shall be installed. Typically, there will be only one location per building. ITSTD-22
- .13 Elevator Systems:
 - 1- Phone – A minimum of (1) FTP Category 6A cable for voice communications shall be installed from the MCR or LCR, to a specified elevator phone demarcation location. Typically, there will be one cable installed per elevator car in a building, unless a third-party elevator communications system is used (for example a Webb System). If a third-party elevator communications system is used in a building, then one (1) FTP Category 6A cable for voice communications will be installed at a demarcation point agreeable to both UBC IT and the company installing the third-party system, typically the UBC IT MCR. Regardless of the inclusion of a third-party system the standard elevator communications demark cables shall be installed. ITSTD-22
 - 2- Access Control – A minimum of (1) FTP Category 6A cable for data communications shall be installed from the MCR or LCR to a specified elevator Access control demarcation location. Typically, there will be one cable installed per elevator car in a building. ITSTD-22
 - 3- Typically, these two elevator specific services will appear in separate demarcation locations within the elevator machine rooms due to the nature of the equipment that will be connected
- .14 PML/ Water Meter - A minimum of (1) FTP Category 6A cable for data communication and (1) Category 6A cable for voice communication shall be installed from the MCR, or LCR to specified meter locations. There may be more than one per building. ITSTD-22
- .15 The Contractor shall install equipment racking in Communication rooms to UBC Information Technology's specifications and satisfaction. ITSTD-04, 11
- .16 The Contractor must finalize equipment layouts of Communication rooms with UBC Information Technology Representative before installation can proceed. ITSTD-04, 05, 11, 12
- .17 The Div 27 Contractor must fire-stop the inside of all conduit or cable tray penetrations of fire rated barriers (floors and walls). Div 26 Contractor must fire-stop the outside of all conduit and cable tray penetrations of fire rated barriers. See Section 27 05 07 for Fire-stop information.
- .18 The Div 27 Contractor is responsible for the 'air stopping' the inside of all conduit or cable tray penetrations of any areas that require airborne isolation or air pressure isolation. Div 26 Contractor must 'air-stop' the outside of all conduit and cable tray penetrations.

- .19 The Integrity of the UBC structured cable system must be preserved in all aspects of the installation. All cables installed for UBC IT must appear in designated UBC communications rooms and use UBC IT designated pathways unless instructed otherwise. UBC IT cables should not be installed in shared pathways when UBC IT dedicated pathways are available. UBC IT cables should not travel (exposed) through shared communications spaces or shared utility spaces. All UBC IT communications rooms should be linked to each other with continuous riser pathway dedicated to UBC IT.

1.5 OTHERS IN INFORMATION TECHNOLOGY PATHWAY

- .1 All other cable systems that have been pre-approved by UBC IT to share the IT designated pathways must install their cables in accordance with the UBC IT Division 27 guidelines.
- .2 All other cables systems that have been pre-approved by UBC IT to share the IT designated pathways must keep their cable bundles separate from the IT cable bundles.
- .3 No other cable systems that have been pre-approved by UBC IT to share the IT designated pathways will cause any IT pathway to be over filled or reduce future capacity of the functional IT infrastructure.
- .4 UBC IT cabling will always take precedent over other cabling systems within IT pathways.
- .5 UBC IT will have first choice of pathways. If another cable system has prematurely used the IT pathway that UBC IT requires, then that system will remove their cables or provide alternate pathway at no cost to UBC.
- .6 Zone pathways are the only pathways that are suitable for cable system sharing.
- .7 Conduits designated to be 'drop' conduits or conduits with a dedicated purpose are not suitable for cable system sharing.
- .8 UBC IT network cabling system J-Hooks are not suitable for sharing and will not be used by other systems.
- .9 Examples of other cable systems that will need authorization before they will be allowed to share IT pathways on any given project are:
- Security cabling
 - BMS cabling
 - Access control cabling
 - RF distribution cabling (Cellular, Radio, Microwave)
 - Intercom cabling
 - Audio Video cabling
- .10 Coordinate with UBC IT representative on site if required.
- .11 Pathway that is to be used for communications room riser shall be enclosed when passing through shared spaces such as utility rooms and other non UBC IT communications rooms.

2.0 PRODUCTS - INSIDE PLANT

2.1 MANUFACTURERS

- .1 All horizontal cable and associated jacks, connectors, patch panels and faceplates shall be FTP Category 6A appropriate and manufactured by CommScope, Uniprise SLX series.
- .2 All voice backbone (Riser) cables shall be Category 3, however termination hardware located in MCRs and LCRs shall be Category 6 - GigaBIX. The termination hardware shall be manufactured by BELDEN – GigaBIX IDC system.
- .3 All fibre cables and pigtails shall contain glass manufactured by Corning.
- .4 All fibre termination hardware shall be manufactured by Corning- CCH System, or as directed by UBC Information Technology.

2.2 MATERIAL

- .1 This section specifies various manufacturers' materials including, but not limited to, cable, jacks and outlet plates, patch panels, equipment racks, GigaBIX blocks, and other Communications components used in Communications infrastructure installations at UBC.
- .2 The Contractor shall install and connect voice and data network using Contractor supplied material. Typically, data patch cords are not included as part of the contractor's scope.
- .3 The Contractor shall replace and connect existing voice and data cabling where applicable with FTP Category 6A cable and termination hardware.
- .4 The Contractor shall return all removed hardware and accessories to UBC Information Technology for re-tasking or disposal, unless otherwise agreed. All removed redundant and abandoned cable will be disposed of by the contractor at no cost to UBC and in accordance with applicable environmental regulations.
- .5 All materials used must be CSA approved or Electrical Safety Authority of British Columbia recognized standard association approved and installed in accordance with manufacturers' specifications and recommendations.
- .6 Where substitutions of specified materials are allowed, they must at all times meet or exceed the specifications given by the manufacturers listed and be subject to approval by the UBC Information Technology Representative in writing prior to their use.
- .7 The Contractor shall ensure that the completed project includes installation of all materials required to fulfill the Contract as detailed on IT drawings and in the Contract Documents.
- .8 The following material shall be supplied by the Contractor.

CommScope Uniprise SLX List

Category 6A CMR/P, 4 PR, 23 AWG (CS44 BLU C6A 4/23 F/UTP, UN884018404)

Category 6A - T568-A SLX Jacks (USL10G-SHLD, A.WHT, 760238128, Alpine White is default colour for field installation, metal or black colour is acceptable for comm room installation)

SG/DG faceplates and blank inserts - Alpine White (21110XX-3)

Category 6A - 24 port patch panels (CPP-SDDM-SL-1U-24,760237046 c/w all jacks supplied)

Cable management panels (if requested)

2-port modular box (1-1933668-3 or 1-1116698-3 for wireless and special systems demarcations)

Patch panel bracket kits (if requested)

Decora 2/3/4 -port strap kits (SL or 110, straight, Alpine white)

Modular furniture faceplates (SL or 110, straight, colour to match furniture)

BELDEN - GigaBIX List

25 Pr 24 AWG CMR/P Cat 3 Backbone cable

GigaBIX 300 Pr Mounts (AX101472)

GigaBIX termination strips (AX101447, AX101448)

GigaBIX designation strips and labels (AX101483)

GigaBIX distribution rings (AX101478)

GigaBIX wire guards (AX101486)

CORNING List

24 strand (Typical count) SM 8.3 micron MIC for backbone cables. All dielectric, OFNR/P – CMR/P OS2.

2 strand MM or 4 strand MM composite OM4 MIC 50/125 micron CMR/P for horizontal cables if specified.

Pigtails must use Corning glass and SC connectors

Fibre panels shall be of the CCH System:

- Rack mounted distribution panels are typically CCH-02U or CCH-04U
- Multimode splice modules are typically CCH-CS12-E7-P00TE
- Single mode splice modules are typically CCH-CS12-59-P00RE

CABINET – APPROVED PARTS

.1 In new buildings, all cabinets shall be of the same manufacturer.

.2 Cabinet layouts include:

Four (4) 19" TIA mounting rails, tapped,

One (1) mid mounted minimum 50 mm D x 150 mm W vertical channel for incoming cable dressing and

Two (2) horizontal (front and rear mounted) cable manager.

Optional price for top, ventilated sides, front and or back door only when specified.

Electron Metal – Part number CB4-0049378-001 Series 4000 cabinet – includes:

- 24" x 83" x 36" – 44RU
- 2 pairs of 19" mounting rails TAPPED 12-24 c/w RU markings
- 1 universal accessory channel
- 1 LH rear vertical cable manager
- 1 RH rear vertical cable manager
- Qty 100 12-24 screws
- No doors / No side panels / No top

J-HOOK SYSTEM

- .1 Panduit J-Mod Cable support system for spurs from main tray system to outlet location. Maximum of 2" cable bundle per J-hook. Minimum of 2-J hooks per bracket otherwise additional brackets and J-hooks required to complete system. Bracket mounting to suspended ceiling drop wires is not allowed. Ensure equipment meets all applicable codes when installed in plenums.
- . 2 J-Hooks should not be utilized in new buildings or large-scale renovations. J-Hook usage is reserved for small renovations or localized additions where it is not economically feasible to install the preferred forms of pathway.

The following consumable materials shall be supplied by the Contractor at the Contractor's expense.

Pulling lubricants

Pull tapes

Cable Ty raps

Velcro fasteners

Cable labels

All designation labels

Fibre termination consumables

Any miscellaneous material to facilitate cable system installation

2.3 HANDLING AND PROTECTION OF EQUIPMENT AND MATERIALS

- .1 The Contractor shall be responsible for safekeeping his own and any subcontractors' property, such as equipment and materials, on the job site. UBC assumes no responsibility for protection of above-named properties against damage, fire, theft and deterioration from inclement environmental conditions.

3.0 EXECUTION

3.1 PROTECTION OF OWNER'S FACILITIES

- .1 The Contractor shall effectively protect the Owner's facilities, equipment and materials from dust, dirt and damage during construction.
- .2 The Contractor shall remove protection at completion of the Work. In areas that are continued to be used during construction, protection material and clean up shall be done at the end of each day.

3.2 PRE-INSTALLATION SITE SURVEY

- .1 Prior to start of systems installation, the Contractor shall meet at the project site with the UBC Information Technology Representative, the Consulting Engineer, and representatives of trades performing related work to co-ordinate efforts. The Contractor shall review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with other trades shall be necessary to plan the crucial scheduled completions of the equipment room and Communication rooms.
- .2 The Contractor shall examine areas and conditions under which the system is to be installed. The Contractor shall not proceed with the work until satisfactory conditions have been achieved.

3.3 INSTALLATION - GENERAL

- .1 The Contractor shall Supply all materials, labour, tools and services required to install a complete cabling system
- .2 The Contractor shall perform all work of installation of components, cable terminations, bonding, testing, of cables and racks as indicated to provide a complete voice and data cabling network as specified by the manufacturer
- .3 The Contractor under Division 26 shall provide all pathway and raceway systems for the Communications cables. All pathways and raceways will be installed for the purpose of installation of high-performance communications cable and the installation may be required to supersede any Code safety limitations to maintain the performance aspects of the communications cables. (Refer to Section 27 05 28)
- .4 The Contractor shall supply & install interconnecting Backbone cabling between floors as indicated.
- .5 The Contractor shall supply & Install horizontal cabling between MCR or LCR, and Communication outlets.
- .6 The Contractor shall support cabling in cable tray and drop conduit, or J-hooks runs to Communications outlets.
- .7 The Contractor shall not carry out any cable terminations until acceptance of the methodology has been obtained.
- .8 Cable supported by J-hook run shall be bundled with Velcro tape at maximum 300 mm on center, after leaving the cable tray.

- .9 Cables on plywood backboards in Communications Rooms shall be supported with J-Mod system and or Velcro tape at maximum 600 mm on center or closer as necessary to dress installed cables in neat and tidy bundles as per Section 27 15 00.
- .10 The Contractor shall install equipment and wiring in Communications Rooms to provide a logical progression for cabling and to minimize cables crossing.
- .11 Cables, installed on J-hooks, shall follow building lines and be anchored where a change of direction occurs to avoid excessive slack, or sags. Cables shall be bundled at J-hooks per Section 27 15 00.
- .12 J-Hooks should not be utilized in new buildings or large-scale renovations. J-Hook usage is reserved for small renovations or localized additions where it is not economically feasible to install the preferred forms of pathway.
- .13 The Contractor shall maintain manufacturer's minimum bending radius for all cables. At initial cable installation on tray, run cables parallel to each other with a minimum of crossovers.
- .14 Defective material and or cabling installed shall be replaced at no cost to UBC.
- .15 The Contractor shall leave data wiring system in complete and operating condition.
- .16 Layouts may not show countertops, benches, and baseboard heaters. The Contractor shall locate voice/data outlets above countertops and baseboard heaters and in benches next to power outlets.
- .17 The Contractor shall locate voice/data outlets adjacent to existing power outlets where possible.

3.4 COMMUNICATION CABLE - GENERAL

- .1 All cables shall run without a splice between a communications room and a communication outlet via cable tray, conduit, J-hook, pack pole, cable channel, or surface raceway.
- .2 All cables shall be CSA-CMR/P rated as required to meet any and all applicable codes and as dictated by each project's particular requirements.
- .3 The Contractor shall ensure that there is no rough handling, kinking, denting or abrasion of the cable, and that the cable shall not be left on the ground where it may be stepped on or run over by vehicles.
- .4 Cable shall not be pulled through 90° conduit fittings such as an LB type joint. LB type fittings are not acceptable in Communications pathways. When installing cables, care shall be exercised to avoid sharp bends, protruding metal edges and unnecessary stress. The minimum bending radius of Category 6A cables shall be 25 mm and minimum bending radius of other cables shall be 10 times of outside jacket diameter. Sharp metal edges in cable trays which could cut the cable shall be smoothed and the cable dressed away from these edges. Dropouts shall be provided for cables leaving horizontal trays.
- .5 Unless specified otherwise, all intra-building cable shall be pulled by hand. Excessive pulling force will cause alteration of the cable's transmission characteristics to the extent that the installed system may not operate within the specified limits and the cable run will have to be replaced at no cost to UBC.

- .6 The Contractor shall ensure that the cable runs freely from the reel or box, without excessive back pull and that all slack is taken up slowly. Precautions shall be taken to protect reeled and unreeled cable from any source of possible damage while attended or unattended.
- .7 If cable lubricants are necessary, ensure that they are compatible with the cable's outer sheath. Refer to the lubricant and cable manufacturer's specification sheet to ensure compatibility. Detergent-based lubricants shall not be used.
- .8 When multiple pathways are available from one location to another, the Contractor shall fill up one pathway before installing cables in other pathways, choosing UBC IT designated pathway over shared pathway.
- .9 The Contractor shall leave the manufacturer recommended amount of slack within the outlet box following termination, as too much slack at the point of termination may result in testing failures and too little slack can compromise future maintenance. No slack loops are permitted in any part of the system.
- .10 Communications cables of all types must not be painted as at a minimum it will void the manufacturer warranty. Any cables that are painted will be immediately replaced at no cost to the University.

3.5 UTP/FTP INSTALLATION

- .1 All UTP/FTP cable system work completed by the Contractor must be approved by the UBC Information Technology Representative. The following basic requirements must be met to gain system acceptance.
 - .1 Receive, check, unload, handle, store and adequately protect equipment and materials to be installed as part of the Contract. In existing buildings, store in areas as directed by the UBC Information Technology Representative. Installation includes setting in place, fastening to walls, floors, ceilings, cabinets or other structures where required, interconnecting cabling of system components if specified, equipment alignment and adjustment and other related work whether or not expressly defined herein.
 - .2 Install materials and equipment in accordance with applicable standards, codes, requirements and recommendations of national, provincial and local authorities having jurisdiction and with manufacturer's printed instructions.
 - .3 Adhere to manufacturer's published specifications for pulling tension, minimum bend radii and sidewall pressure when installing cables.
 - .4 Install horizontal cabling from outlets to the nearest Communications closet in a continuous run without a splice, unless otherwise noted.
 - .5 Most designs call for a cable tray/zone conduit, and J-hook support structure to facilitate cable system installation. When installing, ensure cable is not subjected to stress due to contact with tray/conduit support mechanisms, bonding lugs or any metal burrs within the support structure. Particular care must be taken when working around corners and offsets. Pulling lubrication must be used at all times to ensure a stress-free installation.
 - .6 Cable forming and termination procedures shall conform to the following requirements:

- .1 All cable installation shall be done in a neat and tidy fashion, with cable routing closely following building lines. All cable forming within the MCR's and LCR's shall also follow building lines.
- .2 Cable shall be neatly arranged by full cable combing with no crossovers within the bundle. The UBC Information Technology Representative shall have final approval of cable forming quality and any workmanship issues. Bundles may be formed in Communication rooms using Velcro fasteners. Cables must not exhibit sheath deformation due to over-tightening. If cable forming is not performed to the satisfaction of the UBC Information Technology Representative, the Contractor shall be responsible to re-form the bundles at no cost to the Owner.
- .3 Termination practices must strictly comply with manufacturers' recommendations. Particular care must be taken to limit sheath removal length and pair un-twist at point of termination. The TE cable termination tool – PN-1725080-1 or similar must be used for all Category 6A terminations. Use of 110 Impact tools is not acceptable. .4 Cables shall be terminated in sequential order on patch panels and on GigaBIX termination hardware.
- .5 At each Communication outlet, follow the same termination practices as stipulated for the Communication room. The Contractor shall leave the manufacturer recommended amount of slack within the outlet box following termination, as too much slack at the point of termination may result in testing failures and too little slack can compromise future maintenance.
- .6 The Contractor shall neatly dress all cables within the Communications room to follow building lines. The objective being, to provide a reasonable amount of slack into each cable run, while at the same time provide neatness and promote order as the cables migrate from the point-of-entry to the termination point. No slack loops are permitted.
- .7 The UBC Information Technology Representative must give final approval to cable forming in the Communications rooms and termination quality at the outlets and in the Communications rooms before the work can be deemed as completed.
- .8 In Communication rooms, horizontal cables shall be bundled separately from entrance and backbone cables. Cable bundles are not to exceed 24 cables per bundle in any communications room, and are not to exceed 40 cables per bundle in any other location.

3.6 MISCELLANEOUS CABLES

- .1 UBC IT does not accept or employ; hybrid, under-carpet, or flat cables.

3.7 CABLE SUPPORT

- .1 Cables must be properly supported at all times. Cables shall not be left on floors of Communication rooms, or hallways, and shall be installed in a manner that will not allow deformation of the cable over time.

- .2 Unless specified otherwise, all cables shall be bundled and supported to the walls at maximum intervals of 600 mm with Panduit J-mod system and Velcro type straps.
- .3 Do not deform the cable jacket, specifically when using cable fasteners or ties.
- .4 When installing Communications cables in long vertical drops in a building, the bundle of cables shall be rotated horizontally 180° every fourth floor.
- .5 J-Hooks should not be utilized in new buildings or large scale renovations. J-Hook usage is reserved for small renovations or localized additions where it is not economically feasible to install the preferred forms of pathway.

3.8 **BIX CONNECTORS**

- .1 The Contractor shall install GigaBIX distribution rings to support jumper wire, in a configuration that allows for the future expansion of the bix field. See ITSTD-13 for details.
- .2 Only BIX punch tools shall be used when terminating cables on GigaBIX connector.
- .3 Multi-pair cable bundles entering GigaBIX mounts and the hinging of GigaBIX connectors shall be on the jumper side of the mount.
- .4 Backbone 25-pair UTP cables from the same Communication room must be grouped together and terminated sequentially on the GigaBIX connectors; group the cables from each Communications room together. Once the first riser is terminated and numbered, every other riser in its group continues the number sequence.
- .5 Backbone 4-pair UTP/STP cables are not to be installed unless directed by UBC IT.
- .6 Horizontal 4-pair UTP/STP cables are terminated with a maximum of six (6) cables per GigaBIX connector.
- .7 Space for the protectors shall be provided to the left of the GigaBIX connector mounts.

3.9 **FIBRE OPTIC INSTALLATION**

- .1 All fibre optic cable system work completed by the Contractor must meet quality approval as stipulated by the UBC Information Technology Representative and consulting Engineer. The following requirements must be met to gain system acceptance.
 - .1 Receive, check, unload, handle, store and adequately protect equipment and materials to be installed as part of the Contract. In existing buildings, store in areas as directed by the UBC Information Technology Representative and Consulting Engineer. Installation includes setting in place, fastening to walls, floors, ceilings, cabinets or other structures where required, interconnecting cabling of system components, equipment alignment and adjustment and other related work whether or not expressly defined herein.
 - .2 Install materials and equipment in accordance with applicable standards, codes, requirements and recommendations of national, provincial and local authorities having jurisdiction and with manufacturers' printed instructions.
 - .3 Adhere to manufacturers' published specifications for pulling tension, minimum bend radii and sidewall pressure when installing cables.
 - .4 The typical fibre backbone cables shall consist of a single 24 strand single mode

cable. All fibre shall be terminated using SC UTP connectors or SC UTP pigtails. Only pre-polished connectors will be accepted, UBC will not accept on site polished connectors. There shall be spot inspections by the UBC Information Technology. Any re-termination is done at no cost to UBC.

- .5 No manual fusion splicing shall be performed.
- .6 Fibre cable preparation, pigtail routing, and forming within the splice or distribution panel shall be as per manufacturer printed instructions.
- .7 When splicing, all 900um fibre strands transitioning from cable sheath to splice tray and splice tray to bulkheads must be bundled inside protective tubing.
- .8 After testing is complete all connector end faces will receive a final cleaning with a Cle-top or equivalent cleaning device. Alcohol wipes shall not be used.
- .9 Dust caps must be present and installed on all fibre connectors and adapters that are not properly mated.

3.10 **TERMINATIONS**

- .1 All cables shall be terminated in Communication rooms and at Communications outlets.
- .2 The Contractor will not leave any cables un-terminated unless directed to do so by UBC Information Technology.

3.11 **TESTING**

- .1 Category 6A UTP/STP testing shall conform to current ANSI/TIA/EIA-568-C Standard. Every cabling link in the installation shall be tested to the most current version of the ANSI/TIA/EIA Standard. Testing shall be accomplished using a CommScope Approved field tester with the appropriate permanent link adapters. Permanent link testing procedures shall be used to certify the system.
- .2 25-pair Category 3 backbone cable testing shall consist of testing each cable pair for opens, shorts, grounds, crosses and pair reversal. Only a 100% pair pass rate will be accepted.
- .3 Initially test every fibre within the fibre optic cable with a light source and power meter utilizing procedures as stated in TIA/EIA-526-14-A. Measured results shall be within manufacturers' loss budget calculations. If loss figures are outside this range, test cable with optical time domain reflectometer to determine cause of variation. Correct improper splices and replace damaged cables or connectors at no cost to UBC.
 - .1 Cables shall be tested at 850 nm and 1300 nm for multimode fibre optic cables.
 - .2 Testing procedures shall utilize "Method 1" – one jumper reference.
 - .3 Bi-directional testing of optical fibres is required.
- .4 Random testing on all cabling mediums shall be done by UBC. Where any portion of the system does not meet the specifications, the Contractor shall correct the deviation and repeat all applicable testing at no additional cost to UBC.
- .5 Supply a complete set of electronic test results for all UTP/FTP and fibre optic tests performed.

- .6 After testing is complete all connector end faces will receive a final cleaning with a Cle-top or equivalent cleaning device. Alcohol wipes shall not be used.
- .7 Dust caps must be present and installed on all fibre connectors and adapters that are not properly mated.

END OF SECTION 27 05 08

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 WARRANTY OVERVIEW
 - 1.4 MANUFACTURER CERTIFICATION
 - 1.5 WARRANTY COVERAGE

1.3 WARRANTY OVERVIEW

- .1 The structured cabling Manufactures 25-year performance warranty shall be applied to all work performed. All manufacturer warranties shall be transferred to the Owner.
- .2 The warranties of each item shall be listed and submitted along with shop drawings to the Information Technology Representative.
- .3 Detail specific items, or equipment components that are subject to separate conditional warranties. Warranty proprietary equipment and systems involved in contracts during the guarantee period.
- .4 The Contractor shall supply to the Information Technology Representative a Certification Document issued by the cable/component manufacturer stating that the Category 6A structured cable system is proven to be performance compliant and covered under the manufacturer warranty.
- .5 The Contractor must also provide a Category 6A certificate issued by the cable/component manufacturer guaranteeing data transmission performance to support gigabit (1000Base-T) Ethernet applications for a period of 25 years.
- .6 Final payment shall not relieve the Contractor of these obligations.

1.4 MANUFACTURER CERTIFICATION

- .1 The Manufacturer certification must guarantee:
 - .1 That the cable design and installation delivered by the Consulting Engineer and Contractor, will not negate or void any part of the certified system.
 - .2 That all materials and labour are covered for the full certification period.
 - .3 Should the Contractor cease to be in business, the full certification remains valid.

1.5 WARRANTY COVERAGE

- .1 The Warranty coverage shall, as a minimum, include:
 - .1 Warranty against defects in materials and workmanship from the date of installation.
 - .2 25 years coverage.
 - .3 Repair or replacement of a failed component, covering materials and labour, at no cost to the Owner.
 - .4 Single point of contact for all warranty services.
 - .5 Upon request and without cost to UBC the Manufacturer must make available it's Technical Representative to conduct site visits and inspections to ensure complete technical compliance of the installed system.

END OF SECTION 27 05 09

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 DESCRIPTION OF WORK
 - 1.4 REFERENCE
 - 1.5 STATUTORY AUTHORITY – ELECTRICAL SAFETY
 - 2.0 PRODUCTS
 - 2.1 COMPONENTS
 - 3.0 EXECUTION
 - 3.1 INSTALLATION

1.3 DESCRIPTION OF WORK

- .1 Grounding and bonding practices at UBC shall comply with all applicable codes.
- .2 All new Communications metallic raceway shall be bonded to the Telecommunications Main Grounding Busbar (TMGB) in Main Communications Room or Telecommunications Grounding Busbar (TGB) in Local Communications Rooms.
- .3 In existing buildings, bond all existing Communications metallic raceway to be reused or modified to the nearest TMGB or TGB.
- .4 All power, service, and communications grounds shall be bonded. Bonding conductors shall be as short as possible and routed with a minimum of bends. All bends made on the conductor shall be sweeping bends.
- .5 Where practicable, all bonding conductors shall be installed without a splice. Where a splice is necessary, it should be accessible and located in a communications space. Conductors shall be spliced using irreversible compression-type connectors, exothermic welding, or equivalent. All joints shall be adequately supported and protected.
- .6 Bonding connections shall be made with bolts, crimp connectors, clamps, or lugs specifically designed for the purpose.
- .7 The following bonding conductors shall be connected to the TMGB
 - .1 The metallic jacket of all entrance cable,
 - .2 Cable protectors.
- .8 The following ground conductors shall be connected to the nearest TGB:
 - .1 All Communications metallic raceways,

- .2 The metallic jacket of shielded Intra or Inter -building backbone cable.
- .3 Equipment racks.
- .4 The shields of all FTP / STP communications cables where they appear in all communications rooms/ closets/ remote cabinets or consolidation points. The field ends of these cables are not to be bonded to ground.
- .9 The Communication grounding and bonding shall be independent from the building ground system except for a single connection between the to the main Electrical room ground busbar.

(Refer to Standard Drawings ITSTD-16, ITSTD-17)

1.4 **REFERENCE**

- .1 Canadian Electrical Code, Part 1.

1.5 **STATUTORY AUTHORITY – ELECTRICAL SAFETY**

- .1 Current Canadian Electrical Code, Part 1.
- .2 Current B.C. Electrical Code Regulation.

2.0 **PRODUCTS**

2.1 **COMPONENTS**

- .1 Main Communications Room: Copper busbar – (TMGB), c/w two (2) 50 mm insulated standoffs, with a minimum dimension of 100 mm wide X 300 mm long X 6 mm thick.
- .2 Local Communications Room: Copper busbar (TGB), c/w two (2) 50 mm insulated standoffs, with a minimum dimension of 50 mm wide X 300 mm long X 6 mm thick.
- .3 Cabinet bonding will be achieved with the use of a vertical bonding strip mounted on the front rail between equipment and cabinet rail.

Panduit RGS134-1Y or equivalent.
- .4 All busbars shall be pre-drilled with standard NEMA 10-32 bolt hole. Allow space for the connectors used.
- .5 Bonding conductor shall be green PVC jacketed, stranded copper, soft conductor, unless otherwise noted. (bare #6 AWG. in cable tray) Unless installed in conduit system, bonding conductor jacket shall be minimum CMR rated.
- .6 All bonding conductors and connectors shall be approved as defined in CSA C22.1.
- .7 Bonding conductors shall be identified on both ends of the conductors, with data plate cable marker complete with double straps, to indicate where the destination end of the conductor is located, such as 'Comm. Rm. 011' or ' Cable tray in Rm. 123'.

- .8 All FTP /STP communications cables will have appropriate matching connecting hardware (patch panels, jacks) that preserve the bonding continuity from the cable shield through to the bonding conductor of the rack / cabinet/ closet/ remote cabinet / or consolidation point.

3.0 **EXECUTION**

3.1 **INSTALLATION**

- .1 Install a complete, permanent, and continuous bonding and grounding system for Communications infrastructure and, equipment, including all necessary conductors, connectors and accessories, as indicated in IT drawings and this document, and to conform to requirements of Provincial Electrical Inspection Department and Canadian Electrical Code.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 The TMGB shall be connected to the building main Electrical ground busbar with a # 1/0 AWG green PVC jacketed stranded copper conductor.
- .4 All TGB's shall be connected to the TMGB with a #2 AWG green PVC jacketed stranded copper conductor installed in conduit.
- .5 Label conduit every 3 M with the description: "Communication Ground Only".
- .6 Bonding conductors placed in metallic conduits longer than one meter must be bonded to each end of the conduit with the appropriate bonding bushing.
- .7 Where the Communication rooms are stacked then the bonding conductor shall be a common riser bonding conductor for connection to the stacked Communication rooms.
- .8 In all cases the bonding conductors shall always be larger to smaller gauge from the building main Electrical busbar out to the last TGB.
- .9 Where Communication rooms are not stacked then install a separate bonding conductor from the MCR to LCR.
- .10 Bonding conductors shall be fixed to the walls and neatly formed around the perimeter of rooms.
- .11 A bonding busbar shall be placed in the center of the terminal wall in each Communication room, centered @ 250 mm AFF and mounted to the wall with insulating stand-offs. The location of the bus bar must not interfere with wall space designated for vertical riser cables or be mounted above or behind riser conduits and sleeves.
- .12 A lug shall be crimped to each end of the bonding conductor. Bonding conductors shall be bolted on the appropriate ground busbar with a 6 mm copper alloy bolt and nut.
- .13 Leave 6 spare connectors in the Main Communication room and 4 spare connectors in each Local Communication room.

- .14 Prior to attaching a lug to a painted or galvanized surface, the paint shall be scraped off to bare metal, to provide maximum contact. Flat washers and lock washers shall be used with the bolts.
- .15 Install a bare #6 AWG copper stranded conductor, in the entire length of surface raceway or cable tray and bond to the telecommunications grounding system.
- .16 The cable tray bonding conductor shall be bonded to cable tray by a bonding clamp at each straight length of tray regardless of length and each elbow and T-fittings.
- .17 All splices of bonding conductors shall be outside of the cable trays.
- .18 Conduits for individual outlet shall be bonded using a #12 AWG stranded insulated copper conductor from the conduit bonding bushing to the cable tray bonding conductor.
- .19 The metallic jacket of all inter-building cable shall be bonded with a #6 AWG green PVC jacketed stranded copper conductor at the jacket opening at both ends of the cable, using a bonding clamp designed for the cable used.
- .20 The metallic jacket of metallic shielded intra-building backbone cable shall be bonded with a #6 AWG green TW jacketed stranded copper conductor at the jacket opening, using a bonding clamp designed for the cable used.
- .21 Cable protectors shall be bonded with a #6 AWG green TW jacketed stranded copper bonding conductor.
- .22 Communication equipment shall be bonded through power receptacle's ground conductor
- .23 Equipment Racks and metal items in the Communication rooms shall be bonded to the appropriate ground busbar. Power panels and outlets in Communication rooms will be bonded to their supply side only.
- .24 All Communication conduit and tray leaving the Communication room shall be bonded at the supply side only.
- .25 There shall be no interconnecting bond wires between local Communication rooms on the same floor level.
- .26 All Communication outlet boxes and conduits shall be bonded via the communications bonding infrastructure.
- .27 Install #12 AWG insulated stranded copper bonding conductor to Wiremold surface raceway and bond to the building and telecommunications grounding systems for joint-use power and Communications applications. Bond to telecommunications grounding system if the raceway is dedicated only for Communications use.
- .28 Protect exposed bonding conductors from mechanical damage.

END OF SECTION 27 05 26

1.0 GENERAL

- .1 This document describes the allowances and restrictions for Communications Pathways

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 REFERENCES
 - 1.4 CUTTING AND CORING
 - 1.5 ENTRANCE, INTERCONNECTING, RISER PATHWAYS
 - 1.6 INTERIOR PATHWAYS
 - 1.6.1 General
 - 1.6.2 Pull Boxes
 - 1.6.3 Locations of Outlets
 - 1.6.4 Mounting Heights
 - 1.6.5 Avoiding Electromagnetic Interference (EMI)
 - 1.6.6 Cable Trays
 - 1.6.7 Zone Conduit Pathways
 - 1.6.8 Conduits
 - 1.6.9 J-Hooks
 - 1.7 SURFACE RACEWAYS
 - 1.8 COMMUNICATION SYSTEM OUTLET BOXES
 - 1.9 COMMUNICATION SYSTEM OUTLET PLATES

1.3 REFERENCES

- .1 Current Canadian Electrical Code
- .2 Current B.C. Electrical Code

1.4 CUTTING AND CORING

- .1 All cutting and coring will be completed by an appropriate contractor or trade. The cutting and coring work will be coordinated with the General Contractor of the project.
- .2 Any cutting and coring work outside of a project with a General Contractor will be approved by UBC IT before proceeding.

1.5 ENTRANCE, INTERCONNECTING, RISER PATHWAYS

- .1 Entrance ducts, interconnecting ducts, riser ducts, and any floor penetrating conduits in all communication rooms shall be positioned against a wall and not interfere with any open floor space as depicted in ITSTD-06. The exact location shall be verified with UBC

Information Technology Representative before installation. The use of a pull pit in the communication rooms is not acceptable. (Refer to Section 27 05 05).

- .2 The riser system connecting the stacked Communications rooms shall consist of a minimum of a four (4) 100mm Hilti Gang plate / speed sleeve system (preferred) or as indicated on drawings for communications cable use. Security cable and other approved systems cable fill requirements are not accounted for within these 4 sleeves as they are dedicated to Communications cable fill.
- .3 Hilti Gang plate / speed sleeve system will protrude above floor level as the system installation practice dictates. Ducts shall protrude exactly 100 mm above finished floor level and shall be encased in concrete.
- .4 Riser ducts connecting vertically stacked rooms may consist of a schedule 40 steel sleeve that protrudes exactly 50 mm through the ceiling of the lower room and exactly 100 mm through the floor of the upper room. If possible, use the preferred Hilti Gang plate/ Speed sleeve system. The resulting gap will be bridged with vertically mounted flex/ basket tray over plywood.
- .5 When sleeves are used, use schedule 40 steel pipe sleeves for penetrations through exterior masonry/concrete walls and foundations, concrete floor slabs on grade and above grade, and concrete-filled decks.
- .6 After installation of the inter-building cables in the Main Communication Room, the ducts shall be sealed with an approved re-enterable sealing material if not using the Hilti Speed Sleeve system.

1.6 INTERIOR PATHWAYS

.1 General

- .1 The Contractor shall supply and install a system of cable raceways consisting of a combination of cable tray, zone conduit, pull boxes and drop conduit. The cable trays or zone conduits extend horizontally from the Communications rooms, down the hallways or corridors to become the main zone pathway to support communication structured cable system. Each Communications outlet shall be connected to the nearest cable tray or zone pull box with dedicated drop conduit. J-hooks are not be used on major large scale renew, renovation, or new construction projects unless a specific situation warrants their use and this must be specifically allowed by UBC IT. Zone conduit pathway will not be shared with other systems i.e. security or BMS, when in new construction.
- .2 Where raceway size is not specified, the raceway shall be sized to not exceed a 40% fill ratio after all communications cables are installed including shared access non-IT cable systems that have been installed by others (for example Security cables). Where there are zero bends in the raceway, the fill ratio may be increased to 50%.
- .3 Where isolated renovations are re-using existing building pathways – cable overfill situations can be acceptable depending on the circumstances, as this is the

expected use case of the building zone pathway systems. Each situation will be reviewed and approved by UBC IT representative as needed.

- .4 All raceway, including J hooks shall be installed parallel to the building lines, keeping cable run length at an absolute minimum.
- .5 A pull tape shall be left in all raceways after installation of the cables. Pull tape shall be Greenlee 4435 or approved equal.
- .6 The minimum pathway size will be 27mm regardless of fill ratio except as allowed in 1.4.8.
- .7 Connecting outlet boxes together without the use of appropriately sized zone conduit and pull boxes or "daisy chaining" is a practice that is restricted to special circumstances and will only be employed with the approval of UBC IT.
- .8 All empty communication raceway shall be clearly and permanently marked at both ends to indicate belonging to the communications system. Green paint stripes are used to indicate communications.
- .9 Provide approved dedicated pathway for installed cables that vertically drop to a cable tray location when that location is without wall support.
- .10 In open office environments, the preferred method of extending the conduit from the outlet to the cable tray is via perimeter walls. If this is not possible then use Pac poles or run in "pony" walls.
- .11 All hangers, supports and brackets shall be provided and installed to be consistent with the requirements of the B.C. Building Code. On walls inadequate to support the equipment, provide angle or channel iron supports to bear the equipment weight, independent of the wall or conduit.
- .12 Provide seismic bracing for all communications infrastructure, communications equipment and components where required. If seismic bracing is supplied, provide a seismic restraint structural review of all elements which form part of the communications infrastructure installation. A structural engineer registered with the APEGBC must sign and seal the report.
- .13 Use only fire-rated listed assemblies for the type of sleeve being installed through CMU walls or gypsum walls for Communications penetrations. Sleeve type shall be the preferred Hilti Gang plate / Speed Sleeve system or alternatively electrical metallic tubing. (See 27 05 07)

.2 Pull Boxes

- .1 Unless otherwise specified, the minimum size of a pull box shall be 300 mm X 300 mm X 150 mm deep. UBC Information Technology Representative shall be consulted in all cases.
- .2 All pull boxes will be sized appropriately to adequately accommodate the number of conduits entering and leaving and respect the bend radius of intended cables,

at the time of installation. Pull boxes in unusual locations will also be sized in a manner that allows for the number of conduits and additionally sized to compensate for any access restrictions, if possible, i.e. – a longer box than is strictly necessary for number of connected conduits will afford extra accessibility and allow for easier installation of cables due to the access restrictions present.

- .3 All pull boxes must be positioned and installed in such a way that they are within 1 m of an accessible ceiling area or hatchway. Conversely an access hatch must be provided within 1 m of each installed pull box that is located in an inaccessible area.
- .4 Access hatches should be located in service access areas wherever possible.

.3 Location of Outlets

- .1 Locations of outlets are determined in part through a consultation process between UBC IT and the client in addition to industry standard practice. UBC IT consultation process must be incorporated in the production of any structured cabling system design.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Changes to location of outlets at no extra cost or credit, provided distance does not exceed 1 M, and information is given before installation.

.4 Mounting Heights

- .1 Mounting height of infrastructure is from finished floor to centre line of equipment unless specified or indicated otherwise.
- .2 If mounting height of infrastructure is not specified or indicated, verify with consultant before proceeding with the installation.
- .3 Install infrastructure at the following heights unless indicated otherwise:
 - .1 Wall electrical receptacles for IT use:
 - .1 General: 300 mm or match mounting height of existing receptacles.
 - .2 Communication room: 300 mm or match mounting height of existing receptacles.
 - .3 Above top of continuous baseboard heater: 200 mm
 - .4 Above top of counters or counter splash back: 150 mm
 - .5 In mechanical rooms: 1067 mm
 - .2 Voice/data outlets:

- .1 above finished floors – generally 300 mm, or match mounting height of existing voice/data outlets
- .2 above counters splash backs - 150 mm.
- .3 residential bedrooms: 850 mm

.5 Avoiding Electromagnetic Interference (EMI)

- .1 Installations of communications cable pathways must avoid close proximity to potential sources of electromagnetic interference (e.g., motors and transformers that share distribution space, copiers used in work areas).
- .2 To avoid electromagnetic interference the following minimum clearances shall be provided:
 - .1 clearance of 1200 mm from large motors or transformers.
 - .2 clearance of 300 mm from conduit and cables used for electrical power distribution.
 - .3 clearance of 120 mm from fluorescent lighting or UTP cabling manufacturer installations guidelines, whichever is greater
 - .4 Pathways should cross perpendicular to fluorescent lighting and electrical power cables and conduits or preferably avoid the areas entirely

.6 Cable Trays

- .1 Provide cable trays in approximate location and general routing as shown on drawings – optimize routing to minimize cable lengths and provide best access for future installations.
- .2 Cable trays are usually installed in the false ceiling space of hallways and located to keep conduit lengths to a minimum. When raceway is not installed in a readily accessible false ceiling space, access hatches shall be installed at a nominal spacing of 9 Meters. Additional access hatches must be provided at all sections of tray where a change of direction occurs. Additional hatches must be provided wherever there are drop conduits intersecting the tray.
- .3 Zone cable trays that will be installed through ceilings of classrooms that carry cables servicing areas outside and beyond the classroom itself, must be installed so that cables can be pulled through and past the classroom without needing to access the ceiling of that classroom. The intent is to allow future servicing without disturbing the class in session, while also avoiding after-hour servicing requirement. In essence the cable tray is to be installed in a straight line, through

the classroom with no bends or changes in elevation or interruptions, with access to the tray from the adjoining spaces. Multiple classrooms as adjoining spaces will simply lengthen the straight section of cable tray spanning across all classrooms. Alternative solutions will be considered in consultation with UBC IT.

- .4 Conduits and cables containing line voltage conductors (including branch circuit wiring) shall not be supported from the same supports used for communication cable trays or from the communication cable trays themselves.
- .5 Provide cable support tray dropouts at locations where cables exit the cable tray and the combined weight of the cables can cause deformation in any of the cables in that bundle.
- .6 Cable trays should be installed continuously in the required direction and dimensions to form a continuous and connected tray system as per the manufactures guidelines where appropriate. Disjointed sections of tray are not considered connected simply due to proximity. All elevation changes, tee connections, drop outs, and bends will be constructed as per manufacturer instructions and intentions.
- .7 See Section 27 05 07 for fire stop of tray penetrations at fire rated walls and floors.
- .8 Trays shall be positioned to allow the best access for future installations and minimize cable lengths. If during construction, tray section becomes inaccessible due to congestion, UBC IT must be notified and corrections must be implemented.
- .9 A minimum of 300mm clearance must be maintained above the overall length of an installed cable tray. Short sections of tray can have reduced clearance provided the tray does not change direction in the section with limited clearance. Along its length, one side of an installed cable tray must be accessible with enough space for the head and shoulders of an installer.
- .10 Cable trays shall not be penetrated or impeded by other services. Cable tray capacity must not be diminished by other systems. If during construction, tray sections become obstructed due to infringement by other systems, UBC IT must be notified and corrections must be implemented.
- .11 Sharp metal edges in cable trays which could cut the cable shall be smoothed and or covered. Cables will be dressed away from these edges.
- .12 Canstrut, Flex, or basket cable tray and fittings are specified, others may be accepted with UBC IT pre-approval before installation.
- .13 Connect the new cable tray system to the existing cable tray (if exists). Re-work existing tray ends to suit tie-in.

.7 Zone Conduit Pathways

- .1 It is acceptable to install an appropriately sized zoned conduit and pull-box system instead of cable tray. Zone conduits are not to be shared with other system's cables i.e. security or BMS when it is in new construction. Other systems will require their own zone conduits for their cable installations; however appropriately sized zone pull boxes can be shared.
- .2 Zone conduit is defined as any conduit that connects one pull box to another pull box or connects to a pull box with more than one communications outlet connected to that pull box.
- .3 Minimum zone conduit size is 35mm with a cable fill ratio of 40%, typically this equates to 8 - Cat6A cables.
 - .1 UBC IT recommends the use of the CommScope Cable fill calculator tool located at the CommScope web site - <https://calcpathways.commscope.com/>
- .4 Minimum zone conduit pull box size is 300mm x 300mm x 150mm.
- .5 Zone conduit installations are required to have:
 - a maximum of 9000 mm between pull boxes.
 - a combined maximum of 180 degrees in bends and offsets between pull boxes.

.8 Conduit

- .1 This section applies to all communications conduits, regardless if used for zone, drop, demark, or other applications.
- .2 Conduit shall be EMT or rigid steel except for special cases where floor boxes must be fed with in slab conduit. (See 1.6.8.11)
- .3 Where no specific allowance is made or no description offered, the default minimum conduit size shall be 27 mm.
- .4 All conduits shall have sweeping bends with inside radius being no less than six (6) times the internal diameter of the conduit. For conduit 50mm or larger, the radius shall be no less than ten (10) times the internal conduit diameter
- .5 All conduit installations are required to observe:
 - a maximum of 9000 mm between pull boxes.
 - a combined maximum of 180 degrees in bends and offsets between pull boxes.
 - must not be installed in slab

- .6 Outlet boxes are not to be directly connected together with conduit i.e. – ‘daisy chaining’. Zone conduit and pull boxes must be used to feed outlet boxes individually – even when the outlet boxes are laid out in series or in difficult locations.
- .7 An allowance for the use of 21mm conduit for communications pathways is acceptable in these specific situations:
 - drop conduit to outlet boxes in residential bedrooms
 - drop conduit to outlet boxes in single occupant offices
 - drop conduit to outlet boxes for building service demarcations - if services are not combined together in the same outlet box - i.e. elevator, meters, fire alarm
- .8 LB type fittings are not acceptable for communications pathways. Use of a pull box in these situations will allow for a tight corner transition and provide the proper bending radius.
- .9 Coreline conduit type is not acceptable at any time and is not to be used for UBC IT pathways on campus.
- .10 Flexible metal and PVC jacketed flexible metal conduit shall not be used unless allowed by the UBC Information Technology Representative.
- .11 In slab conduit is not acceptable, except when supplying floor boxes where conduit poke through to the floor below is not practical. In this specific case, minimum 27mm ridged PVC will be accepted. Conduits are to leave the slab and rise up walls to ceiling spaces above or down to ceiling space below as soon as practical. Coreline product is not acceptable in any circumstances and is not to be used for IT pathways at UBC.
- .12 When cable trays are used, conduit shall be attached to the edge of the tray with a conduit bracket designed for this purposed. If this is not possible, conduits shall be stubbed within 150 mm above the tray and terminate in a bonding type bushing. All drop conduits must be bonded to the cable tray.
- .13 Where conduits meet a cable tray, they will be installed and routed so that the conduits end within 1 meter of an accessible ceiling area or hatchway or an access hatch must be provided for each conduit / tray intersecting location. Minimizing cable lengths will take priority over routing conduits to existing ceiling hatches.
- .14 Provide a maximum of 45-degree bends where conduits meet cable trays and cables are running free air from the conduits to cable trays. This will create a waterfall effect to reduce the strain on cables.
- .15 In rooms where conduits are installed on the surface of walls, locate them so as not to interfere with the installation of the white boards, wall details or other obstructions.
- .16 Conduits installed in new walls will be placed inside the wall cavity.

.9 **J-Hooks**

- .1 J-Hooks and hangers - when allowed by UBC IT, must be firmly affixed to or hung from building structure and shall not be affixed to or hung from building services, i.e. ducts, pipes, electrical conduits, sprinkler pipes, etc. J-Hooks and hangers will have a maximum spacing interval of 1.5m and a J-Hook or hanger must be present in the apex of each change of direction.

1.7 **Surface Raceways**

.1 General

- .1 Surface raceways must be specifically designed to accommodate high performance structured network cabling systems. Wiremold or Panduit surface raceway products may be used for voice and data outlets.
- .2 Where Wiremold raceway has been used on existing walls; continue to use the same make and model of Wiremold raceway.
- .3 Surface raceway and/or flush mount wall outlet in conjunction with flexible conduit can be used to feed modular furniture.
- .4 When the surface raceway is used to distribute power and communication cables, a manufactured barrier, separating communication cables from power cables shall be installed in the raceway.
- .5 For individual outlets where recessed conduit is not possible (i.e. exposed concrete walls) 27 mm surface raceway shall be used.

.2 Products

- .1 Where metallic raceway is required it shall be as manufactured by Wiremold. The colour shall match existing Wiremold installation. Where contradiction exists between colour noted on drawing and on site, the colour of onsite existing Wiremold shall take precedence.
- .2 Non-metallic surface raceway shall be manufactured by Panduit. Except as noted, colour of Panduit shall be off-white on painted surfaces and grey on unfinished concrete surfaces.

.3 Installation

- .1 The surface raceway shall parallel building lines and hug ceilings, baseboards, and corners. Raceway length shall be kept to a minimum.
- .2 The surface raceway base shall be mechanically fastened to walls and supporting structures. Use of double-sided tape alone is not acceptable. For non-metallic

surface raceway the maximum spacing of fastener is 500 mm. The recommended fasteners are as follow:

- .1 Masonry surface – Tapcon masonry type fastener, 6 mm diameter.
- .2 Dry wall with no stud – Toggle AF “Alligator type” anchor.
- .3 Dry wall with stud – Dry wall screw
- .3 The surface raceway shall maintain its integrity when passing through a wall or supporting structure. The raceway cover shall be cut 100 mm from either side of the penetration.
- .4 Surface raceway extending into the ceiling shall connect to the conduit extending from the cable tray with the appropriate fitting or pull box.
- .5 When installing surface raceway, manufactured bends and fittings must be used. Installation shall be in accordance with the manufacturer's instructions.
- .6 Wire clips shall be installed in two-piece surface raceway installations at 450 mm intervals. Additional wire clips shall be used when the raceway is secured to a ceiling or large amount of cables are installed.
- .7 When installing cable in surface raceway, cable fill shall not exceed 40%.

1.8 Communications Outlet Boxes

.1 Wall Outlet Boxes

- .1 A Communications outlet is **defined as** the point at which the Communications equipment **i.e. computer, phone, building service panel**, is connected to the University networks. The outlet consists of an outlet box and cover plate, connecting conduit, **potentially** several jacks, and its connecting cables.
- .2 **All communications outlet boxes will connect directly back to cable tray or zone pull box utilizing the default 27mm size conduit at a minimum unless specifically allowed.**
- .3 **These specific outlet box types may use 21mm conduit directly connected back to cable tray or zone pull box as per 1.6.4.7.of this document:**
 - Residential bedrooms
 - Single occupant offices
 - Building service demarcations if not combined together - i.e. elevator, meters, fire alarm
- .4 Unless specified on the drawings all outlet boxes will follow this selection matrix:

Cable count	Box type	Gang count	Mud ring size
1 Cable	4x4 or MBD	1	single
2 - 6 cables	4x4 or MBD	2	double
7 - 9 cables	MBD	3	N/A
10 - 14 cables	MBD	4	N/A
More than 14 cables require multiple boxes			

- .5 Communications outlets that are considered demarcation points are not required to have faceplates as bare jacks conserve space and allow for box covers to be installed. In addition, a 4x4 box is the default selection and use of MBD boxes is discouraged.
- .6 Flush mounted outlet boxes shall be mounted flush to the surface of the wall and all gaps at the edges of the outlet box shall be filed and finished before the installation of the faceplates. Filling and finishing of walls to installed faceplates is not to be used as a typical practice.
- .7 Communications outlets shall be located so that the equipment will be no further away than 5 Meters from the outlet as per current TIA/EIA Standards.

.2 Floor Outlet Boxes

- .1 Floor boxes must be specifically designed to accommodate high performance communications structure cable systems.
- .2 Floor boxes must have Uniprise SLX Series compatible outlet mounting points.
- .3 Floor box selection must be confirmed with UBC Information Technology during the design phase.
- .4 Floor boxes will have a dedicated 27mm conduit for the sole use of UBC IT for Voice and Data services. Other systems (such as AV, Security, ect) must use separate pathway.
- .5 Floor boxes must have a code compliant separation from any electrical power systems installed in the same floor box.

.3 Outlet box products

.1 Flush-Mount Box

Each Communications outlet shall be housed in a deep masonry box with a depth of approximately 90 mm or a standard 4x4 box, as needed. . Approved low voltage Communications rings can be used where specified and approved by

UBC IT.

.2 Surface-Mount Box

Manufacturer:

Wiremold V5744-2 (dual-gang for use with conduits)

V2144-2 (dual-gang for use with V2100)

V3044-2 (dual-gang for use with V3000)

Hubbell HWPFS/CS/HBLF/CS series c/w cover (surface floor box)

Panduit JBP2D1W (132mmx132mmx70mm dual-gang for use with Panduit)

Or approved Equivalents

1.9 COMMUNICATION SYSTEM OUTLET PLATES

.1 General

- .1 Unless specified to the contrary, all outlet plates shall be plastic or stainless steel with appropriate cutouts and permanently marked designations, as specified in the outlet specifications of the related sections.
- .2 All stainless-steel outlet plates shall be an approved product of the cabling system in use.
- .3 Where plastic plates are specified they shall be the same colour as determined for the power outlets or Uniprise SLX Series Alpine White. Decora straps with plastic plates / stainless plates are interchangeable for solid plastic plates.
- .4 Ensure that total depth of raceway and outlet plate is sufficient for terminating category 6A cable and jacks.

.2 Execution

- .1 Unless specified otherwise, all communication outlets shall be flush mounted with the finished wall.
- .2 Communication outlets shall be mounted at the same height as power receptacles, except where otherwise noted.
- .3 All outlets shall be positioned to enable easy, unobstructed access.
- .4 All outlets shall be positioned to clear millwork and furniture.
- .5 Outlets shall be positioned in close proximity to the Communication equipment.
- .6 Surface Raceway and Rack Pole Mounted Outlets
 - .1 Outlets on large surface raceway shall be dual duplex or rectangular cutouts and not bushed holes.

- .2 Outlets in joint use surface raceway shall be single gang duplex, or rectangular cutouts and not bushed holes. They shall be mounted staggered with power outlets [if the system allows](#).
 - .3 When installing outlets in joint Power / Communications surface raceway, pack poles or modular furniture, each individual outlet requirement shall be maintained. i.e. where a dual gang outlet is specified two single gang outlets are required. Exact details will be determined on site with the UBC Information Technology Representative.
- .3 Modular Furniture Mounted Outlets
- .1 Modular furniture with pre-installed telecom cable is not acceptable.
 - .2 The two preferred methods of servicing IT in modular furniture are:
 - .1 Terminate [communications](#) cables in wall outlets near the modular furniture area - extend [with patch cords](#) through furniture to user work areas.
 - .2 If the modular furniture is specifically designed to accommodate high performance communications outlets, then the telecom cables can be extended through the furniture to the user work area.
 - .3 Pac poles must be split channel or dedicated low voltage.
 - .4 Pac poles must not contain IT outlets unless specifically designed to accommodate high performance communications outlets.

END OF SECTION 27 05 28

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 OVERVIEW
 - 1.4 PRODUCTS
 - 2.0 EXECUTION
 - 2.1 COMMUNICATION ROOMS
 - 2.2 UTP HORIZONTAL CABLE
 - 2.3 BACKBONE CABLING
 - 2.4 ENTRANCE CABLING

1.3 OVERVIEW

- .1 Unless specified otherwise, designation labels on outlet plates shall be printed on designation strips located behind label windows on plastic plates, as detailed in these and related specifications. Alternate methods must be submitted to the Information Technology Representative for approval. Lamacoid labels will not be accepted.
- .2 After terminating and identifying a Communications cable, each cable shall be identified with a unique cable number, as detailed in these and related specifications. A circuit (CCT) starting number and range will be provided to the contractor by the UBC Information Technology Representative. A sample database sheet for circuit (CCT) numbering is included in Appendix B. The Contractor shall follow the sample database format without any modification and provide one database file in same format for each building.
- .3 The Contractor shall supply a CCT spreadsheet produced from the UBC IT supplied sample spreadsheet file, to the UBC Information Technology Representative. This is to be done following termination of the voice and data cables within a communication room, and regardless if termination of field ends are completed or not. The spreadsheet shall identify whether an outlet is new, existing being replaced, or is part of special services such as an emergency phone, elevator phone, BMS, fire alarm monitoring, security, clock etc. The spreadsheet will also identify all Access Point cables with the designation "APx" where x is an incremental number related to the amount of AP locations integral to the job. As the Access point cables are installed in pairs, the two associated cables will be identified as paired to each other by setting the x variable to that same number. All AP cables that are connected to the site installed APs (as typically one cable in each pair is not connected) must include the UBC IT provided AP Radio Name (as indicated on each AP) in the alternate comment field of the CCT spreadsheet. In addition, all other special service cables should be identified in the comments field with a description of the special service. Some, but not all, examples of special services are cameras, fire alarm, elevator, clock, emergency phone, etc.

- .4 The Contractor will be responsible to correct any labeling errors that may result by pre-labeling the cables before submitting the CCT data sheet to the UBC IT representative for approval.
- .5 All Communication rooms will be assigned a unique terminal ID number (which is not the room number). The number will be displayed in the form of a stick-on plastic labels or 3D printed numbers (or negative numbers) as approved by the UBC Information Technology Representative. The numbers should be approximately 50 mm tall, proportionally scaled and in the case stickers, shall have permanent Blue or Black digits on a Yellow or Orange background. The Contractor shall install these labels in all Communication rooms to the satisfaction of the UBC Information Technology Representative. Alternative labels to be approved by UBC IT before use.
- .6 Before commencing the labeling, the Contractor shall supply samples of methods of labeling and materials used for approval by the UBC Information Technology Representative.

1.4 **PRODUCTS**

- .1 Labels for GigaBIX terminals.
- .2 Labels are supplied in sheets:

Green label	Entry connect	P0748012
Blue label	Horizontal 4-pr	P0748006
Purple label	Backbone 100-pr	P0748017
	Backbone 4-pr	P0748008
Brown label	Inter-building 100-pr	P0748018
	Inter-building 4-pr	P0748010
Grey label	2 nd level BB 100-pr	P0748019
	2 nd level BB 4-pr	P0748011

SUBSTITUTES ARE NOT ACCEPTED

2.0 **EXECUTION**

- 1. Review labeling methods and procedure with the Information Technology Representative prior commencement of labeling.
- 2. Labeling shall conform to standard Drawing ITSTD-32, 34, 63, 64 & 65.
- 3. Panduit numbered label strips or equal shall be approved by the UBC Information Technology Representative. The Contractor shall label each outlet with 9 mm black on white mechanical label.
- 4. The Contractor shall label each cable with permanent self-adhesive label with minimum, 3 mm high characters, in the following locations:
 - i. Inside outlet box at the work area

- ii. Behind the Communications room data patch panel, or voice punch down block.
- 5. The Contractor shall install colour-coded labels for each GigaBIX termination field on a BELDEN/CDT GigaBIX designation strip. BELDEN/CDT colored labels shall conform to ESTD drawings.
- 6. NORDX/CDT – IBDN labeling system is produced by SILVER FOX LTD.

2.1 COMMUNICATION ROOMS

.1 MCR / LCR TERMINAL ID ASSIGNMENTS

All Communication rooms shall have unique terminal numbers assigned:

B21 will be second basement level – representing 1st Communications Room.

B11 will be first basement level – representing 1st Communications Room.

001 will be ground level – representing 1st Communications Room.

011 will be 1st floor level – representing 1st Communications Room.

021 will be 2nd floor level – representing 1st Communications Room.

022 would then be 2nd floor level – representing 2nd Communications Room on that level.

2.2 UTP/STP HORIZONTAL CABLE

.1 Data

- .1 Data horizontal cable shall be identified at each termination with a unique number at the cable jacket end.
 - i.e. CCT001258-011-P1-4

CCT001258 Range supplied by UBC Information Technology
Representative

011 Represents assigned MCR/LCR Terminal ID

P1-4 Represents patch panel and jack position.

.2 Voice

- .1 Voice horizontal cables shall be identified at each termination with a unique number at the cable jacket end.
 - i.e. CCT001258-011-052
 - CCT001258 Range supplied by UBC Information Technology
Representative
 - 011 Represents assigned MCR/LCR Terminal ID.
 - 052 Represents GigaBIX connector cable position.
- .2 GigaBIX connector positions will increase sequentially without repeating starting with position number 1 and continuing through 72 then starting on the next frame with position 73, through position 144 then 145 to 216 and so on.
- .3 GigaBIX terminated cables with specific functions must include this function label on the GigaBIX label strip. i.e. – a GigaBIX terminated cable that services the

elevator phone must have the word 'Elevator' and the field end room number "Rmxxx" on the GigaBIX label in addition to the GigaBIX position. This would apply to all special services including, among others – elevator, fire alarm, BMS, security, clock, bell.

2.3 BACKBONE CABLING

.1 Data Copper

- .1 Typically UBC IT does not require Copper backbone cables for data purposes. When the Contractor has been instructed to install CAT 6A UTP/STP cables in the Backbone these cables shall be grouped in counts of six and identified on each cable and patch panel termination with a label and purple icons.

NOTE:

Backbone cables are grouped onto the same patch panel and not mixed with horizontal cable terminations patch panels. (Refer to Standard Drawing ITSTD-32)

- i.e. 011 Rm xxx to 012 Rm xxx Port1-6
 011 Rm xxx - represents MCR Terminal ID and room number
 012 Rm xxx - represents LCR Terminal ID and room number
 Port1-6 - represents which ports of the patch panel are included.

.2 Voice Copper

- .1 When the Contractor has been instructed to install multiples of 25 pair CAT 3 UTP cable in the Backbone from MCR to each of the LCR's, these Backbone cables shall be identified at both ends and on the GigaBIX designation strips. (Refer to Standard Drawing ITSTD-32)
- .2 On the GigaBIX designation strip in the Communications room, the Backbone cable pair count will be indicated starting with 01 and sequentially increasing until the end of that cable (typically 25). The pair count restarts for each cable.

i.e. 011 Rm xxx to 012 Rm xxx 25PR
 011 Rm xxx - represents MCR Terminal ID
 012 Rm xxx - represents LCR Terminal ID.
 25PR - represents the total pair count going to that room.

.3 Fibre

- .1 When the Contractor has been instructed to install fibre (24SM typical) cable from the MCR to each LCR, each end of the cable and termination panel will be labeled with a "From - To" Label. (Refer to Standard Drawing – ITSTD-32)

Fiber Cable Label and Fibre Panel Card Label

- i.e. 011 Rm xxx to 012 Rm xxx 24MM
 011 Rm xxx represents MCR Terminal ID
 012 Rm xxx represents LCR Terminal ID
 24MM represents 24 multi-mode strand cable

2.4 ENTRANCE CABLE

(Refer to Section 27 05 06 – by Others)

END OF SECTION 27 05 53

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 OVERVIEW
 - 1.4 WORK INCLUDED
 - 1.5 FIBRE QUALITY ASSURANCE
 - 1.6 FIBRE TESTING SCOPE
 - 1.7 TESTING OPTICAL FIBRE CABLE
 - 1.8 OPTICAL LOSS TESTING
 - 1.9 COPPER TESTING SCOPE
 - 1.10 TESTING CAT 6 INSTALLATION
 - 1.11 OPTIONAL REQUIREMENTS

1.3 OVERVIEW

- .1 The Contractor shall allow in the Tender for the presence of qualified test Personnel for all testing.
- .2 Test equipment shall be approved by the UBC Information Technology Representative in writing before it can be used to test the structured cabling systems.
- .3 Final details of all test parameters, scope, and methodology to be performed by the Contractor, as described in this Testing Section, shall be verified with the UBC Information Technology Representative.
- .4 All terminations shall be completed and all Communications equipment installed before the tests are performed.
- .5 The UBC Information Technology Representative shall determine at time of testing, and which terminations shall be included in the performance test.
- .6 UBC Information Technology reserves the right to monitor the testing process as it happens.
- .7 The UBC Information Technology Representative reserves the right to verify the Contractors' test results. In case of a discrepancy between the UBC Information Technology Representative's test results and the Contractor's test reports, then UBC Information Technology Representative's test results shall be considered accurate. In this instance, the Contractor shall correct any deficiencies at no cost to UBC.

1.4 **WORK INCLUDED**

- .1 Provide all labour, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.
- .2 In order to conform to the overall project event schedule, the cabling contractor shall monitor work progress and coordinate cable testing with other applicable trades.
- .3 In addition to the tests detailed in this document, the contractor shall notify the-UBC Information Technology Representative of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional test results at no additional charge.

1.5 **FIBRE QUALITY ASSURANCE**

- .1 All testing procedures and field-test instruments shall comply with applicable requirements of:
 - .1 All applicable ANSI TIA/EIA standards for safe use and testing of Fibre Systems
- .2 Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall be allowed to execute the tests. These must be issued by any of the following organizations or an equivalent organization:
 - .1 Manufacturer of the Fibre optic cable and/or the Fibre optic connectors.
 - .2 Manufacturer of the test equipment used for the field certification.
 - .3 Training organizations (e.g., BICSI)
- .3 A UBC Information Technology Representative shall be invited to witness and/or review field-testing.
 - .1 A UBC Information Technology Representative shall be notified of the start date of the testing phase five (5) business days before testing commences.
 - .2 The UBC Information Technology Representative will select and test a random sample of 5% of the installed links. The results are to be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the Installation Contractor under supervision of the UBC Information Technology Representative shall repeat 100% testing at no cost to the UBC.

1.6 **FIBRE TESTING SCOPE**

- .1 Initially test every strand within the fibre optic cable with a light source and power-meter utilizing procedures as stated in current ANSI/TIA/EIA standards. Measured results shall be within manufacturers' loss budget calculations. If loss figures are outside this range, test cable with optical time domain reflectometer to determine cause of variation. Correct improper splices and replace damaged cables or connectors at no cost to UBC Information Technology.
- .2 All tests performed on optical fibre cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with current ANSI standards.

- .3 All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work. The following test parameters shall be adhered to

:

- .1 Multimode fibre optic cables shall be tested at 850 nm and 1300 nm.
- .2 Testing procedures shall utilize "Method 1" – one jumper reference.
- .3 Bi-directional testing of optical Fibres is required.
- .4 Submit all fibre optic test results in electronic format for all fibre optic strand tests performed, in addition to the required hard copy.

1.7 **TESTING OPTICAL FIBRE CABLE**

- .1 Field-test instruments shall have the latest software and firmware installed.
- .2 Link and channel test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative (reports) may be generated.
- .3 If required, fibre end faces shall be optically inspected at 250X magnification. Scratched, pitted or dirty connectors shall be diagnosed and replaced at no cost to UBC.
- .4 End face images shall be provided electronically.
- .5 Testing shall be performed on each cabling segment (connector to connector).
- .6 Testing shall be performed on each cabling channel (equipment to equipment) that is planned for use as per Information Technology' instructions.
- .7 Testing of the cabling shall be performed using high-quality test cords of the same Fibre type as the cabling under test. The test cords for OLTS testing shall be between 1 m and 5 M length. The test cords for OTDR testing shall be at least 100 meters for the launch cable and at least 25 meters for the receive cable.

1.8 **OPTICAL LOSS TESTING**

.1 **Backbone Link**

- .1 Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method 1, One Reference Jumper or the equivalent method.
- .2 Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
- .3 Use the One Reference Jumper Method specified by current ANSI/TIA/EIA standards or an equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

.2 **Horizontal (multimode) link**

- .1 The horizontal optical Fibre cabling link segments need to be tested at only one wavelength. The horizontal link should be tested at 850 nm or 1300 nm bi-

directional in accordance with current ANSI/EIA/TIA standards or the equivalent method.

.3 Centralized (multimode) link

- .1 The centralized optical Fibre cabling link segments need to be tested at only one wavelength. The centralized link should be tested at 850 nm or 1300 nm bi-directional in accordance with current ANSI/EIA/TIA standards or the equivalent method.

1.9 COPPER TESTING SCOPE

- .1 Category 3 Intra and Inter backbone cable testing shall consist of testing each cable pair for opens, shorts, grounds and pair reversal. Only a 100% pair pass rate will be accepted.
- .2 Random testing on all cabling mediums shall be done by the UBC Information Technology Representative. Where any portion of the system does not meet testing specifications, the Contractor shall correct the deviation and repeat all applicable testing at no additional cost to the Information Technology.
- .3 The following items shall be submitted to UBC Information Technology Representative upon completion of testing the installed cables:
1. Supply a complete set of UTP/STP test results in electronic format.

1.10 TESTING CATEGORY 6A INSTALLATION

- .1 Category 6A UTP/STP testing shall conform to current ANSI/ TIA/EIA - T568-C standard. Testing shall be accomplished using a CommScope approved Cable Analyzer field tester with appropriate permanent link adapters. Permanent link testing procedures shall be used to certify the system.
- .2 All links must attain a "PASS" certification, unless otherwise released from this requirement by the UBC Information Technology Representative.
- .3 Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall be allowed to execute the tests. Appropriate training programs are limited to installation certification programs provided by BICSI and its authorized training partners, the Association of Cabling Professionals (ACP) and recognized cabling manufacturers in the industry.
- .4 The tester shall be within the calibration period recommended by the tester manufacturer in order to achieve the vendor-specified measurement accuracy and be acceptable to UBC Information Technology.
- .5 All FTP Category 6A cable test results must show continuity of shield from end to end.

1.11 OPTIONAL REQUIREMENTS

- .1 A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase 5 business days before testing commences.
- .2 A UBC Information Technology Representative will select a random sample of 5% of the installed links for testing and storing the results in accordance with the prescriptions in

the current TIA/EIA Standard. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of UBC Information Technology Representative shall repeat 100% testing at no cost to UBC.

END OF SECTION 27 08 00

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 OVERVIEW
 - 2.0 CATEGORY 3 VOICE INTRA BACKBONE CABLES
 - 2.1 CATEGORY 6A DATA INTRA BACKBONE CABLES
 - 2.2 DATA FIBRE INTRA BACKBONE CABLES
 - 2.3 FIBRE OPTIC CABLES

1.3 OVERVIEW

- .1 The backbone configuration shall be a two-level hierarchical star structure with separate dedicated cables from the Main Communication Room to each Local Communication Room.
- .2 In a Main Communication Room (MCR), Intra Backbone cables shall be bundled separately from Entrance and Horizontal cables.
- .3 In a Local Communication Room (LCR), Horizontal cables shall be bundled separately from Intra Backbone cables.
- .4 Where it is specifically noted that a Backbone cable is not terminated in a Communication Room, a minimum of 5 meters slack shall be left. The starting point of measurement shall be defined at time of installation by the Information Technology Representative.

2.0 CATEGORY 3 VOICE INTRA BACKBONE CABLES

- .1 Voice backbone cabling consisting of multiples of 25 pair Category 3 unshielded twisted-pair shall be installed by the Contractor, from the Main Communication Room (MCR) to each zone LCR as directed by the Information Technology Representative.
- .2 Multi-pair cable bundles entering GigaBIX mounts and the hinging of GigaBIX connectors shall be on the jumper side of the mount.
- .3 Backbone Category 3, 25-pair UTP cables from the same communication room must be grouped together and terminated sequentially on the GigaBIX connectors; group the cables from each communications room together. Once the first riser is terminated and numbered, every other riser in its group continues the number sequence. (Refer to Standard Drawing ITSTD-32 & 64.)
- .4 Wall space for the lightning protectors shall be provided to the left of the GigaBIX mounts. (Refer to Standard Drawing ITSTD-06)

2.1 CATEGORY 6A DATA INTRA BACKBONE CABLES

- .1 Data backbone cabling consisting of Cat6A cables is not to be used unless specifically requested by UBC IT.

2.2 DATA FIBRE INTRA BACKBONE CABLES

- .1 Data backbone cabling consisting of a minimum of 24 strand – OS2, 8.3/125 single-mode optical fibre cable shall be installed from the MCR to each LCR. (Refer to Standard Drawing ITSTD – 32 & 63)

2.3 FIBRE OPTIC CABLES

- .1 All fibre optic cable system work completed by the Contractor must be approved by the UBC Information Technology Representative.
- .2 The following basic requirements must be met to gain system acceptance:
 - .1 Receive, check, unload, handle, store and adequately protect equipment and materials to be installed as part of the Contract. Store in areas as directed by the Information Technology Representative or General Contractor. Installation includes setting in place, fastening to walls, floors, ceilings, or other structures where required, interconnecting wiring of system components where specified, equipment alignment and adjustment and other related work whether or not expressly defined herein.
 - .2 Install materials and equipment in accordance with applicable standards, codes, requirements and recommendations of national, provincial and local authorities having jurisdiction and with manufacturers' printed instructions.
 - .3 Adhere to manufacturers' published specifications for dressing spliced fibre pigtails in fibre panel, pulling tension, minimum bend radii and sidewall pressure when installing cables.
 - .4 No manual fusion splicing shall be performed.
 - .5 Fibre cable preparation, pigtail routing, and forming within the splice or distribution panel shall be as per manufacturer printed instructions.
 - .6 When splicing all 900um fibre strands transitioning from cable sheath to splice tray and splice tray to bulkheads must be bundled inside protective tubing.
 - .7 Acceptable SM terminations are:
 - Preferred solution - Corning CCH Cassette with Pigtails – SC connector
 - Corning Unicam pre-polished stub – SC connector (for service/ repair only)
 - Pigtail with Corning glass – SC connector

END OF SECTION 27 13 00

1.0 GENERAL

1.1 DOCUMENTS

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 SUMMARY

- .1 Section Includes:
 - 1.0 GENERAL
 - 1.1 DOCUMENTS
 - 1.2 SUMMARY
 - 1.3 OVERVIEW
 - 1.4 CATEGORY 6A HORIZONTAL CABLE INSTALLATION
 - 1.5 GigaBIX DISTRIBUTION
 - 1.6 REMOVAL AND REPLACEMENT OF EXISTING CEILINGS
 - 1.7 ACCESSIBILITY
 - 1.8 MISCELLANEOUS CABLES

1.3 OVERVIEW

- .1 The horizontal configuration shall be a star structure with separate dedicated cables run 360 degrees from the servicing zone Local Communication Rooms to the outlets.
- .2 The maximum length of horizontal cable shall not exceed 90 meters in any 360 degree direction.
- .3 In a Communication Room, horizontal cables shall be bundled separately from Entrance and Interconnecting backbone cables. [Horizontal cables will be bundled in groups of 24 to match with associated patch panels.](#)
- .4 Where it is specifically noted that the horizontal cable is not to be terminated, a minimum of 600 mm cable slack shall be coiled inside the outlet box. A minimum of 5 meters slack shall be left in the Communication Room.
- .5 Velcro straps shall be used to support the cables. The straps shall be loosely tightened in such a manner that it can slide around cable bundle.
- .6 Minimum length of the cables between the Communication Room termination point and a consolidation point shall be 15 meters. The UBC Information Technology Representative must be consulted to approve all designs implementing consolidation points.
- .7 Each cable shall be terminated at workstation outlets on eight-position modular jacks with pin/pair assignment wired to T568A.
- .8 The Contractor shall leave manufacturer recommended amount of slack in the cable, at the outlet box following termination, as too much slack at the point of termination may result in testing failures and too little slack can compromise future maintenance.
- .9 The Contractor shall neatly dress all cables within the Communications room to follow building lines. The objective being, to provide a reasonable amount of slack into each cable run, while at the same time provide neatness and promote order as the cables migrate from the point-of-entry to the termination point.

- .10 The cable pair twist must be maintained as per the Manufacturer specifications at the point of termination.
- .11 Refer to the following documents for guidelines on installation:
 - .1 Manufacturer Installation Guideline Documentation.
 - .2 Current TIA/EIA-568-C documents.

1.4 **CATEGORY 6A HORIZONTAL CABLE INSTALLATION**

- .1 Approved cable shall be CommScope Uniprise SLX Series Category 6A, UTP or STP, 23AWG, 100ohm solid copper, CMR-rated. CMP or LS0H rated cables shall be used if required by code.
- .2 All UTP/STP cable system work completed by the Contractor must be approved by the UBC Information Technology Representative. The following basic requirements must be met to gain system acceptance:
 - .1 Receive, check, unload, handle, store and adequately protect equipment and materials to be installed as part of the Contract. Store in areas as directed by the UBC Information Technology Representative or General Contractor. Installation includes setting in place, fastening to walls, floors, ceilings or other structures where required, interconnecting wiring of system components, equipment alignment and adjustment and other related work whether or not expressly defined herein.
 - .2 Install materials and equipment in accordance with applicable standards, codes, requirements and recommendations of national, provincial and local authorities having jurisdiction and with manufacturer printed instructions.
 - .3 Adhere to manufacturer published specifications for pulling tension, minimum bend radii and sidewall pressure when installing cables.
 - .4 Install horizontal cabling from outlets to the nearest Communication Room or Closet in a continuous run and without a splice, unless otherwise noted.
 - .5 When installing, ensure cable is not subjected to stress due to contact with tray/conduit support mechanisms, bonding lugs or any metal burrs within the support structure. Particular care must be taken when working around corners and offsets. Pulling lubrication must be used at all times to ensure a stress-free installation.
- .3 Most designs call for a cable tray/zone conduit, and conduit to facilitate cable system installation.
- .4 Where J-hook systems are used to distribute horizontal cables the J-hooks shall be spaced at maximum intervals of 1200 mm following building lines. The Contractor shall install infrastructure to support all cables installed above removable ceilings if no infrastructure is present or is inadequate.
- .5 Cable forming and termination procedures shall confirm to the following requirements:

- .1 All cable installation shall be done in a neat and tidy fashion. All cable forming within the MCRs and LCRs shall follow building lines.
- .2 Cable shall be formed by full cable combing with no crossovers within the bundle. The UBC Information Technology Representative shall have final approval of cable forming quality and any workmanship issues. Bundles shall be formed using Velcro fasteners. Cables must not exhibit sheath deformation due to over-tightening. If cable forming is not performed to the satisfaction of the UBC Information Technology Representative, the Contractor shall be responsible to re-form the bundles at no cost to UBC.
- .3 Termination practices must strictly comply with manufacturers' recommendations. Particular care must be taken to limit sheath removal length and pair un-twist at point of termination. The correct cable termination tool must be used for all Cat 6A terminations. Use of 110 Impact tools is not allowed.
- .4 Cables shall be terminated in sequential order on patch panels and on GigaBIX termination hardware in Communications Rooms.
- .5 At each communication outlet, follow the same termination practices as stipulated for the Communication Room. The Contractor shall leave the manufacturer recommended amount of slack within the outlet box following termination, as too much slack at the point of termination can result in testing failures and too little slack can compromise future maintenance.
- .6 The UBC Information Technology Representative must give final approval to cable forming, and termination quality before the Contractor can deem the Communication room or outlet work complete.
- .7 The Contractor shall attend a mandatory site visit during the Tender period to a previously completed Communication Room showing clearly the level of workmanship required to meet UBC expectations and acceptance.
- .8 In Communication Rooms, horizontal cables shall be bundled in groups of 24 matching with and terminated on 24 port patch panels only.
- .9 All wireless Access Point cables must be mixed with the regular horizontal cables and terminated "where they fall" in the patch panel field. Do not group the AP cables as this will create a disproportionate power load on one network switch.
- .10 Cable shall be installed in accordance with the manufacturer recommendations and standard industry practices.
- .11 At no point shall cables rest on acoustic ceiling grids, panels, mechanical equipment, or supports for other services.
- .12 Horizontal distribution cables shall be bundled in no more than 40 cables. Cable bundles in excess of 40 cables may cause deformation of the bottom cables within the bundle. Cable distribution in a comm room will not exceed 24 cables per bundle.
- .13 Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to UBC.

- .14 UTP/FTP 4 pair cable shall be installed so that there are no bends less than four times the cables outside diameter (4 x cable O.D.) at any point in the run. Pulling tension shall not exceed 25-foot/pounds for a single cable.
- .15 All cables shall be terminated in Communication Rooms and at Communications outlets. Leave no cables un-terminated unless specified in IT drawings or as directed by the UBC Information Technology Representative.
- .16 Before commencing with the installation and termination of a communication system, provide the UBC Information Technology Representative with termination details in the form of shop drawings if requested.
- .17 As the layout and termination of Communications systems is a critical component of the contract work, compliance with materials specifications and execution methods are mandatory.

1.5 **GigaBIX DISTRIBUTION**

- .1 Install GigaBIX distribution rings to support jumper wire.
- .2 Only BIX punch tools shall be used when terminating cables on a GigaBIX connector.
- .3 Multi-pair cable bundles entering GigaBIX mounts and the hinging of GigaBIX connectors shall be on the jumper side of the mount as per NORDX/CDT standards.
- .4 Horizontal 4-pair UTP/STP voice cables are terminated with a maximum of six (6) cables per GigaBIX connector.
- .5 Space for the entrance protectors shall be provided to the left of the GigaBIX connector mounts. (Refer to Standard Drawing ITSTD-06)

1.6 **REMOVAL AND REPLACEMENT OF EXISTING CEILINGS**

- . 1 Due to current architectural trends and the installation of overly large ceiling tiles in new buildings, Contractors are to review with the UBC Information Technology representative if they are to attempt the removal of any larger than normal ceiling tiles.
- .2 Carefully remove existing ceiling as required to perform the Work. Store removed tiles in an area designated by the Owner. Modify and augment existing suspension systems as necessary. Restore ceiling system to their original finish.
- .3 Repair any damage to ceilings due to modifications, removal, and replacement of same. Replace damaged ceiling tiles, including tiles with holes or openings left as a result of demolition, with similar materials.
- .3 The contractor will be held responsible for any damaged or missing tiles in the area of work at the conclusion of the job. The Contractor is advised to document the conditions of existing ceilings in the area of work, noting any missing or damaged tiles with date-stamped photographs delivered to the UBC Information Technology Representative prior to start of construction.
- .4 The Contractor will be held responsible at the conclusion of the job for any damaged or missing tiles in the area of work that cannot be proven to be existing prior to his site possession. If at the conclusion of the work, holes remain in the spline ceilings for which

no replacement tiles can be found, or if in the opinion of the Architectural Consultant, the spline ceiling tiles have been damaged to the extent that they must be replaced, then the Contractor is required to replace these tiles from another room with similar tiles and in that room from where the replacement tiles come from, replace the entire ceiling with a T-Bar and 600 mm x 1200 mm acoustical tile system. The choice of this room is subject to the approval of the Architectural Consultant.

- .5 As 600 mm x 600 mm spline ceiling tiles are no longer commercially available, the contractor is advised to take extreme care when removing and replacing these tiles since they are fragile and easily broken. The spline tiles to be removed and replaced with 600 mm x 1200 mm acoustic tiles must be carefully removed and stored. They may be used for patching other areas of spline tile ceiling. The remainder are to be turned over to the UBC Information Technology Representative.
- .6 After removal of existing ceiling, the Contractor shall temporary support and protect all electrical and non-electrical devices that are not properly supported

1.7 ACCESSIBILITY

- .1 Install all work in a manner that allows easy accessible for adjustment, operation and maintenance. Provide access panels where required to allow access to junction boxes and devices for maintenance purpose.

1.8 MISCELLANEOUS CABLES

- .1 UBC Information Technology will not accept and does not employ hybrid or under-carpet cabling.

END OF SECTION 27 15 00

1.0 GENERAL

2.0 DOCUMENTS

- 2.1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

3.0 SUMMARY

3.1 SECTIONS

- 1.0 GENERAL
- 2.0 DOCUMENTS
- 3.0 SUMMARY
- 4.0 WIRELESS ACCESS POINT LOCATION SPECIFICATIONS
- 5.0 PHYSICAL SECURITY
- 6.0 INDOOR LOCATIONS
- 7.0 OUTDOOR LOCATIONS
- 8.0 APPENDICES

4.0 WIRELESS ACCESS POINT LOCATION SPECIFICATIONS

- 4.1 These specifications are tailored for the wireless equipment that the University of British Columbia is deploying as of the date of last revision of this document.
- 4.2 The following criteria must be met regardless of mounting type and location:
- 4.2.1 Two (2) category 6A cable runs shall be provided to each AP location [unless otherwise specified](#).
 - 4.2.2 All APs shall be mounted in the horizontal plane [unless specific variance is allowed by UBC IT](#).
 - 4.2.3 If site conditions necessitate vertical electrical boxes, a right-angle wall mounting bracket (see Reference Section 8.1) shall be used.
 - 4.2.4 The preferred location for AP outlets is on ceilings unless the ceiling height exceeds 4572mm. In the event that ceiling heights exceeds the specified limit, [wall mount locations will be used](#), consult with UBC IT Wireless group for alternative options.
 - 4.2.5 All wireless access points shall be installed such that the line of sight between the access point and its coverage area is not obstructed by other building components (architectural elements, HVAC ducting, plumbing, cable tray, lighting, ceiling fixtures, etc.) Contractors and Consultants shall take this requirement into consideration when scheduling the installation of conduit and access points in new buildings to ensure that AP installations do not become obstructed as other building components are installed. Regardless of reason, any AP that must be moved more than 1 meter from the designated spot on the drawings, must receive approval from UBC IT.
 - 4.2.6 For all outdoor access point installations, the required CEC and BCBC codes shall govern for locating, mounting, grounding, servicing cable and enclosures used.

4.2.7 All [construction](#) drawings will clearly indicate AP locations with the standard data outlet symbol with the additional "AP" lettering. ["WAP" is also recognized although not preferred.](#)

4.2.8 The Contractor shall install category 6A cables "where they fall" on patch panels in Local or Main communications rooms as dictated by a maximum run distance of 90 meters. AP cables shall not be purposely grouped together as this may cause unbalanced power loading on switches.

4.3 Special Rooms and Areas

4.3.1 Rooms such as Lecture Theaters, class rooms, and large capacity study areas must receive special consideration. These areas receive a high density of student population at times and can overwhelm a single AP regardless of signal coverage. Additional APs must be installed to handle the potential capacity of the room or area.

4.3.2 A rough guideline for design is 1 AP installed per 70 seats or per 100 meters squared of common study area.

5.0 **PHYSICAL SECURITY**

5.1 When APs are located in common, public or secluded areas, all reasonable measures to hide or protect the AP from theft and vandalism without affecting the APs' signal propagation shall be considered. The use of an external enclosure should be considered a last resort.

6.0 **INDOOR LOCATIONS**

6.1 T-BAR CEILING MOUNT

6.1.1 APs will be installed below the ceiling grid at a maximum height of 3658mm.

6.1.2 A minimum of 3000mm of cable slack shall be coiled at the specified AP location.

6.1.3 Coiled cable must be supported by a J-hook above the specified AP location.

6.1.4 Where possible, access points shall be installed at the intersection of ceiling T-rails, such that the ceiling grid clip straddles the T-rail intersection. (see Reference Section 8.3)

6.1.5 Patch cables shall be routed such that they are not visible from below the access point.

6.1.6 All access points in T-bar ceilings will have some method to supply a secure and stable mounting point for UBC's current type of APs.

6.2 STRUCTURAL OR SOLID CEILING MOUNT

6.2.1 APs will be installed below the ceiling structure at a maximum height of 4572mm.

6.2.2 In the case of Structural ceilings where surface raceway systems are to be used the following criteria must be met:

6.2.2.1 Cables shall be terminated in deep double-gang sized Wiremold or Panduit box, with appropriate mud ring.

6.2.2.2 All installed surface boxes must use reinforced mounting points.

6.2.2.3 For surface-mounted access point, cables shall be routed to location via surface mounted raceway and side entry double gang box. Double gang box cannot be located less than 2000mm AFF.

- 6.2.2.4 Ceiling surface mounted electrical boxes shall not be installed less than 500mm from any adjoining walls.
- 6.2.3 In the case of structural ceilings where concealed 27mm conduit is used, a double gang deep masonry back box (MDB-2) or double gang deep back box and mud ring shall be installed.
- 6.2.4 Ceiling electrical boxes shall not be installed less than 500mm from any adjoining walls
- 6.3 WALL MOUNT
- 6.3.1 APs will be installed below a maximum height of 4500mm and typically are installed at a height of 3048mm.
- 6.3.2 Wall mounting is to be avoided if possible as it puts the AP in a horizontal plane which is problematic for signal propagation.
- 6.3.3 Coordinate with UBC IT for assistance in avoiding wall mounts.
- 6.3.4 If wall mounting is unavoidable, right-angle AP mounting brackets (see Reference Section 8.1) will be supplied.
- 6.3.5 Electrical boxes on walls or pillars shall not be installed less than 500mm from any adjoining wall or ceiling.
- 6.3.6 All wall mounted locations will use a single gang back box.

7.0 OUTDOOR LOCATIONS

- 7.1.1 Selection of locations for outdoor wireless access points shall be based on the following sequence of preferences:
- Street-level pole mount
 - Exterior building wall mount
 - Exterior building pole mount (soffit)
 - Roof mount only if requested
- 7.1.2 All exterior building mounted AP locations will have a corresponding accessible interior demarcation junction box (4x4 is acceptable) ideally located within 3m of each exterior location. Cat6A cables for these outdoor APs will terminate at the interior demarcation box as bare jacks. At the time of AP installation an outdoor rated extension patch cable will be installed to connect the AP to the drop cable.
- 7.2 STREET LEVEL POLE MOUNT
- 7.2.1 Cable terminations shall be routed and completed to the nearest building communications rooms with 27mm solid PVC conduit, enclosed in an outdoor NEMA Type 4 rated junction box or similar enclosure.
- 7.2.2 Constant 110V AC power and SM optical fibre cable will be required if the distance between the building communications room and the pole-mounted access point exceeds 90 meters. AC power will not be required and Outdoor rated Category 6A Shielded copper cable can be used if the location is within the 90m distance limitation.
- 7.2.3 If power is provided, the appropriate outdoor-rated GFCI receptacle shall be installed.
- 7.2.4 APs shall be mounted to poles according to the design of the pole, within a 3000 to 7500mm range, with ideal mounting height at 5000mm.

7.3 EXTERIOR BUILDING WALL MOUNT

- 7.3.1 Provided that the cable length limit of 90 meters is met, outdoor rated category 6A shielded cable to the mount point will be sufficient.
- 7.3.2 Provision shall be made in the building design for the attachment of a 6 * 6 * 4 NEMA Type 4 rated junction box (see Reference Section 8.4) to which outdoor AP mounting brackets (such as the type described in Reference Section 8.5) can be affixed flush to the building.
 - 7.3.2.1 If building material prevents flush mounting of junction box, proceed to install NEMA rated junction box directly to building exterior. AP shall be mounted flush to the junction box.
 - 7.3.2.2 Cable termination shall be completed within the exterior mounted junction box.
- 7.3.3 APs shall be mounted at a height of between 3000 to 7500mm, with ideal mounting height at 5000mm.
- 7.3.4 APs shall not be mounted on walls in areas where signals may be attenuated by external building elements (e.g., large canopies, balconies, design elements that impinge on the line-of-sight between the AP and the ground level.)
- 7.3.5 In the event that the prior conditions cannot be met, consult with UBC IT Wireless group for alternative options.

7.4 EXTERIOR BUILDING POLE MOUNT (SOFFIT)

- 7.4.1 In areas that an AP cannot be mounted to the building wall, install pole mount to underside of soffit.
 - 7.4.1.1 APs shall be mounted at a height of between 3000 to 7500mm, with ideal mounting height at 5000mm.
 - 7.4.1.2 Pole mount shall be 50.8mm – 76.2mm in diameter at a minimum length of 305mm from the underside of soffit.
 - 7.4.1.3 [Cabling shall be terminated at the associated interior demarcation box.](#)
 - 7.4.1.4 [Extension cabling from the interior demarcation box](#) shall be terminated in a NEMA Type 4 rated junction box at the bottom end of the pole mount [when requested.](#)
- 7.4.2 Pole mounts shall not be mounted on soffits in areas where the affixed AP's signals may be attenuated by external building elements (e.g., large canopies, balconies, design elements that impinge on the line-of-sight between the AP and the ground level.)
- 7.4.3 In the event that the prior conditions cannot be met, consult with UBC IT Wireless group for alternative options.

7.5 ROOF MOUNT

- 7.5.1 Roof mount locations shall be [only be](#) considered if the building height is no greater than 10500mm [and if UBC IT specifically requests the inclusion of the option.](#) All buildings should use exterior wall mount [or soffit mount](#) locations for the external APs [as the default preference.](#)
- 7.5.2 For each of the indicated roof top AP locations provide one 27mm conduit stub up/ out terminated in an outdoor NEMA Type 4 rated junction box or similar enclosure in the vicinity of the indicated roof top AP location.

- 7.5.3 The conduit stub up/ out shall be capable of preventing rodent ingress.
- 7.5.4 Roof top masts are to be parapet mounted at the building edge to minimize the radio shadow at the base of the building.
- 7.5.5 If parapet mount is not an option, NPRM shall be seismically braced to roof.
- 7.5.6 In the event that the prior conditions cannot be met, consult with UBC IT Wireless group for alternative options.
- 7.5.7 All roof top location masts and associated hardware are to be supplied and installed by Div 26.

8.0 **REFERENCE**

- 8.1 Right-angled indoor wall mounting bracket
 - 8.1.1 Drawing ITSTD – 50
 - 8.1.2 <https://www.chatsworth.com/en-us/products/wireless-enclosures/oberon-hi-pointtm-open-ceiling-and-surface-mounts/na/oberon-hi-point-open-ceiling-and-surface-mounts-1008/1008-00-wh>
- 8.2 Indoor wall mount location [clearances drawing](#)
 - 8.2.1 Drawing ITSTD-51
- 8.3 Indoor T-Bar ceiling location drawing
 - 8.3.1 Drawing ITSTD – 53
 - 8.3.2 https://www.cisco.com/c/en/us/td/docs/wireless/access_point/mounting/guide/apmount.html
- 8.4 Outdoor AP NEMA rated junction box [as this example or equivalent:](#)
 - 8.4.1 <https://pvcelectrical.cantexinc.com/Page/4-in-x-4-in-x-2-in-Junction-Box-5133705>
- 8.5 Outdoor AP mounting bracket
 - 8.5.1 Drawing ITSTD – 52
 - 8.5.2 http://www.cisco.com/c/en/us/td/docs/wireless/access_point/1530/quick/guide/ap1532qsg.html
- 8.6 [Outdoor AP](#) detailed installations drawings – ITSTD – 54, 55, 56, 57.

END OF SECTION 27 21 33

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 28 16 00 Intrusion Detection
- .2 Section 28 13 00 Access Control
- .3 Section 28 20 00 Safety and Security Cameras
- .4 Section 27 05 08 Cable Infrastructure Design Guidelines, sub sections 1.4.9 and 1.5
- .5 Section 27 05 05 Communication Rooms Design Guidelines, sub section 1.4
- .6 Section 28 31 00 Fire Detection and Alarm
- .7 Section 14 20 00 Elevators

1.2 Coordination Requirements

- .1 UBC Campus Security and Secure Access
- .2 UBC Campus and Community Planning
- .3 UBC Information Technology
- .4 UBC Building Operations Electrical Technical Support

1.3 Description

- .1 UBC Campus Security and Secure Access supports UBC's ongoing strategy to increase safety and security to the University community. The guidelines herein have been created by Campus Security and Secure Access to clarify the design and installation process of electronic security systems on the UBC campus.
- .2 The guidelines are intended to foster cooperation between all parties involved whether they be UBC related or not.
- .3 Special consideration must be given to the security industry as being technology based. Industry advancements have an evolutionary effect on the design and manufacturing of security equipment. It is therefore critically important that Campus Security and Secure Access remain flexible in its implementation of UBC standards and guidelines.
- .4 This document must be read, interpreted and coordinated with all other related Sections to deliver a complete electronic security system.
- .5 The Campus Security and Secure Access Guidelines and others mentioned herein prescribe minimum acceptable standards for all equipment and procedures relating to electronic security.
- .6 Security systems to be installed as part of newly constructed buildings or as part of renovations within existing buildings shall always reflect the intent of Campus Security and Secure Access standards and guidelines.
- .7 Campus Security and Secure Access is the UBC group solely responsible for the consultation, design installation, verification, maintenance, and management of all electronic security on campus.
- .8 Any and all proposed changes to these standards shall be subject to approval in writing by Campus Security and Secure Access prior to implementation.

1.4 Terminology

- .1 Electronic Lockbox
 - .1 A UBC card-enabled key safe to control onsite distribution of keys.
- .2 Access Control System
 - .1 A card access system used to manage and control to UBC space and assets. The unlocking of selected entries is scheduled and controlled electronically to allow authorized user entry via card reader, keypad, etc.
- .3 Access Control Panel
 - .1 An access system's onsite processor that manages access devices and governs the scheduling of all card reader controlled entries. Can be used singly or in tandem.
- .4 Access Device
 - .1 Any device included in an access system that is connected to and managed by the access control panel (i.e. card reader, RTE motion, etc.)
- .5 Access Card
 - .1 As provided by the UBC Card program, a proximity credential presented at a card reader by an authorized user to grant access.
- .6 Card Reader
 - .1 An access card recognition device, typically proximity type that allows for the entry of an authorized card holder.
- .7 Card Reader Door
 - .1 A "controlled door" that includes a card reader for authorized entry and unlocking.
- .8 Controlled Door
 - .1 A single, double, or group of doors whose locking functions are provided by system scheduled electronic locking.
- .9 Electronic Locking Hardware
 - .1 Access control door hardware, typically "handset" or "panic" type aesthetically identical to regular hardware and whose locking function is controlled electro-mechanically.
- .10 Electric Strike
 - .1 An access control door strike designed as a replacement for a regular strike plate that is controlled electro-mechanically.
- .11 Request to Exit (RTE) Motion
 - .1 A motion detector installed at a controlled or card reader door to monitor occupant egress.
- .12 Request to Exit Hardware
 - .1 A dry contact included within a controlled or card reader door's egress hardware to monitor occupant egress.
- .13 Intrusion Detection System
 - .1 A control system that manages the various installed devices (door contact, motion detectors, etc.) and communicates their status for monitored response. The system is enabled and disabled through devices such as keypads and card readers.

- .14 Intrusion Detection Control Panel
 - .1 An alarm system's central processor responsible for monitoring and reporting both system and device status.
- .15 Intrusion Detection Device
 - .1 Any device included in an alarm system that is controlled and monitored by the alarm control panel (i.e. siren horn, keypad, motion detector, etc.).
- .16 Intrusion Detection Keypad
 - .1 A tactile keyed, multifunction device manually operated by an authorized user typically for arming and disarming.
- .17 Monitored (Secured) Area
 - .1 A protected area, in whole or in part, within a secured perimeter.
- .18 Monitored Door
 - .1 A single, double or group of doors that have their open or closed position monitored by a door position contact. Monitored doors typically define the perimeter of a secure area.
- .19 Door Position Contact
 - .1 A sealed magnetic reed contact that monitors a door's open/close position.
- .20 Motion Detector:
 - .1 A spatial protection device used to detect movement within a secured area by monitoring changes in microwave and/or infrared field patterns.
- .21 Glass Break Detector
 - .1 A micro phonic device used to detect glass breakage by "listening" to specific frequencies typical of breaking glass, from initial impact to shattering.
- .22 Movable Object Detector
 - .1 An optical "transceiver" device used to monitor a fiber optic cable loop that is routed through the protected equipment (i.e. computer, printer, etc.)
- .23 Photo Electric Beam
 - .1 A continuous narrow focus infrared beam emitted from a transmitter and acknowledged by a receiver. These devices are typically installed outside a building's perimeter in a "fence post" configuration.
- .24 Siren Horn
 - .1 An audible device triggered to sound during an alarm condition.
- .25 Safety & Security Camera System
 - .1 Compliant with UBC Policy #118, a video management system typically consisting of cameras, server and storage environment, and software. Used for managing live and recorded images.
- .26 Safety & Security Camera
 - .1 A video image capturing device installed to view a specific area of concern.
- .27 Video Encoder
 - .1 A device that converts analogue composite video inputs to Ethernet outputs.
- .28 Mid-span Injector
 - .1 A device that provides inline PoE/PoE+ to a structured data run.

2.0 CONTRACTOR AND/OR CONSULTANT RESPONSIBILITIES

2.1 General

- .1 The contractor and/or consultant has the responsibility to ensure that all provisions of these Standards are met and to specifically advise the University in writing of any contemplated exceptions and obtain approval from Campus Security and Secure Access for all contemplated changes.

2.2 UBC Procedure

- .1 Campus and Community Planning shall facilitate the communications and efforts of the contractor with Campus Security and Secure Access.

2.3 System Design

- .1 The security system shall be designed by through consultation and approval by Campus Security and Secure Access.

2.4 System Infrastructure

- .1 Campus and Community Planning and the project architect/engineer must ensure that the contractor provide the correct security infrastructure for the building. This infrastructure shall include:
 - .1 Cable pathway.
 - .2 Cable.
 - .3 Security panel power and space allocation in Comm Rooms.
 - .4 Communication lines (telephone or LAN).
 - .5 Preparation of door frames, doors, walls, ceilings, etc., to accept security devices and hardware.
 - .6 Provision of door hardware to accept UBC keyed cylinders
 - .7 Fire Alarm interface.
 - .8 Elevator control interface.
 - .9 Door hardware power.
- .2 All pathways expressly installed for Communications (Data and Telephone) will only be used for other types of cable with the permission of UBC IT. See Section 27 05 08 Cable Infrastructure Design Guidelines sub section 1.5.
- .3 Electronic Safety & Security cabling to be installed within Division 27 pathways (cable tray or riser conduit) shall comply fully with all Division 27 requirements. Unless otherwise approved or directed, ESS cabling (outside of cable trays or riser conduit) shall be installed in a separate conduit pathway.

2.5 System Installation

- .1 All Intrusion (Section 28 16 00 Intrusion Detection), Access (this section), and Camera system (Section 28 20 00 Electronic Surveillance) equipment installation work shall be performed by Campus Security and Secure Access. If under special circumstances, security installation is to be contracted out to outside companies, the contractor must be acceptable to Campus Security and Secure Access, and all such work shall be done under the direction and supervision of Campus Security and Secure Access. The contractor must use provincially trade qualified technicians who individually have a minimum of five years of Enterprise System level commercial installation experience.

2.6 System Verification

- .1 System verification shall be performed by Campus Security and Secure Access. The contractor must ensure and coordinate through Campus and Community Planning the verification of all security related equipment and its performance as an integrated part of the security system (i.e. fire alarm interface, elevator interface, door hardware, etc.).

2.7 Contract Documents

- .1 The contract documents shall clearly indicate that Campus Security and Secure Access will be installing the UBC keyed cylinders and security equipment. The contract documents shall also require that all conduit, cable, etc. be clearly marked/tagged and cross-referenced to shop drawings.

2.8 Shop Drawings

- .1 Before commencing with the installation of security system infrastructure, the University requires that the consultant or contractor supply Campus Security and Secure Access with design and installation details in the form of shop drawings (i.e. door hardware, system interface, etc.)
- .2 The Contractor shall be responsible for all errors or omissions in the shop drawings and for meeting all requirements of the contract documents.

3.0 CAMPUS SECURITY AND SECURE ACCESS RESPONSIBILITIES

3.1 General

- .1 Campus Security and Secure Access will assist departments in determining their security requirements and act as the agent to: ensure quality and consistency, ensure justification for the system installation, ensure adherence to the university guidelines.

3.2 Consultation

- .1 Consult, coordinate, and/or supervise the consultation of on-campus security systems.

3.3 System Design

- .1 Design, coordinate, and/or supervise the design of on campus security systems. Where applicable, work with project architects and engineers to provide input to, and approval of, electronic security systems designs.

3.4 System Installation

- .1 Supply and install all electronic security equipment on campus in whole or in addition to existing systems. Coordinate inclusion of related equipment (Door hardware, elevator, fire alarm, etc).

3.5 System Verification

- .1 Verify, coordinate, and/or supervise the verification of on-campus security systems (including related equipment).

3.6 Post Installation

- .1 Service, maintain, and manage each and all of the electronic security systems on campus.
- .2 Arrange for the preparation of as-built documentation of the completed installation, including wiring schedules.

3.7 Performance Standards

- .1 To ensure compliance with industry-wide standards, the latest edition of the following documents and standards, current and proposed, are referenced and shall be complied with in the design, material selection, installation, configuration / programming, and system verification. This shall apply equally to new installations, upgrade and renovations at UBC. Whereas referenced codes dictate minimum requirements for safety, where a contradiction may exist between any of the following, and absent written direction from UBC, the most stringent requirement shall be met and included in the project cost.
 - .1 Campus Security and Secure Access Guidelines.
 - .2 UBC Technical Guidelines incorporating Division 28 Electronic Safety and Security.
 - .3 BC Electrical Code (& issued Technical Bulletins).
 - .4 BC Fire Code (& issued Technical Bulletins).
 - .5 BC Building Code (& issued Technical Bulletins).

4.0 SYSTEM DESIGN

4.1 General

- .1 System design shall produce a consistent outcome to increase safety and security for the University, reduce risk, and enable access. Campus Security and Secure Access provides consultative input to project teams and user stakeholders to ensure the successful application of security technology with operational requirements.

4.2 Operational Function

- .1 The following functional requirements shall be identified prior to the design of any security system to be installed on Campus:
 - .1 Space ownership and usage.
 - .2 Location of perimeter doors.
 - .3 Location of entrances/exits (daytime and after hours).
 - .4 Location of disabled access points.
 - .5 Location of vulnerable interior spaces.
 - .6 Location of special areas (computer labs, expensive equipment, library, chemical storage, sensitive research operation, etc.).
 - .7 Building hours of operation.
 - .8 System monitoring.

4.3 Application

- .1 The following requirements shall be included in the consideration and design of any security system on campus:
 - .1 Electronic Lockbox
 - .1 A Lockbox shall be installed at an appropriate location to facilitate keyed access to authorized personnel.

- .2 Monitored Doors
 - .1 All building perimeter doors shall be monitored and mechanically locked to prevent entry at all times, with the exception of controlled door and card reader doors.
- .3 Controlled Doors
 - .1 Depending on building requirements, selected doors will be designated as controlled doors to be electrically locked/ unlocked on a time schedule basis.
- .4 Card Reader Doors
 - .1 At least one door (typically disabled access door, or if none, the main door to the building) shall be provided with card access control. Additional doors may be designated as card reader doors depending on the building size and layout, after-hours use, space ownership and functionality, and pedestrian traffic into and through the building.
 - .2 All classroom doors shall be provided with card access control. Refer to [UBC Learning Space Design Guidelines](#) 5.12.2 Key Strategies, Card Access, Security of Learning Technology Equipment for additional details.
- .5 Intrusion Devices
 - .1 Areas within a building that are considered high risk shall include the installation of intrusion system devices.
 - .2 Areas within a building that are considered to be "reasonably accessible" from the building exterior may include the installation of a detection device (i.e. motion sensor, glass-break sensor, photo-beam, or other applicable devices).
- .6 Arm/Disarm
 - .1 System arming/disarming shall be provided on a "per zone or per area" basis via keypad, card reader or combination thereof.
- .7 Monitoring
 - .1 System monitoring shall be provided via UBC Information Technology voice grade phone service or campus LAN.
- .8 Safety and Security Cameras
 - .1 Areas considered high risk or special interest may include the installation of a safety & security camera.
- .9 Electronic Safety & Security Typical Application Drawings
 - .1 For all projects with Electronic Safety & Security scope, the following typical application drawings shall be referenced and complied with, in addition to all aspects of Division 28 Technical Guidelines sections.
 - .2 ACS Card Reader Door Typical:
https://technicalguidelines.ubc.ca/Division_28/dwg/AS-1_Card_Reader_Door_Typ.a.pdf
 - .3 Typical Lock Box Installation with Camera (ITSTD-27):
https://technicalguidelines.ubc.ca/Division_27/dwg/ITSTD-27.pdf
 - .4 Intrusion Devices Typical:
https://technicalguidelines.ubc.ca/Division_28/dwg/AS-2_Intrusion_Devices_Typ.pdf

- .5 CCTV Communications Demark for IP Cameras in T-Bar (Typical) (ITSTD-23): https://technicalguidelines.ubc.ca/Division_27/dwg/ITSTD-23.pdf
- .6 CCTV Communications Demark for IP Cameras in Solid Ceiling (Typical) (ITSTD-24): https://technicalguidelines.ubc.ca/Division_27/dwg/ITSTD-24.pdf
- .7 CCTV Communications Demark for IP Cameras in Solid Ceiling, Outlet in T-Bar (Typical) (ITSTD-25): https://technicalguidelines.ubc.ca/Division_27/dwg/ITSTD-25.pdf

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 28 05 00 Campus Security and Secure Access: General Standards
- .2 Section 08 71 00 Door Hardware

1.2 Coordination Requirements

- .1 UBC Campus Security and Secure Access

1.3 Description

- .1 This section covers requirements for Access Control Systems. The Access Control System is installed by UBC Campus Security and Secure Access. General Requirements for this system for Consultants and Contractors are provided in Section 28 05 00 Electronic Security Systems: General Standards.
- .2 These guidelines provide reference to particular types, grades and models of products. In general, the references include both generic descriptions and specific product details. These references shall not be construed as a directive to sole-source products from any particular vendor except where this is specifically stated.
- .3 Access Control System that manages and controls occupant access into buildings and/or assets, and that the arming and locking of selected entries is scheduled and controlled electronically to allow authorized user entry via card reader, keypad etc., shall include the following:
 - .1 Electronic lock box
 - .2 Access control panel.
 - .3 Access devices.
 - .4 Card readers.
 - .5 Access cards.
 - .6 Door position contacts.
 - .7 Request to Exit motion detectors.
 - .8 Hardware egress dry contacts.
 - .9 Electrified locking hardware.
 - .10 Power Supply - Hardware.
 - .11 Power transformers.

2.0 EQUIPMENT SPECIFICATIONS AND REQUIREMENTS

2.1 Lock Box

- .1 Device Location
 - .1 Lock box shall be wall mounted, located in suitably determined area restricted to authorized personnel via card reader. Campus Security and Secure Access to confirm location.
 - .2 Mounting surface shall include solid plywood material minimum 38 mm thickness to span entire lock box dimensions.
- .2 Power Raceway
 - .1 Armoured cable to enter lock box through rear cutout. Un-switched 120VAC, dedicated breaker c/w generator and/or UPS backup whenever possible.

- .3 Data Raceway
 - .1 Demark for Lockbox. Reference to Communications Standard Drawing ITSTD-27
- .4 Device Features
 - .1 Powered directly from un-switched 120VAC.
 - .2 Control circuitry housed in mechanically secured lock box c/w with tamper.
 - .3 Wall mounted.
 - .4 UBC Card compatible
 - .5 Minimum 32 key slot capacity. Confirm sizing with Campus Security and Secure Access.

2.2 Access Control Panel

- .1 Device Location
 - .1 Panels to be mounted in communications room within the protected area. (Exact location to be confirmed by UBC IT- Connectivity Infrastructure). If it is not possible to locate the panel in the communication room, panel should be mounted in a secure room within the protected area.
 - .2 Panels must not be mounted above ceiling if space is "return air" plenum type.
- .2 Raceway
 - .1 Power transformer fed from un-switched 120VAC, dedicated breaker c/w generator and/or UPS backup whenever possible.
- .3 Cabling
 - .1 All related wiring for panels should be concealed and home-run whenever possible. FT4 rated wire, FT6 rated if required.
 - .2 Wire path and dressing within communication rooms to conform to UBC IT - Connectivity Infrastructure standards.
- .4 Device Features
 - .1 Cabinets/enclosures shall typically be cam lockable, 20" x 24" x 6", with side-hinged door.
 - .2 Powered from Class 2 step down transformer (typically 16 VAC).
 - .3 Control circuitry housed in a mechanically securable keyed box c/w with monitored tamper switch as directed.
 - .4 Wall mountable.
 - .5 UBC Card compatible.
 - .6 Provide 5 Vdc to 12 Vdc for related end devices.
 - .7 Power supplies shall be 16VAC in, 12VDC out, 2A fused.
 - .8 Minimum two reader ports.
 - .9 Minimum one fully programmable per reader port.
 - .10 Support "end of line resistor" fully supervised zones. Processing capabilities for all major reader formats. Fully programmable or either serially via LAN. Panel to panel expandable either serially or via LAN. Windows based operating software Operating temperature 0° C to +40° C.

2.3 Card Reader

- .1 Device Location
 - .1 To be wall mounted typically on the restricted entry side of the controlled door.
 - .2 Standard mounting height 915 mm AFF, disabled 760 mm if required.

- .2 Raceway
 - .1 19 mm conduit terminated to single gang box, stub to Cable Tray.
 - .2 Surface Wiremold equivalent: V700 raceway to V5747-1 box.
- .3 Cabling
 - .1 3 pair twist/strand/shield c/w drain 22 AWG FT4 rated, FT6 if required. Belden 5542FE or approved equivalent.
 - .2 Home run to control panel.
 - .3 Maximum wire length 80 meters/run unless specified otherwise.
- .4 Device Features
 - .1 5Vdc to 12 Vdc operation.
 - .2 Wiegand and/or other standard protocol
 - .3 2-color LED status display.
 - .4 Sealed weatherproof construction.
 - .5 Operating temperature -40° C to +65° C
 - .6 Encrypted authentication read function, 13.56 MHz.

2.4 Request-to-Exit Motion Detector (RXM)

- .1 Device Location
 - .1 Should be wall-mounted above the controlled door, free from conflict with exit signage, aimed/directed to primary direction(s) of approach.
 - .2 Can be ceiling-mounted if necessary.
- .2 Raceway
 - .1 19mm conduit terminated to 4x4 box c/w 2 gang plaster ring, stub to Cable Tray.
 - .2 Surface Wiremold equivalent: V700 raceway to V5747-2 box.
- .3 Cabling
 - .1 6/22 FT4 rated wire, FT6 rated if required. Belden 5504UE or approved equivalent.
 - .2 Home run to control panel.
 - .3 Maximum wire length 80 meter/run unless specified.
- .4 Device Features
 - .1 12 Vdc operation.
 - .2 Alarm output dry contact N/O or Form C if required.
 - .3 Passive infrared detection or microwave if required.
 - .4 Noise filtering adjustable output relay time.
 - .5 LED status indicator.
 - .6 Insect immunity.
 - .7 Fully adjustable viewing angle, vertical and horizontal.
 - .8 Integrated 90 db local door alarm sounder (Piezo buzzer) independently controlled by access control panel/system.

2.5 Door Contacts

- .1 Device location
 - .1 **Frame:** Flush mounted concealed contact to be installed in the top of the door frame 305 mm from strike side edge. Frame to be provided with 25mm diameter by 38mm deep through hole c/w back box for raceway termination.
 - .2 **Door:** Concealed magnet should sit no more the 13mm away from contact with the door in a fully closed position. Top of door to allow for installation of 25mm diameter by 38mm deep magnet assembly.

- .2 Raceway
 - .1 13mm conduit terminated to frame back box. Stub to Cable Tray.
 - .2 Surface Wiremold equivalent: V500 raceway to V5747-1 box.
- .3 Cabling
 - .1 4/22 FT4 rated wire, FT6 rated if required. Belden 5502UE or approved equivalent.
 - .2 Home run to control panel or keypad/expansion module if applicable
 - .3 Max wire length 80 meters/run unless specified
- .4 Device Features
 - .1 Hermetically sealed, corrosion-proof reed switch.
 - .2 Minimum 13mm operating gap between contact and magnet.

2.6 Power Transformers

- .1 Device location
 - .1 Shall be "wire-in" type and mounted close to the control panel in the communication room. Plug-in type under restricted circumstances.
 - .2 Compatible with any 13mm punch out conduit box.
 - .3 Must not be installed above false ceiling if space is "return air" plenum type.
- .2 Raceway
 - .1 Power transformer fed from un-switched 120VAC, dedicated breaker c/w generator and/or UPS backup whenever possible.
- .3 Cabling
 - .1 2/18 FT4 rated wire, FT6 rated if required. Belden 5300UE or approved equivalent.
 - .2 Home run directly to control panel
 - .3 In communication room, dress cable to UBC IT - Connectivity Infrastructure standards
- .4 Device Features
 - .1 Fully certified Class 2 rated.
 - .2 ULC and CSA approved.
 - .3 Fail-safe in the event of current overload or short circuit.
 - .4 16VAC input, 40VA output minimum.

2.7 Power Supply – Door Hardware

- .1 General
 - .1 UBC Campus Security and Secure Access equipment interfaces to Electrified Hardware at Power Supplies.
- .2 Device Location
 - .1 Power Supply shall be located in communications room (exact location to be confirmed by UBC IT - Connectivity Infrastructure). Locations subject to hardware design.
 - .2 UBC Campus Security and Secure Access equipment interfaces to Electrified Hardware at Power Supplies.
- .3 Raceway
 - .1 19mm conduit terminated directly to Power Supply enclosure. Wiremold equivalent V700.
 - .2 Supply may source power to more than one Electrified Hardware Device. Subject to Hardware design.

- .4 Cabling/Interface
 - .1 Subject to Hardware design.
 - .2 Power Supply to be equipped with “Dry Trigger” function (i.e. SDC CR4) to allow complete isolation of UBC Campus Security and Secure Access equipment from Hardware power.
 - .3 “Dry Trigger” cable: 4/22 FT4 rated wire, FT6 rated if required. Belden 5502UE or approved equivalent.
- .5 Power/Features
 - .1 Direct power to Supply fed from un-switched 120VAC, dedicated breaker c/w generator and/or UPS backup whenever possible.
 - .2 Equipped with battery backup whenever possible.
 - .3 Interface to Fire Alarm when required by code.
 - .4 ULC listed power supplies and distribution boards.
 - .5 Dual voltage 12 or 24 VDC field selectable continuous output.
 - .6 Minimum 2A output.
 - .7 Minimum four (4) output distribution boards.

2.8 Electrified Hardware

- .1 General
 - .1 Electrified Hardware requirements and specifications are not included in this section. See Section 08 71 00 Door Hardware.
 - .2 Hardware interface requirements to UBC Campus Security and Secure Access equipment described above, Power Supply – Hardware

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 28 05 00 Electronic Security Systems: General Standards

1.2 Coordination Requirements

- .1 UBC Electronic Systems and Campus Security and Secure Access

1.3 Description

- .1 This section covers requirements for Intrusion Detection Systems. The Intrusion System is installed by Campus Security and Secure Access. General Requirements for this system for Consultants and Contractors are provided in Section 28 05 00 Electronic Security Systems: General Standards.
- .2 These guidelines provide reference to particular types, grades and models of products. In general, the references include both generic descriptions and specific product details. These references shall not be construed as a directive to sole-source products from any particular vendor except where this is specifically stated.
- .3 Intrusion detection system that monitors the various alarm devices (door contacts, motion detectors, glass break detectors, duress (panic) buttons etc.) and transmits their status over voice grade telephone line or IP network, and that is enabled and disabled through devices such as keypads, card readers or key switches where necessary, shall include:
 - .1 Intrusion detection control panel.
 - .2 Intrusion detection devices.
 - .3 Siren horns.
 - .4 Intrusion detection keypads.
 - .5 Door position contacts.
 - .6 Motion detectors.
 - .7 Glass breaks detectors.
 - .8 Photo electric beams.
 - .9 Movable object detectors.
 - .10 Power transformers.

2.0 MATERIALS SPECIFICATION

2.1 Alarm Control Panel

- .1 Powered from Class 2 step down transformer (typically 16VAC)
- .2 Control circuitry housed in a mechanically securable box with tamper option
- .3 Wall mountable
- .4 Provide 12VDC for related data bus and detection devices
- .5 Function in all major communication formats
- .6 Support "end of line resistor" fully supervised zones
- .7 Fully programmable
- .8 Fully upgradeable/downloadable
- .9 Multi access code/multi user
- .10 Event scheduling
- .11 Event logging
- .12 Multi keypad

- .13 Comm line supervision
- .14 A/C fail supervision
- .15 Low battery supervision
- .16 EXPROM or non-volatile RAM memory retention
- .17 Operating temperature 0 C to +40 C

2.2 Keypads

- .1 12 VDC operation
- .2 Two way digital data transfer to and from control panel
- .3 LED arm/disarm status
- .4 Back lit keys
- .5 Back lit LCD alpha numeric display, with optional configurable audible annunciation
- .6 Menu driven/user interactive
- .7 Min. 5 digit code length
- .8 Equipped with onboard zone inputs

2.3 Motion Detectors

- .1 12VDC operation
- .2 Alarm output dry contact N/O or Form C if required
- .3 Dual detection technology (microwave and passive)
- .4 Noise filtering for both microwave and passive infrared
- .5 White light immunity
- .6 Turbulent air immunity
- .7 Insect/pet immunity
- .8 RIF immunity
- .9 Ambient temperature compensation
- .10 Operating temperature - 15C to +50 C

2.4 Audio Glass Break Detectors

- .1 12VDC operation
- .2 Alarm output dry contact N/O or Form C if required
- .3 Microprocessor based frequency analysis
- .4 Audio discrimination
- .5 Processing capabilities for plate, wired, laminated, and tempered glass

2.5 Photo Electric Beams

- .1 12VDC operation
- .2 Alarm output dry contact N/O or Form C if required
- .3 Dual infrared photoelectric beams
- .4 Selectable beam frequency
- .5 Selectable beam intervention time
- .6 Weatherproof housing with tamper switch
- .7 Operating temperature - 30C to +40C

2.6 Magnetic Contacts

- .1 Hermetically sealed, corrosion proof reed switch
- .2 Min. 13mm operating gap between contact and magnet

2.7 Power Transformers

- .1 Fully certified Class 2 rated
- .2 ULC and CSA approved
- .3 Fail-safe in the event of current overload or short circuit
- .4 16VAC input, 40VA output minimum.

3.0 EXECUTION

3.1 Alarm Control Panel

- .1 Device location
 - .1 Panels should be mounted in communications room within the protected area. (Exact location to be confirmed by UBC IT - Connectivity Infrastructure). If it is not possible to locate the panel in the communication rooms, panel should be mounted in a secure room within the protected area. Confirm with Campus Security and Secure Access.
 - .2 Panels must not be mounted above false ceiling if space is "return air" plenum type.
- .2 Wiring
 - .1 All related wiring for panels should be concealed and home-run whenever possible.
 - .2 FT4 rated wire. FT6 rated wire when required.
 - .3 Wire path and dressing within communication rooms to conform with UBC IT - Connectivity Infrastructure standards
 - .4 Power- transformer fed from un-switched 120VAC dedicated breaker c/w generator and/or UPS backup whenever possible.

3.2 Keypads

- .1 Device location
 - .1 Keypad to be wall mounted within the protected area
 - .2 Standard mounting height between 1220mm and 1524mm.
- .2 Wiring
 - .1 6/22 FT4 rated wire. FT6 rated if required
 - .2 Home run to control panel
 - .3 When using conduits to conceal wire, mount keypads to double- gang boxes
 - .4 When using V series wire mold to conceal wire, mount keypads to shallow double-gang boxes
 - .5 Max wire length 80 meters/run unless specified

3.3 Motion Detectors

- .1 Device location
 - .1 Motion should be wall or ceiling mounted
 - .2 Standard wall mounting height 2286mm
 - .3 Motion should be corner mounted facing away from perimeter windows
- .2 Wiring
 - .1 6/22 FT4 rated wire. FT6 rated wire if required
 - .2 Home run to control panel or keypad/expansion module where applicable
 - .3 When using conduit to conceal wire, mount detector to single gang box

- .4 When using V series wire mold to conceal wire, mount detector to shallow single gang box
- .5 Max wire length of 80 meters/run unless specified otherwise

3.4 Audio Glass Break Detectors

- .1 Device location
 - .1 Wall or ceiling mounted within protected area
 - .2 Standard wall mount height 2438mm
 - .3 Detector should be facing perimeter glass
- .2 Wiring
 - .1 6/22 FT4 rated wire. FT6 rated wire if required
 - .2 Home run to control panel or keypad/expansion module if applicable
 - .3 When using conduit to conceal wire, mount detector to single gang box
 - .4 When using V series wire mold to conceal wire, mount detector to shallow single gang box model
 - .5 Max wire length 80 meters/run unless specified otherwise

3.5 Photo Electric Beams

- .1 Device location
 - .1 For external use mostly
 - .2 Defines protected area by creating an "electronic fence"
 - .3 Should be pole-mounted at a height between 610mm and 1829mm
- .2 Wiring
 - .1 Adhere to NF standards
 - .2 6/22 FT4 rated wire. FT6 rated wire if required
 - .3 Home run to control panel or keypad/expansion module if applicable
 - .4 Concealed pathway
 - .5 Max length of 80 meters/run unless specified otherwise

3.6 Magnetic Contacts

- .1 Device location
 - .1 Contact should be installed in the top of the door frame, in line with the center of the door.
 - .2 Magnet should sit no more the 13mm away from contact with the door in a fully closed position.
 - .3 Contact should be flush mounted and concealed in door frame whenever possible.
- .2 Wiring
 - .1 4/22 FT4 rated wire. FT6 rated wire if required
 - .2 Home run to control panel or keypad/expansion module if applicable
 - .3 When using conduit to conceal wire, the pipe should stub directly into the frame or terminate directly above frame in a single gang box
 - .4 When using wire mold to conceal wire, the wire mold should stub directly into the frame or terminate directly above frame in a shallow single gang box model
 - .5 Max wire length 80 meters/run unless specified otherwise

3.7 Power Transformers

- .1 Device location
 - .1 Should be "wire-in" type and mounted as close to the control panel as possible, preferably in the communication room. Plug-in type under restricted circumstances.
 - .2 Compatible with any 13mm punch out conduit box.
 - .3 Must not be installed above false ceiling if space is "return air" plenum type.
- .2 Wiring
 - .1 Adhere to UBC IT - Connectivity Infrastructure standards
 - .2 2/18 FT4 rated wire. FT6 rated wire if required
 - .3 Home run directly to control panel
 - .4 In communication room, dress wire to cable facilities standards

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 28 05 00 Access Services: General Standards

1.2 Related UBC Policy

- .1 Policy No.: SC16 - Safety and Security Cameras

1.3 Coordination Requirements

- .1 UBC Electronic Systems and Campus Security and Secure Access.

1.4 Description

- .1 All Safety and Security Camera installations shall comply with UBC Policy No. SC16:
<https://universitycounsel.ubc.ca/policies/video-cameras-policy/>
- .2 This section covers requirements for Safety and Security Cameras. Cameras are installed by Campus Security and Secure Access. General Requirements for this system for Consultants and Contractors are provided in Section 28 05 00 Electronic Security Systems: General Standards.
- .3 These guidelines provide reference to particular types, grades and models of products. In general, the references include both generic descriptions and specific product details. These references shall not be construed as a directive to sole-source products from any particular vendor except where this is specifically stated.
- .4 Safety and Security Camera system that monitors both live and recorded events may include the following:
 - .1 IP camera.
 - .2 Video Encoder
 - .3 Mid-span Injector
 - .4 Video Management System (VMS) software.
 - .5 VMS server and storage.
 - .6 Desk top computer.

2.0 MATERIALS

2.1 IP Camera

- .1 Device Location
 - .1 Wall or ceiling mountable. Whenever possible, camera should be faced away from available light source. Exact location and viewing angle shall be confirmed by Campus Security and Secure Access.
- .2 Wiring
 - .1 Demark for IP Cameras. Reference to Communications Standard Drawings ITSTD-23, ITSTD-24, and ITSTD-25
- .3 Device Feature
 - .1 PoE Class 3 or better.

- .2 Minimum resolution 1920 x 1080 (2MP), capable of 30+ IPS, minimum 2 streams at full resolution.
- .3 Minimum illumination 0.16 lux (Colour), 0.08 lux (Black & White).
- .4 RJ45 connector.
- .5 Video Compression supported includes H.264, H.265, MJPG.
- .6 Support for optional onboard memory card (microSD) for backup storage, minimum Class 10, sized for minimum 72 hours video retention at full stream quality (i.e. 2MP, 30+ IPS).
- .7 Where directed, IK10 vandal resistant rating.
- .8 Unless otherwise directed for a specific application, all cameras shall be indoor/outdoor rated, IP66/67 rated for outdoor applications, complete with IP66/67 connectors in all outdoor applications.
- .9 New cameras shall support minimum 120dB Wide Dynamic Range, unless directed or approved otherwise.
- .10 All supplied devices shall be CSA/ULC listed, unless approved otherwise.

2.2 Mid-span Power over Ethernet (PoE) Injector

- .1 Device Location
 - .1 Should be installed in the Telecom Room or closet rack mounted, subject to input from Div. 27, else a mechanically secured and alarmed room. Shelf, bracket, or rack mountable.
- .2 Wiring
 - .1 Dedicated power 120Vac. RJ45 Ethernet connectors.
- .3 Device Features
 - .1 120VAC, 60hz operation. Provides PoE/PoE+, 30/60W full power per port, 100m data extension. IEEE 802.3af compliant. Operating temperature -20° C to +40° C.
 - .2 Minimum eight (8) POE/POE+ ports.
 - .3 Include a network port for remote connection and management.
- .4 Application
 - .1 Where a small quantity (one or two) cameras are fed from a network switch, they shall be connected to and powered from that PoE/PoE+ switch, without a separate PoE midspan.
 - .2 Where three or more (3+) cameras are connected to the same switch, a multi-channel PoE/PoE+ midspan shall be installed in a mutually approved space, and cameras shall be fed from that midspan.
 - .3 Any cameras which have an integral heater, and most PTZ cameras, will generally require PoE+ power supply.

END OF SECTION

1.0 **GENERAL**

1.1 Related UBC Guidelines

- .1 Section 27 05 08 Cable Infrastructure Design Guidelines – 1.4.10
- .2 Section 27 05 05 Communication Rooms Design Guidelines – 1.4
- .3 Section 08 71 00 Door Hardware

1.2 Coordination Requirements

- .1 UBC Energy & Water Services (Vancouver)
- .2 UBC Building Operations Electrical Technical Support (Vancouver)
- .3 UBC Information Technology
- .4 UBC Facilities Electrical (Vancouver)
- .5 UBC Facility Management (Okanagan)

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 General Requirements

- .1 The fire alarm system shall be a complete electrically supervised, single stage, non-coded addressable system. The system shall incorporate only addressable notification appliances in addition to addressable speakers if required.

The system shall be the following:

Vancouver: Simplex 4100ES series control panel, Autocall 4100ES or equivalent.

Okanagan: Edwards EST3 series or equivalent.

Equivalents will be evaluated by UBC Facilities Electrical (Vancouver) / Facility Management (Okanagan). Approval of equivalent equipment will be provided in writing by UBC Facilities Electrical (Vancouver) / Facility Management (Okanagan).

- .2 All fire alarm systems must be designed by a Professional Engineer currently registered in BC.
- .3 All fire alarm systems shall comply with the following standards:
 - .1 CAN/ULC-S524.
 - .2 CAN/ULC-S537.
 - .3 BC Building Code.
 - .4 Canadian Electrical Code as amended for British Columbia.
- .4 Interfacing fire alarm system with BMS system.
 - .1 Review Section [25 05 00 Building Management System \(BMS\)](#) for interfacing.
 - .2 Provide form C dry contact signals to BMS as applicable.
 - .3 [The fire alarm system shall not be controlled by the BMS during a fire alarm event.](#)
- .5 Each ancillary function of the fire alarm system shall have its own independent bypass switch, (i.e. fans, door holders, security locks, bells, elevator homing, BMS, monitoring, etc.). Each switch is to be clearly labeled with LED annunciation of its normal and active positions.

- .6 Commissioning/Verification
 - .1 At the completion of verification of the fire alarm system and before fire alarm monitoring is connected, UBC Building Operations Fire and Life Safety (Vancouver) / Facility Management (Okanagan) shall be provided with:
 - .1 A colour photocopy of the current red line electrical drawings.
 - .2 A complete copy of the Verification Report.
 - .3 A complete list in excel format of all field devices installed.
 - .4 A detailed matrix describing device inputs and outputs. Included are all smoke control sequences, FEO Service matrix and other ancillary operations.
 - .5 A copy of the currently installed fire alarm panel program and ES Panel Programmer Report.
- .7 Any operation of the smoke control sequence of operation shall be controlled by hard wired interlocks with the fire alarm panel whenever possible. BMS control of smoke control system components shall not be permitted.
- .8 Avoid nodes and networked panels in buildings where possible. One panel is preferred.
- .9 Ancillary functions requiring 120VAC shall be fed from separate circuits, independent of the A.C circuit that feeds the fire alarm panel.
- .10 All fire alarm system field circuits shall have connected loads/devices to a maximum of 60% of manufacturers allowable.
- .11 Window actuator systems shall not be tied to the fire alarm system.
- .12 FA devices in grey or black colour is not permitted. FA Devices in non standard colours shall only be considered if the surrounding finishes provide adequate contrast for ease of identification. Non standard colours must be approved by UBC Facilities Electrical.

2.2 Main Control Panel

- .1 The main control panel shall be modular type, complete with all necessary plug-in modules or plug-in cards, and shall contain zone indication and all manually operated functions in the front cover behind a lockable door with viewing window. The panel shall contain enough bypass switches with a least 3 spares to provide each special system and/or ancillary system with bypass capability.
- .2 The location of fire alarm control panel shall be in the Main Electrical Room.
- .3 The 120VAC circuit supplying the Main Fire Alarm Control Panel shall have a surge protection device installed in or connected to a 4" square electrical box within 1m of FACP or as per manufacturer specifications. Preferred device is a Ditek DTK-120HW or equivalent.
- .4 The FACP shall be fed from a 120/208V Panelboard within the same room as the control panel. Distribution Boards/Switchboards are not acceptable.
- .5 The FACP enclosure shall not be used as a raceway for power or ancillary system wiring. All power and ancillary wiring within the FACP enclosure shall only be permitted when terminating (not splicing) to FAS cards and modules mounted within the FACP enclosure.

2.3 Pre-Action Control Panel for Sprinkler System

- .1 Pre-action control panel for sprinkler system, if required, has the following requirements:

- .1 Capable of disabling the following using a separate switch for each:
 - .1 Notification appliance circuits (audible & visual).
 - .2 Notification appliance circuits (audible & visual).
 - .3 Releasing circuits.
 - .4 Alarm, supervisory and trouble signals to base building FACP.
 - .5 Ancillary equipment required by design (hatches, shutters, fans, etc.).
 - .2 Monitored by the base building FACP individual points for:
 - .1 Releasing panel alarm.
 - .2 Releasing panel supervisory.
 - .3 Releasing panel trouble.
 - .3 Connected to:
 - .1 All tamper switches on a supervisory zone.
 - .2 All low air and low water pressure switches on separate supervisory zone.
 - .3 All devices that monitor release on an alarm zone.
 - .4 If annunciation is required using a separate LED as part of a base building FACP graphic type annunciator then the releasing panel shall be networked with the base building FACP.
- .2 A complete sequence of operation matrix identifying all possible input conditions and corresponding outputs shall be provided to UBC Facilities Electrical (Vancouver) / Facility Management (Okanagan) before system demonstration.

2.4 Central Fire Alarm Monitoring

- .1 The Project Manager shall contact the UBC Facilities Electrical (Vancouver) / Facility Management (Okanagan) and request the UBC Fire Alarm Monitoring Installation Procedure at least 3 months before substantial completion.
- .2 UBC IT Voice Services, upon receipt of valid request, will provide analog service for fire alarm monitoring at the designated service demarcation in the building. The completion timing of this service is based on the date of submission of the request for service. The designated UBC fire alarm monitoring company will be responsible to make the final connection between the monitoring equipment and the analog service demarcation point. The analog demarcation point is not to be altered or modified in any way.

2.5 Monitoring Transponder

- .1 (Vancouver) UBC Electrical Technical Support shall provide monitoring equipment at the project's cost.
- .2 The Electrical Contractor shall install the provided cabinet, internal stand-offs, transformer and all required conduit complete with pull strings as per UBC Standard Drawing E11-1.
- .3 The transponder shall use a dedicated circuit from the same power panel as the fire alarm panel. This circuit shall not share a neutral with any other circuit.
- .4 The UBC Fire Alarm System monitoring company shall install, connect, test and commission all components within the cabinet, cabling to the UBC ITS demarcation and cabling to the Fire Alarm Panel including all required terminations.

2.6 Alarm Annunciator

- .1 The location of the annunciator shall be acceptable to the Authority having jurisdiction.

- .2 The fire alarm annunciator shall be located on the inside of the building envelope to protect against rain and weather damage.
- .3 The fire alarm annunciator shall be mounted on an insulated wall, interior wall or on standoffs to avoid cold condensation issues.
- .4 The annunciator shall be manufactured by a company usually engaged for such equipment.
- .5 The fire alarm annunciator shall have a keyed enable switch to avoid tampering by the public when in alarm acknowledge, supervisory acknowledge and trouble acknowledge functions.
- .6 An active graphic style annunciator shall be required for buildings with 10,000 square meters of space or greater.

2.7 Other Requirements

- .1 No combined type detectors will be acceptable.
- .2 Each valve, switch, contact, etc. that requires connection to the FACP shall be monitored by an individual module.
- .3 All remote monitor, isolator and relay modules shall be mounted in a dedicated electrical box external to the cabinet of the equipment they monitor or control with manufacturer supplied mounting brackets and covers.
- .4 Door hold open devices shall be monuments rather than integrated door closure and hold open devices.
- .5 Where an Emergency Generator is supplied, the Fire Alarm Control Panel and all remote Fire Alarm equipment shall be supplied with power from the Life Safety Distribution.
- .6 Where an Emergency Generator is supplied, the Fire Alarm System shall monitor the Generator and Transfer Switch for any and all abnormal conditions.
- .7 Beam type detectors shall be Fire Ray 5000 or approved equivalent. Approval of equivalent equipment shall be provided in writing by Building Operations Electrical Technical Specialist. (Vancouver)
- .8 Aspiration type detection shall be VLP-012 VESDA LaserPLUS or equivalent. The end sampling point of each pipe run shall terminate 1m to 2m above finished floor in a readily accessible area to allow for system testing and maintenance. Approval of equivalent equipment shall be provided in writing by Building Operations Electrical Technical Specialist (Vancouver).
- .9 (Vancouver) Contact UBC Building Operations Electrical Technical Support for acceptable temporary Fire Alarm Control Panel passwords.
- .10 One minute inhibit shall be disabled in panel program unless required by any applicable code or standard.
- .11 One minute time delay shall be active from time of AC power loss until Fire Trouble is activated.
- .12 The following requirements apply to UBC Okanagan only:

- .1 Commissioning should include proper verification to UBCO Campus Wide Systems (CHP and Security Firework stations)
 - .2 Fire system contractor responsible for insuring Omega Communications Ltd converts EST-3 signal to be able to communicate to Kelowna Fire Department. This is to be done minimum two weeks prior to verification to allow for scheduling of Omega.
 - .3 Fibre connections to the Campus Wide System from Library to CHP needs to be scheduled minimum 2 weeks prior to verifications with IT Services and Facilities Management.
 - .4 Fire system contractor responsible for updating maps on Fire Works Stations in CHP and Security.
- .13 Ceiling Mounted notification appliances shall be installed in locations that are accessible with a maximum 12' ladder. Wall mounted locations shall be considered in instances where ladder access is not possible.
- .14 Back boxes shall be utilized for any surface mounted pull station. Manufacturer supplied steel stamped boxes shall be utilized for interior applications and cast iron for exterior applications.
- .15 **Exterior Fire Alarm Devices installation requirements:**
- .1 Bottom Entry
 - .2 Weather Rated
 - .3 Metal Shroud: Required to be mounted such that it does not interfere with operation or maintenance of FA device or adjacent equipment. Minimum of 6" vertical clearance from device and sized with a minimum 6" extension from the outermost edges of the FA device.

2.8 Panel Manufacturer's Responsibility and Inspection Requirements

- .1 Notwithstanding the Contractor's obligations, the entire fire alarm system shall be the responsibility of the panel manufacturer. Prior to acceptance of the system by the Consultant, the manufacturer shall check the entire system and certify the operation of all devices.
 - .2 The manufacturer shall make an inspection of the new fire alarm equipment installed under this contract, including those components necessary to the direct operation of the system such as manual stations, fire detectors and controls. The inspection shall comprise of an examination and subsequent verification of all equipment in accordance ULC-CAN4-S537. All equipment of the fire alarm system shall be listed for use with the panel manufacturer.
- .1 In case of partial occupancy of a building; a partial verification of the fire alarm system may be performed. This shall not waive the requirement of a complete verification as part of the substantial completion process for the entire building when complete.

END OF SECTION

1.0 **MATERIALS AND DESIGN REQUIREMENTS**

1.1 **Grading**

- .1 Grades of lawns and plantings shall comply with best management practices related to site drainage, and be kept within safe, stable and maintainable limits using appropriate slope retention design and construction methods.
 - .1 Site-specific design strategies should be used to avoid excessive, inaccessible or unsafe slopes (lawns or plantings). Such strategies may include, but not be limited to: terraced landscapes, retaining walls, enclosed planters, access ramps, pathways and stairs.
 - .2 Sloped landscapes must be graded appropriately in relationship to buildings, hardscape and other site elements such that mowers, excavators or other equipment used for maintenance or renovation purposes, are not at risk of losing traction, slipping, and rolling downslope causing injury to operators, bystanders, or damage to property (see .4 below).
 - .1 Balancing cut and, fill and aesthetic grading considerations, should not result in excessive mounding of soils such as to create knolls, hummocks or slopes that cannot be negotiated safely by landscape maintenance staff (either on foot or with power equipment).
 - .3 Grade at toe of steeper mown slopes must be graded to avoid mower-rollover or slippage due to abrupt grade discontinuities into top of retaining walls, or adjacent flat surfaces such as roads and walkways.
 - .4 Avoid planting trees within steep sections near toe of slopes unless conditions in paragraph 1.2.3 above have been met.
 - .5 Sloped landscapes must be structurally stable, and be resistant to surficial erosion or shifting of under-bearing soils, plants, trees or geotextile. Landscape maintenance staff must be able to access and negotiate sloped landscapes on foot or with equipment as needed without undue ergonomic stress, potential injury, loss of footing, or loss of equipment control.
 - .6 To keep slopes within reasonably safe and workable limits, maximum allowable slopes on UBC Campus shall not exceed 5:1 for lawns, and 3:1 for planted slopes. (Please also refer to Section 32 92 23 Sodding and Section 32 92 00 Turf and Grasses.)
 - .7 For specialized circumstances, such as planted slopes for stormwater detention ponds, or stream bank stabilization, variance from the above criteria may be granted subject to pre-approval by Campus Landscape Architect in consultation with Building Operations Head Landscape Technologist. Nonetheless, erosion control technologies such as matting, geo-grids, geo- synthetic bags etc. must be used to ensure stability of soils, mulches and the proper establishment of slope plantings as discussed in 1.1.3 above.
- .2 Under no circumstances should rough or finished grades of lawn, planting or paving result in the burying or otherwise obscuring of existing utility service covers, valve-boxes, manholes, catchbasins, or the like. Should a circumstance arise where a service will fall below proposed finish grades, contractor must halt work and contact the owner immediately before proceeding.

*****END OF SECTION*****

1.0 **DESIGN REQUIREMENTS**

- 1.1 All Division 32 Technical Guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications.
- 1.2 All landscape work must conform to requirements and specifications in the current editions of the Canadian Landscape Standard and Master Municipal Construction Documents (MMCD) unless otherwise specified in the contents of UBC's Technical Guidelines.
- 1.3 Landscape work must reference all relevant sections of the Technical Guidelines.
- 1.4 Landscapes must be designed to recognize the limited maintenance resources available to maintain the campus landscape in an institutional context.
- 1.5 Place trees at distances from building that when mature, do not provide a route for squirrels and racoons to access buildings.
- 1.6 Provide a 12" (30cm) gravel/drain rock strip at the base of buildings where planting or lawn areas are adjacent to buildings. Separate aggregate border from planting or lawn area with aluminum edge restraint.
- 1.7 All landscape, area and exterior lighting designs shall be reviewed by UBC Building Operations Electrical Support before Tender Drawings are complete.
- 1.8 All planters and planting areas above ground level must be easily accessible to gardeners, have an available water source, and allow for the safe and easy delivery and removal of organic matter and other debris.

Planters or planting areas raised 3m (10') or more from adjacent finished grade must have built in fall arrest anchors.
- 1.9 Both soft and hard landscapes must be designed to accommodate the loading and movement of heavy equipment in and around buildings for window washing and cladding repair.
 - .1 Movement of a 'manlift' around the building for window washing must be coordinated with the Project Architect, UBC Custodial Services, and/or Municipal Services as appropriate.
 - .2 Contractors must take precautions to protect all surfaces, structures, landscapes, utilities, etc. adjacent to and/or subject to impact from the work being performed.
 - .3 Contractors must provide protection to buildings, trees, lawns, walkways, pathway lights, streets, roads, underground irrigation systems, services, etc. from loss or damage resulting from the work. The Contractor will be responsible for the repair (or costs of repairs) to any damage caused as a result of the work performed by them.
 - .4 Coordinate as early as possible in the conceptual and design development phases with relevant UBC Facilities staff.
- 1.10 All level crosswalks, curb ramps at roads, driveways, tops of steps, and pedestrian ramps to include cast in place tactile warning tiles. 60cm long x width of crosswalk or walking surface of ramp or steps. [See UBC Campus Plan Design Guidelines.](#)

- 1.11 No new water features that are recirculating, depend on mechanical equipment to operate, or require potable water to operate are permitted to be built. Passive rainwater management features are permitted.
- 1.12 Any damage to existing hard and softscape outside the Limit of Work of a project must be restored to pre-existing condition or better if the damage was caused by project construction.
- 1.13 It is recommended that Project Managers request acceptance of new landscapes by Municipal Services during the growing season. Projects not achieving Final Completion of all deficiencies before November 15th should be maintained by the Contractor until May 15th the following year in order to avoid adverse seasonal conditions not conducive to the establishment of the landscape.

*****END OF SECTION*****

1.0 **DESIGN REQUIREMENTS**

- 1.1 UBC practices Integrated Pest Management in compliance with UP7 Pest Control Policy <https://universitycounsel.ubc.ca/policies/pest-control-policy/>. Pests will be controlled whenever possible through integrated pest management (a combination of cultural and biological techniques and selective chemical methods). Pesticides may be used on University land sites and buildings by employees of the University or contractors to the University provided all Federal and Provincial procedures for safety, environmental protection and information are followed. All relevant federal Ministry of Agriculture and British Columbia Ministry of Water, Land and Air Protection regulations are followed.
- 1.2 Landscape plantings and hardscapes must be designed to minimize the need for toxic pesticides and herbicides. Design strategies must include:
- .1 Selecting pest and disease resistant trees and plant material.
 - .2 Selecting hardy, vigorous, drought tolerant plants that can resist being overwhelmed by weed growth.
 - .3 Consider providing a continuous cover of evergreen groundcovers to shade the soil surface and inhibit weed development before shrubs and trees have had enough time to grow and provide cover over bare ground.
 - .4 Specifying growing media and container and field-grown plant material that are guaranteed free of pernicious weeds and seeds as per Canadian Landscape Standard, and Canadian Nursery Stock Standard.
 - .5 Specifying organic mulches that are guaranteed free of weeds and seeds.
 - .6 Specifying resin bonded permeable jointing material in paving joints to inhibit organic residues and weed growth in paving joints. Polymeric sand is not sufficient.
 - .7 Placing trees at distances from building that when mature, do not provide a route for squirrels and racoons to access buildings.

END OF SECTION

1.0 DESIGN REQUIREMENTS

- 1.1 The principals of CPTED should be consider and reviewed at each stage of the project from pre-design through to occupancy, with reference to the extensive literature on this subject.
- 1.2 Project design features that address CPTED issues should be flagged for consideration in the plan reviews by the Emergency Services Committee, including representatives of Campus Planning & Development, Heath Safety and Environment, Campus Security, RCMP, fire, ambulance and UEL and by Advisory Design Review Panel with a CPTEC specialist from Richmond Police.
- 1.3 On complex, large projects, consideration should be given to including a CPTED consultant to the Project Team.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Scope**

- .1 This guideline addresses the quality and scope of landscape maintenance services required during the project maintenance period prior to acceptance of maintenance responsibility by UBC Facilities. Work includes pest, weed and disease control, cultivation, mulching, lawn cutting, warranty and replacement of plant material, stakes, guywires, manual watering, irrigation adjustment and winterizing, etc.

1.2 **Related Work**

- .1 Section 32 00 13 Integrated Pest Management
- .2 Section 32 01 93.01 Tree and Shrub Preservation
- .3 Section 32 93 05 Relocation of Existing Plant Material
- .4 Section 32 80 00 Irrigation
- .5 Section 32 91 00 Planting Preparation
- .6 Section 32 93 00 Plants
- .7 Section 32 92 00 Seeded Lawn and Meadows
- .8 Section 32 92 23 Sodding

1.3 **Workmanship**

- .1 All work shall conform to the standards and practices outlined in the Canadian Landscape Standard – current edition; to be executed by skilled tradespersons well equipped and adequately supervised, and performed in accordance with these Standards.

1.4 **Record of Maintenance Operations**

- .1 Work Schedule: At Substantial Completion, the Project Manager to provide Municipal Services with a schedule outlining the tasks to be undertaken through the maintenance period. These shall include as a minimum: fall/spring clean-up, fertilizer application, mulch application, irrigation, garbage clean-up, pruning, turf top-dressing and aeration.

1.5 **Scope of Work**

- .1 Provide all equipment, material and labour for work specified.

1.6 **Duration and Warranty**

- .1 The landscape maintenance period shall begin at Substantial Completion of the landscape for a period of not less than 60 days and until all deficiencies identified by the Project Landscape Architect and Municipal Services have been addressed. Municipal Services Landscape Architect must be provided with written notice that the landscape is Substantially Complete.
- .2 The Contractor shall be responsible for the maintenance of all project landscape areas including in areas outside the project area that have been damaged by project construction, pedestrian or vehicular traffic, or have been inaccessible to Municipal Services during project construction.
- .3 The warranty on plants and trees will be for one (1) full year commencing from the end of the date of Substantial Completion of the landscape work.
- .4 The Project manager must schedule an end-of-warranty inspection that includes the Project Manager, the Project Landscape Architect, the landscape contractor, and a representative from Municipal Services (contact Landscape Architect, UBC Municipal Services). Provide at

least forty-eight (48) hours notice.

1.7 Notification

- .1 Notify the Project Landscape Architect and UBC Municipal Services Head Landscape Technologist if any disease or insect problems arise during the maintenance period.
- .2 Any pest control measures to be implemented by the Contractor shall be reviewed and approved in writing by UBC Municipal Service prior to their use. Provide the Project Landscape Architect and UBC Municipal Services with a minimum 72-hour notification in writing prior to application of chemical vegetation controls. Follow all municipal, provincial and federal regulations if pesticides are used.
- .3 Notify both the Project Landscape Architect and UBC Municipal Services of any physical changes and/or discrepancies which may affect the implementation of the contract as specified herein or which may endanger the public.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Materials

- .1 The Contractor shall provide all materials, labour and equipment necessary to perform the operations as specified herein and as required to provide the optimum environment for the establishment of the landscape.
- .2 Mulch: If provided during the maintenance period shall conform with requirements in Section 32 93 00 Plants.

2.2 General

- .1 The Contractor shall maintain the project free from any defect resulting from work done or material supplied by the Contractor. The Contractor shall, to the satisfaction of the Project Landscape Architect and UBC Municipal Services, rectify any defect that exists within the Maintenance Period.
- .2 The Contractor shall be responsible for regular examination of the site during the term of the Contract and shall adjust the work schedule to suit site conditions.

2.3 Maintenance of Lawn and Meadow Areas

- .1 The Contractor shall be responsible for the maintenance of all project lawn and meadow areas including any outside the project area that have been damaged by project construction or pedestrian or vehicular traffic. Maintenance of lawn or meadow areas shall include all measures necessary to maintain and protect lawn or meadows in a vigorous, healthy, normal growing condition.
- .2 Begin maintenance immediately after Substantial Completion of the landscape for not less than 60 days and as long as needed to establish lawn.
- .3 All mowed lawn areas shall be cut to maintain a maximum height of 3-1/2" (90mm). Not more than 1/3 of the blade shall be cut at any one mowing. Meadow areas shall be cut once or twice per season as appropriate to desired appearance and weed suppression.
- .4 Equipment shall be sharp, level and prevent burning or gouging of lawn.

- .5 All clippings and debris shall be removed at the time of mowing, and disposed of off-site. This includes but is not limited to wet or dry grass clippings on bollards, lamp posts, concrete walls, curbs and steps, sidewalks and other paved areas, signs, sign posts, benches, tree trunks and stakes, shrub planting, etc.
- .6 The Contractor shall monitor the lawn or meadow areas that are not in a healthy growing condition and reseed them as soon as conditions are favourable. Areas showing shrinkage due to lack of watering shall be top dressed and seeded with the original mix.
- .7 Regular and adequate watering shall be provided in order to promote healthy lawn or meadow growth. In the event of watering restrictions which prohibit the use of the automatic irrigation system or in areas which lack an automatic irrigation system, manual watering shall be performed in quantities and at intervals required to promote healthy, vigorous grass or meadow growth.
- .8 Do not use line trimmers around trees and shrubs. Sprinkler heads shall be trimmed to clear as often as necessary to keep them operating properly. Hard surface areas adjacent to the lawns shall be swept and cleaned after each operation.
- .9 Rolling shall be carried out when required to remove any minor depressions or irregularities.

2.4 Maintenance of Plants and Planted Areas

- .1 The Contractor shall be responsible for the maintenance of all plants, planted areas and trees including any outside the project area that have been damaged by project construction or pedestrian or vehicular traffic. Maintain plants in a vigorous, healthy, normal growing condition, providing an appearance characteristic of their species and appropriate to their surroundings. Such maintenance shall include but not be limited to general cultivation, weed, pest and disease control, mulching, moisture conservation and watering, fertilizing, plant protection, pruning, and general clean-up.
- .2 Begin maintenance immediately after Substantial Completion of the landscape for not less than 60 days and as long as needed to establish the planted areas.
- .3 All plant material shall be alive and in a healthy growing condition at the end of the maintenance period. Plant material which is not in such a condition shall be removed from the site and replaced before project Final Completion.
- .4 Remove and replace dead plants and plants not in healthy growing condition upon notification. Make replacements in same manner as specified for original plantings and within 10 days of written request from Project Landscape Architect or UBC Municipal Services, weather and conditions permitting.
- .5 For maintenance contracts two months or greater, it shall be the responsibility of the Contractor to maintain an adequate level of soil fertility through the regular application of mulches, suitable fertilizers, and the control of soil acidity where required. Lime shall be applied to plant areas where acidity is inappropriately excessive (i.e., below pH 4.5). For lawns, 23-3-23 spring and summer feeder. For shrubs and trees, 8-12-10. No lime shall be applied where specific planting requires an acid condition such as Ericaceous shrubs, rhododendrons and other acid liking broadleaf evergreens.
- .6 For maintenance contracts two months or greater, the Contractor shall apply, slow-release fertilizers to all plants (as described above) once per year. Apply fertilizer to plants once in early spring, after danger of frost has past, and not later than June 30, at manufacturer's suggested rate or as required to promote health growth. Fertilizer shall be slow release, sulphur coated urea base, such as Agrico-Evergro Total (23-3-23) or approved equal.
- .7 Regular and adequate watering shall be provided in order to promote healthy plant growth. In

the event of watering restrictions which prohibit the use of the automatic irrigation system or in areas which lack an automatic irrigation system, manual watering shall be performed in quantities and at intervals required to promote healthy, vigorous plant growth. Planted areas shall be watered at frequencies required to replace moisture at the root zone. Reform damaged watering saucers at the base of all trees.

- .8 Replace or respread damaged, missing or disturbed mulch. Remove dead, broken or hazardous branches from plant material.
- .9 All trees shall be protected against wind and snow damage by adequate staking, guying, tying or wrapping as conditions require. Guys, wire ties and stakes shall be examined at frequent intervals, and adjustments or renewals made to prevent abrasions or other damage to plants. Keep tree supports in proper repair and adjustment. Remove tree supports and level watering saucers at the end of the one-year [warranty](#) period.
- .10 Any plants maintained as hedges must be level and not parallel with the ground.

2.5 Weed Control

- .1 The Contractor shall be responsible for detection, recognition and timely control of plant pests and diseases. The Contractor shall have an up-to-date knowledge of the most effective, non-toxic, organic insecticides, miticides and fungicides, together with the ability to diagnose ailments. Obtain written approval from UBC Municipal Services prior to their application.
- .2 The Contractor shall be responsible for the regular inspection and removal of weeds from all landscape portions of the project. [Chemical pesticides are strongly discouraged from use on the campus except where heavy infestation makes this the only viable option.](#) Obtain written approval from UBC Municipal Services prior to application of toxic chemical pesticides for any extenuating circumstances. Weeding shall be done at a weekly interval during the maintenance period. Any weeds that are identified shall be removed within 1 week of inspection. In no cases shall weeds be allowed to be greater than 50 mm in spread. Weeds must be removed in their entirety, including root systems or any other below-ground parts.
- .3 Weeds are defined as undesirable plants and will include all plant species not intentionally planted or seeded, unless mutually agreed upon by the Project Landscape Architect and/or UBC Municipal Services Head Landscape Technologist and Contractor. Weeds will include, but not be limited to such plants as [Horsetail](#), [Morning Glory](#), annual bluegrass, barnyard-grass, chickweed, crabgrass, clover, couch-grass, dandelion, groundsel, horsetail, mallow, morning glory, prickly lettuce, mustards, oxalis, pigweed, pineapple weed, plantain, shepherd's purse, smart weed, snapweed, sow thistle, stork's bill, thistle and will also include invasive, non-native species such as Scotch broom, Himalayan blackberry, and purple loosestrife. Weeds will also be defined as any of the grass seedlings that germinate and develop in the mulched shrub bed areas that are caused by an over-application in the seeding or hydroseeding operation.
- .4 The Contractor shall monitor the site for the presence of weeds growing in project hardscape. All weeds in these areas shall be removed once per month.
- .5 The type of weeds in an area shall determine the method of treatment. Weed control may consist of, but is not limited to the following:
 - .1 hand-pulling, digging, cultivation,
 - .2 encouraging the growth of desired plants which can compete with weeds, and
 - .3 timing the mowing of grass areas to correspond with the seeding cycle of weeds.
- .6 In situations where there is doubt concerning the necessity or effectiveness of a weed control [strategy](#), the decision of the Project Landscape Architect in consultation with UBC Head Landscape Technologist will finalize the best course of action.

2.6 Irrigation

- .1 Regulate proper application of water through the irrigation system to ensure healthy plant growth.
- .2 Complete blow out and drainage of the irrigation system prior to winter and the complete reinstatement of system operations in the spring.
- .3 Damage to the sprinkler heads or other parts of the system resulting from Contractor's operations shall be replaced without charge to UBC.
- .4 Failures in the irrigation components due to other causes, such as wear, vandalism, accidents caused by others, etc., shall be reported to the Project Landscape Architect and UBC Municipal Services Landscape Architect.
- .5 All irrigation heads shall be kept clear of debris so that good coverage results.

2.7 Litter and Waste Clean-Up

- .1 Clean-up of litter and landscape waste shall be considered part of normal maintenance work. Litter shall include, but not be limited to, bottles, cans, plastic, rubber and all paper. Landscape waste shall include, but not be limited to, windfall, prunings, weeds, grass clippings, fallen leaves, stones and surplus or other waste materials as a result of landscape maintenance and construction operations.
- .2 All waste shall be gathered and removed from the site at the end of each day's maintenance operations. All litter shall be gathered and removed from the site weekly.

*****END OF SECTION*****

1.0 GENERAL

1.1 Scope

- .1 This guideline addresses the protection and care of existing trees, shrubs and plantings that have been designated for retention on or adjacent to new building sites and existing landscapes on the UBC Campus.

1.2 Related Work:

- .1 Section 32 91 00 Planting Preparation
- .2 Section 32 93 00 Plants
- .3 Section 32 93 05 Relocation of Existing Plant Material

1.1 Consulting Arborists and UBC Building Operations ISA certified arborist

- .1 Where trees, or tree preservation strategies are anticipated as part of a development proposal, an ISC Certified Arborist must be retained as an integral member of the project consultant team. The Consulting Arborist is to advise on specific pre- and post-development strategies, and provide expert analysis, details and/or specifications required to optimize planned tree retention and preservation.
- .2 A UBC Municipal Services Arborist Technician will serve as UBC's representative in arboricultural matters and can advise on tree issues with consultants and UBC staff as required.

1.3 Coordination

- .1 Coordinate with a UBC Municipal Services Arborist Technician as early as possible in the conceptual and design development phases of a project.
- .2 Coordinate with a UBC Municipal Services Arborist Technician throughout construction phases regarding any site changes, potential damages or pruning required to existing trees to be retained.

Coordinate with a UBC Municipal Services Arborist Technician during construction regarding any impacts or potential damages to any existing shrubs or plantings designated for retention.

1.4 Standards

- .1 Canadian Landscape Standard - current addition.

1.5 Definitions

- .1 The Critical Root Zone of a tree is an arboricultural rule of thumb for establishing minimum area for tree root protection. It is applied in this guideline for determining Tree Protection Zones and location of tree protection fencing (see 2.1.1 and Fig. 1 below).
- .2 Tree Protection Zone is equivalent to the Critical Root Zone and is defined and enclosed by the Tree Protection Fencing for an individual tree designated for tree preservation and protection.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Tree Relocation and Protection Plans

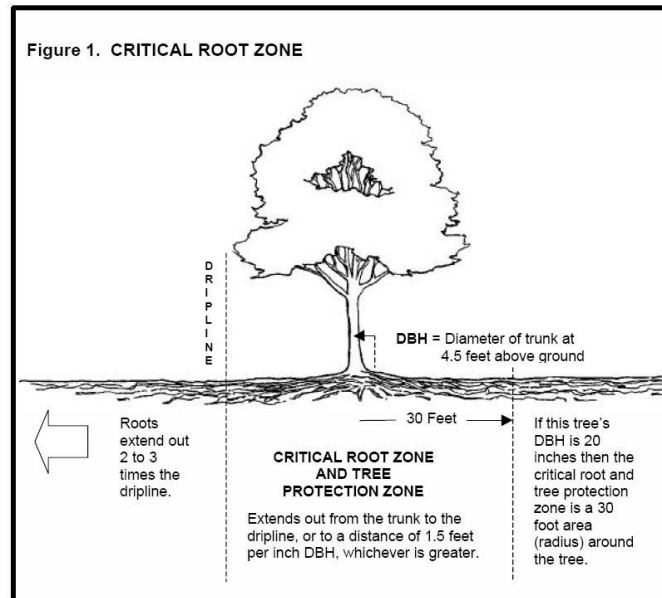
- .1 For trees to be relocated and/or retained on site, the Project Landscape Architect must provide Tree Protection/Relocation Plans indicating surveyed grades at base of trunks, DBH, extents of drip lines and location of Tree Protection Fencing. Specifications and cross-sectional details for applicable preservation strategies including, but not limited to, requirements covered in this general guideline must be included in construction documents.

2.2 Approvals, Inspections and Supervision

- .1 The Planner/Landscape Architect (C+CP), Landscape Architect (Municipal Services), Project Landscape Architect, Consulting Arborist, and a UBC Municipal Services Arborist Technician shall coordinate as early as possible in the project to identify trees to be retained, protected, transplanted or removed and clearly establish tree preservation measures and significant design criteria.
- .2 General Contractor to meet with Project Landscape Architect, Consulting Arborist, and a UBC Municipal Services Arborist Technician as required for review of Tree Protection Plan prior to any fencing or hoarding on site.
- .3 During the construction phase, the Contractor shall contact a UBC Municipal Services Arborist Technician immediately regarding any changes impacting tree preservation on site or to trees immediately adjacent to site boundary.
- .4 Tree Protection Fencing must be approved by a UBC Municipal Services Arborist Technician prior to the commencement of site work.

2.3 Tree Protection

- .1 Tree Protection Fencing must be erected before the onset of construction in relationship to each tree's Critical Root Zone (see fig.1 below) as follows unless otherwise approved in advance in writing by a UBC Municipal Services Arborist Technician:
 - .1 Orange snow fencing securely fastened to 50 x 100 mm (2" x 4") wood frame with uprights driven into the ground. Fencing will be 1.8m (4') in height and extend to at least the dripline, or to a distance of 1.0m (1.5') of DBH (diameter breast height) radius for every 1.8cm (1") of trunk diameter at DBH (diameter breast height), whichever is the greater (see fig. 1 below).
 - .2 Tree Protection Fencing for woodlots or groups of plantings, shall be placed at least 1.0 meter beyond the dripline of outer canopies.



2.4 Tree Protection Signage

- .1 Tree Protection Fencing should be provided with signage at reasonable intervals to discourage hoarding, grade changes and heavy equipment intrusions into Tree Protection Zones. Use either UBC standard signage shown below or an equivalent approved by Campus and Community Planning.



2.5 Root Curtain

- .1 A temporary Root Curtain is required to cover exposed roots and conserve moisture along the cut face of excavations made adjacent to Tree Protection Zones. The Root Curtain is to consist of heavy wire mesh lined with burlap and supporting posts.

2.6 Tree Mulch and Anti-desiccant

- .1 Based on scope of site disturbance and/or adverse drought conditions, the Project Arborist or a UBC Municipal Services Arborist Technician may require that mulch or anti-desiccant be applied to trees either at the beginning or at any time during the construction process.

- .2 Tree chip mulch, including parts of the leaf, twig, bark and stem wood must be free of pests or diseases and must not contain Western Red Cedar or Black Walnut.
- .3 Anti-desiccant shall be specified by the Project Arborist or a UBC Municipal Services Arborist Technician, and applied by an Arborist/Arborist Technician according to the manufacturer's recommendations.
- .4 Provide a sample of the proposed tree mulch and source, and/or anti-desiccant for approval by a UBC Municipal Services Arborist Technician.

2.7 Site Work

- .1 All underground utilities, drainage and irrigation lines must be routed outside the Tree Protection Zone. If utility lines must traverse the Tree Protection Zone, they shall be air-spaded or tunneled under the tree at depths and distances recommended by the Project's Consultant Arborist.
- .2 Any pruning required on the project site must be performed by the Project Arborist.
- .3 Any pruning required outside the construction site to access the site prior to or during construction must be performed by a UBC Municipal Services Arborist Technician.
- .4 Any injury or tree damage during construction must be reported immediately to the Project Arborist or a UBC Municipal Services Arborist Technician who will recommend remedial actions as required to be carried out.
- .5 Any grading, construction or other work that is expected to encounter tree roots must be monitored by the Project Arborist or a UBC Municipal Services Arborist Technician.
- .6 Erosion control devices such as silt fencing, debris basins and water diversion structures must be installed to prevent siltation and/or erosion within the Tree Protection Zones as specified by the Project Arborist or a UBC Municipal Services Arborist Technician.
- .7 Any roots damaged during construction shall be exposed to sound tissue and cut cleanly with proper pruning equipment by the Project Arborist or a UBC Municipal Services Arborist Technician. Under no circumstances shall roots be severed by unqualified personnel using excavation equipment or inappropriate tools.
- .8 If temporary access roads must pass over the root area of trees to be retained, a road bed of 6"-10" wood-chip mulch with a supportive mat of boards or other rigid material shall be created to protect the roots and soil. The road bed shall be replenished as necessary to maintain a 6-10" depth. The Project Arborist or a UBC Municipal Services Arborist Technician is to be consulted for site-specific recommendations which may exceed these requirements.
- .9 Spoil from trenches, building basements, or other excavations shall not be placed within the Tree Protection Zones. No burn piles nor debris pits shall be placed in the Tree Protection Zone. No ashes, drywall concrete tailings or other debris or garbage may be dumped or buried within the Tree Protection Zone.

2.8 Care and Treatment of Retained Trees

- .1 During the construction process, the General Contractor must ensure adequate watering is provided within the Tree Protection Zone of each retained tree. The Contractor General must consult with a UBC Municipal Services Arborist Technician for recommendations on a watering schedule.

- .2 The General Contractor will exercise due diligence, stop work immediately and contact Project Landscape Architect, Project Arborist, and/or UBC Municipal Services Arborist Technician should any unforeseen site conditions impact the success of tree preservation on site.

*****END OF SECTION*****

1.0 **GENERAL**

- .1 The integrity and continuity of unique paving designs or materials such as exposed aggregate, coloured concrete, tile mosaics, rubberized asphalt, etc. may be difficult or impossible to match or replace. Designers should consider the need to repair or replace these materials over time.
- .2 Laying of flagstones or slab type paving with large gaps in between should be avoided due to the likelihood of weeds growing between them.
- .3 The maintenance and repair of non-standard paving materials will be customer funded expenses of the unit requesting them.
- .4 Base prep requirements must follow standard requirements specified in Master Municipal Construction Documents (MMCD).

1.1 **Related Guidelines**

- .1 MMCD Master Municipal Construction Documents, current edition
- .2 Transportation Association of Canada, Geometric Design Guide for Canadian Roads, current edition

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Design Requirements**

- .1 All standard municipal roadways should conform to MMCD and the Transportation Association of Canada's, Geometric Design Guide for Canadian Roads, current editions.
- .2 All road repair, remediation and rehabilitation shall be compliant with MMCD, current edition.

*****END OF SECTION*****

1.0 **MATERIALS AND DESIGN REQUIREMENTS**

1.1 **General Requirements**

- .1 The integrity and continuity of unique paving designs or materials such as exposed aggregate, coloured concrete, tile mosaics, rubberized asphalt, etc. may be difficult or impossible to match or replace. Designers should consider the need to repair or replace these materials over time.
- .2 The maintenance and repair of non-standard paving materials will be customer funded expenses of the unit requesting them.
- .3 All expanses of paving associated with all Public Realm spaces must be detailed to accommodate maximum anticipated vehicular loading. Vehicles and heavy equipment such as snorkel lifts required intermittently to service buildings, large trees, or respond to emergencies, must be accommodated without damage to surfacing due to loading.
- .4 Any utility upgrades or other projects that disturb and damage existing paving shall reinstate paving to original condition in compliance with relevant guidelines.
- .5 Where manholes, catch basins and service covers occur within expanses of unit paving, concrete surrounds should be considered as an additional detail to minimize uneven settling of adjacent paving – especially where increased vehicular loading is anticipated.

1.2 **Unit Pavers**

- .1 Public Realm unit paving should be installed such that:
 - .1 No end paving unit to be smaller than 8" x 8".
 - .2 A complete bonded installation of paving units at the ends and/or edges of paving each course is achieved.
 - .3 A minimum overlap of paving units is specified thus avoiding the incidence of running straight joints or near straight joints.
 - .4 Groupings of similar sized paving units are avoided (e.g. linear runs of 100 mm units would be unacceptable.)
 - .5 Sharp-angled cuts are to be avoided.
 - .6 Place aggregate base over compacted subgrade. Compact base to 100 percent of ASTM D 1557 maximum laboratory density and screed to depth required to allow setting of pavers.
 - .7 Concrete unit pavers to be 4" (100mm) thick in all areas that are accessible to vehicle traffic.
 - .8 Concrete unit pavers to be minimum 2-3/8" (60mm) thick in pedestrian only areas.
 - .9 Edge Restraint: [The edges of all areas of](#) unit paving must be detailed with a continuous, robust edge to support loading and prevent lateral expansion. PVC edge restraint manufactured by Pave-Tech Inc. Provide PAVE EDGE INDUSTRIAL PROFILE edge restraint and all associated parts, including galvanized steel spikes (10"x3/8"). Install as per manufacturer's recommendations, www.pavetech.com.

END OF SECTION

1. GENERAL

1.1 Related Scope of Work and UBC Guidelines

- .1 Section 05 00 00 Metals
- .2 Section 09 90 00 Painting & Coating
- .3 UBC Campus Design Guidelines (Vancouver and Okanagan) – for metal screens and finishes installed in the public realm.

1.2 Description

1. The Guidelines apply to all work completed on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
2. Work includes fencing, screens, guardrails and shelters within 10m of any building.

1.3 Coordination

1. In instances where conflicts are found between the UBC Technical Guidelines and provincial regulations or codes, please notify the UBCV Technical Review Team Architect or UBCO Facilities Management.
2. These guidelines are intended to be read by design consultants and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
3. The Coordinating Registered Professional (CRP) is required to coordinate these requirements with other disciplines.

1.4 Submittals

- .1 Submit required documents to consultants in accordance with Section 013300 Submittal Procedures
- .2 O&M Submittals
 - .1 Product specifications, type and colour.
 - .2 Final reviewed shop drawings for metal fabrications and where required, signed and sealed by a professional engineer registered in the Province of BC.
- .3 Provide Letter of Assurance for 1.5.2.2 above.

2. MATERIALS

- .1 All fencing, screens and shelters within 10 meters of a building shall be constructed using non-combustible materials such as metal.

END OF SECTION

1.0 **GENERAL**

- 1.1 Unique materials and complicated designs or detailing may be difficult or impossible to replace when repairs are needed over time and should be avoided in favor of standard materials that can be easily obtained from local suppliers and sources over time.
- 1.2 Any necessary repair and replacement of site furnishings that utilize non-standard materials or complicated designs, **or are movable and not fixed in place**, will be customer funded expenses of the unit that has requested these site furnishings.
- 1.3 **Movable site furnishings are the responsibility of the sponsor and must not be placed in locations that obstruct standard maintenance and operation.**

2.0 **DESIGN REQUIREMENTS**

- 2.1 UBC preferences for site furnishings including benches, waste receptacles, and light standards are referenced in the Vancouver Campus Plan, Design Guidelines unless otherwise noted in this section.
- 2.2 Provide minimum 2.2m spacing between bollard to allow passage of landscape and snow removal equipment.
- 2.3 Site furnishings must be attached using load-appropriate anchors and tamper-proof bolts and fittings.
- 2.4 It is imperative that hard landscape steps, furniture, walls and railings are designed to be resistant to skateboarding damages. After-the-fact add-on straps and studs are less desirable than surfaces that have been pre-considered as targets, and aesthetically designed to deter skateboarders. Preferred deterrents should be considered at the schematic design stage. Design strategies should include incorporation of air gaps, notching, and offsets in seat walls, uneven surfaces, and other creative alignments and articulation of surfaces, walls, steps and railings.
- 2.5 Minimum one year warranty on all site furnishings.
- 2.6 Minimum five-year warranty on garbage receptacles.

3.0 **MATERIALS**

- 3.1 Materials, **including structural components and fasteners, must be rust and** corrosion resistant.
- 3.2 Materials **must** be resistant to vandalism and to damage from skateboarders.
- 3.3 **Use of tropical hardwoods in site furnishings is not permitted.**
- 3.4 Selection of materials should be environmentally responsible including consideration of embodied energy of production and avoidance of endangered wood sources.
- 3.5 **Clear vertical grain Cedar is to be utilized in custom designed benches and other site furniture as appropriate.**
- 3.6 **Bike Racks: Exterior bike racks installed on campus are to accommodate locking of the front wheel, rear wheel and the frame if desired by the user. UBC has adopted the use of a standard inverted U-style rack as follows.**
 - .1 Manufacturer: Urban Racks (Phone 888-717-8881) or approved equivalent.
 - .2 Model: SU20-E-G (or SS)-CB

- .3 Height 36"
- .4 Width
- .5 2" Schedule 40 steel pipe with flat horizontal cross bar
- .6 Finish: Hot-dipped galvanized or stainless steel

Bike Rack Spacing:

- i. Inverted U-Racks in a row shall be placed between 865mm and 915mm from centre of rack to centre of rack. This allows room for two bicycles to be secured to each rack.
- ii. If adjacent to landscaping, bike racks should be offset 600mm from the landscaping.
- iii. If adjacent to a wall, bike racks should be offset 300mm from the wall.
- iv. The depth of a row of bike racks is to be at least 2.4m.
- v. If designing for multiple rows of bike racks, the aisle space between parked bikes is to be at least 1.2m

Location and Mounting:

- i. Racks are to be surface mounted on a concrete pad at a convenient, weather protected, well-lit location that can be easily accessed by visitors, and seen by occupants of the building.
- ii. Mounting hardware shall be as flush as possible to the ground using 3/8" x 5" anchors and shall include one tamper proof nut per leg of the bicycle rack.
- iii. At the discretion of Campus and Community Planning, bicycle rack installation may be embedded into concrete, rather than surface mounted.
- iv. Where concrete unit paving is used as a surface treatment, installation options include pouring small concrete pads, concrete footing, or embedding the rack in a concrete slab below the unit pavers (least preferred).
- v. Location of racks must not interfere with emergency access routes, pedestrian routes, fire connection points or hydrants and must allow for barrier-free access to the building.

- 3.7 Local supply of materials is preferred.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Scope**

- .1 This guideline addresses the supply and installation of materials and equipment required to provide complete and properly operating irrigation systems for UBC Campus landscapes.

1.2 **Related Work**

- .1 Section 32 91 00 Planting Preparation
- .2 Section 32 92 23 Sodding
- .3 Section 32 93 00 Plants
- .4 Section 33 10 00 Water Utilities

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Design Requirements**

- .1 Irrigation is required in all planting areas to support establishment of new plantings or future planting renovations, and to support plant health during periods of extended drought or unforeseen site disturbances.
- .2 Drip irrigation is prohibited within institutional landscapes maintained by UBC *Facilities*, Municipal Services. **This includes both core and customer funded landscapes.** (See Part 2.11 Exclusions).
- .3 Consider surrounding areas affected by the work. For existing systems work limit, design and specify to protect, restore and/or alter to proper working order. Consider utilizing existing irrigation systems and components. Demo existing irrigation to be supplanted by new irrigation by capping and removing whenever possible. When necessary to abandon piping in place, as in the case of it being within the root zones of trees to remain, show it on the as-built drawings and cap all open ends. Provide smooth transitions and balanced coverage between existing and new systems.
- .4 **In situations where existing irrigation systems are severed or otherwise made inoperable by construction work, temporary irrigation measures must be undertaken by the project to ensure the preservation of adjacent landscape areas that are to remain.**
- .5 Locate valve boxes, valves, and quick coupler valves in beds at least 36-inches off hardscape edges.
- .6 Provide dedicated tree zones when tree water requirements differ significantly from surrounding shrubs and groundcovers.
- .7 Zones shall not be on more than one side of a building.
- .8 In support of UBC's water conservation initiatives (i.e. the Water Action Plan), the following **is required** of all landscape projects to reduce short and long term landscape water requirements:
 - .1 Simple rain sensors in conjunction with high-efficiency heads, valves and controllers must be specified in favour of other less practical technologies such as soil-moisture sensors or weather stations (see also: 2.11 Exclusions).
 - .2 Tough, vigorous, drought tolerant plant species must be specified.

- .3 Provision of evergreen groundcover to reduce soil surface exposure to desiccation.
- .4 Irrigation system water is to be metered separate from that of the building.
- .5 Use of organic soil amendments to improve water retention.
- .6 Organic surface mulches to facilitate soil moisture retention.
- .7 Large growing shade trees in lawn areas are to be irrigated on zones separate from the lawn area that surrounds them.

2.2 Quality Assurance

- .1 All irrigation work and irrigation design shall be done by a competent and experienced irrigation consultant/contractor having the skills, facilities, equipment and personnel adequate for the work specified.
- .2 Irrigation layout must be designed according to recognized design principles to account for adequate overlap (e.g. head to head coverage), efficient and sustainable water use with separate zoning for lawns, plantings, trees etc. and significant micro-climatic variations as required.
- .3 A manufacturer's warranty is required for all irrigation equipment outlined in this guideline and on the irrigation drawing(s).
- .4 Do not cement pipe and fittings under wet or muddy conditions.

2.3 Submittals

- .1 Water Service Connections: All new or substantially modified connections to the water distribution system at UBC require the submission of a Service Connection Application Form (see <https://buildingoperations.ubc.ca/resources/policies-procedures-forms/>). Project design drawings shall be provided to UBC Energy & Water Services for review (see Section 33 10 00 Water Utilities, 2.3 Water Service Connections for further details).
- .2 For Operating and Maintenance Manuals requirements, see Technical Guidelines, Section 01 78 23 Operation and Maintenance Data. Submit one (1) copy of Record drawings to UBC Energy & Water Services.
- .3 For UBC Record drawings requirements, see Technical Guidelines, Section 01 78 39 Project Record Documents.
- .4 Submit one set of special tools and equipment required for proper operation and maintenance of the system.
- .5 Instruction: Once the system is operational, the Project Manager must schedule a site meeting(s) as required to adequately instruct a UBC Municipal Services Irrigation Technologist in the complete operating and maintenance procedures for that system.

2.4 Site Conditions

- .1 Verify the existence and location of all on site utilities and cooperate with the Contractor and UBC Energy & Water Services. Notify the Project Landscape Architect immediately for direction, as to procedure, should any piping or utilities be encountered during excavation.
- .2 Prior to the work of this section, carefully inspect the installed work of other trades or contractors and verify that all such work is complete to the extent that irrigation work may commence properly.

- .3 Field Measurements: Make all measurements in the field and adjust the design to meet the on-site conditions. In the event of major discrepancies between the drawings and the actual site conditions notify the Project Landscape Architect before proceeding with the work.
- .4 Verify the locations of underground services by hand digging or by use of an M-scope.
- .5 Repair all damage to underground services. Damage to services that are shown on the drawings or have been brought to the Contractor's attention in the field shall be repaired at the Contractor's expense.

2.5 Protection and Damage Repair

- .1 Protect existing buildings, equipment, sidewalks, landscape reference points, monuments, markers and other completed work. Make good all damage resulting from work of this contract at no expense to UBC.
- .2 All existing irrigation components, valves and lines to be retained or which serve an adjacent site, must be protected and/or repaired if damaged due to construction activity. [Provisions must be made by a Project Manager to provide temporary irrigation to planting areas whose access to irrigation has been severed during construction.](#)
- .3 Trenches and other excavations cannot be left open overnight unless they are protected to WCB Standards. In all areas excavated trenches must be covered and barricaded to ensure public safety.

2.6 Warranty

- .1 Provide a written warranty for all workmanship and materials for one (1) year from the date of Substantial Completion of the landscape and irrigation work.

2.7 Equals and Alternatives

- .1 Any proposed substitutions must be approved in advance and in writing by UBC Municipal Services. Products and materials must equal or exceed the specifications of the equipment specified.
- .2 The proposed equipment shall have a comparable warranty and a local, well stocked distributor.

2.8 Exclusions

- .1 The following restrictions on irrigation technologies are to be adhered due to limitations with durability, longevity, operations and maintenance:
 - no drip irrigation emitters or tubing systems
 - no centralized weather stations
 - no subscription-based weather sensors

2.9 Pipe and Fittings

- .1 Plastic pipe to be extruded, virgin, high impact PVC pipe that is continuously and permanently marked showing manufacturer's name or trademark, type of material, pipe size and pressure rating. Note: Black, flexible Polyethylene (Poly) pipe may be used where flexibility is essential in working around existing services or tight installations.
- .2 All piping to be Schedule 40 PVC.

- .3 Plastic pipe fittings to be Schedule 40 PVC designed for solvent welding to PVC pipe except where valves, risers, etc. require threaded joints.
- .4 Pipe solvent cement to be CSA approved type as recommended by the pipe manufacturer.
- .5 Pipe sleeves under hard surfaces to be Schedule 80 PVC pipe.

2.10 Solenoid Valves

- .1 Use Rainbird PEB valves or equivalents.
- .2 If a solenoid valve is installed on the irrigation service connection from UBC Energy & Water Services' water distribution system, a hammer arrestor shall be installed upstream of the solenoid valve.

2.11 Sprinkler Heads

- .1 Use Rainbird 1800 Series Spray and 5000 Series Rotors or equivalents.
- .2 Use 12" pop ups in shrub areas.

2.12 Automatic Controller

- .1 Locate in mechanical room.
- .2 Use Rainbird ESP Modular Controller or equivalent.
- .3 Mount an 11x17 color coded laminated zone control map adjacent to the controller, showing the location of main valves, numbered zone valves, associated color coded laterals, and a listing of zone numbers & descriptions, e.g. "turf, west side of building".

2.13 Rain Sensor

- 1. Use Rainbird model WR2RFC Wireless Rain/Freeze Sensor

2.13 Control and Common Wiring

- .1 Insulated single-strand copper wire TWU-40 #14 gauge to be used where directly buried in the landscape. White to be used as the common.
- .2 Wiring from the controller to the landscape may be a minimum of #18 solid wire run in conduit.
- .3 All electrical connections to be made with CSA watertight connectors.

2.14 Water Supply

- .1 The irrigation branch supply from Utilities service main to the demarcation point shall be ductile iron or copper piping as specified in Section 33 10 00 Water Utilities, 2.6, and valves per Section 33 10 00 Water Utilities, 2.7. See also standard drawing 1140-UT-Waterirrig-Demarc for Demarcation point of Utilities service.
- .2 Submit to UBC Energy & Water Services the irrigation load as required on the service connection from UBC Energy & Water Services' water distribution system.
- .3 Upon completion of the irrigation assembly in an irrigation chamber and before service is activated, the contractor shall notify for inspection: Energy and Water Services - Engineering

and Utilities at 604-822-9445. Notification for inspection shall be provided a minimum 24 hours in advance.

2.15 Irrigation Chamber

- .1 For irrigation chamber equipment details, see Section 33 10 00 Water Utilities, 2.6.4.

2.16 Backflow Preventer

- .1 Backflow/Cross Connection Control shall be installed as per BC Plumbing Code. Refer to Section 33 12 13.13 Water Supply Backflow Preventer Assemblies for details.

2.17 Layout of Sprinkler System

- .1 Co-ordinate exact locations of lines, valves and heads, with planting locations to avoid conflicts and damage to plants during installation. Stake locations and check grades of all components.

2.18 Excavation and Backfilling

- .1 The excavation depths for piping shall be:
 - .1 In landscape areas a minimum cover of 300mm (12").
 - .2 Under paving a minimum cover of 450mm (18").
 - .3 On slab: place pipe on filter fabric above drain rock if 300mm (12") cover cannot be met.
- .2 Trenches shall be straight with uniform slopes to the bottom of the trenches.
- .3 Place pipe on firm soil at all points of the trench.
- .4 Backfill trenches in 150 mm (6") layers, tamping to ensure compaction of trench is equal to surrounding undisturbed area.
- .5 Backfill material shall be free from rocks and other unsuitable materials which could damage the pipe or create unusual settling problems.

2.19 Installation of Piping

- .1 Install the piping in accordance with the drawings and with manufacturer's recommendations.
- .2 Pipe installation must include a ¾" hose-bib blow-out connection where it can be accessed with air-compression equipment in-tow for winterization. Locate this on the exterior of the building as close as possible to the water source point of connection. Vertical lines into mechanical rooms below grade should also be manually drainable by ensuring that backflow device is provided with a drain cock valve.
- .3 Where possible, main and lateral lines may occupy the same trench provided a minimum 100mm (4") horizontal clearance can be maintained.
- .4 No line may be installed parallel to and directly over another line.
- .5 All piping to run as straight as possible between fittings.
- .6 For secure, durable connections, all pipe joints must have a double-swipe of bonding agent – i.e. applied to the outside (OD) and inside (ID) respectively – of adjoining pipe surfaces.

- .7 Remove all excess PVC solvent cement from all solvent weld joints.
- .8 The entire irrigation system shall be thoroughly flushed with water to remove dirt, scale and foreign matter before sprinkler heads are installed.

2.20 Installation of Sprinklers

- .1 Pop-up sprinklers shall have an adjustable riser assembly (triple swing joint) assembled by using at least three standard PVC street elbows.
- .2 Triple swing joint risers shall be of Schedule 40 PVC and fittings of Schedule 40 PVC unless otherwise designated on the drawings. Flexible polyethylene swing joints may be substituted where PVC triple single joint installation are not practical.
- .3 The bottom street elbow shall be connected to the side outlet on the lateral line.
- .4 The PVC nipple on a pop-up sprinkler shall be installed at 45° to the lateral line.
- .5 All stationary spray sprinklers shall be installed with two PVC street elbows to connect to the lateral line and a schedule 40 PVC nipple that is long enough to be 100mm (4") above finished grade.
- .6 All sprinkler heads to be installed a minimum of 25mm (1") and maximum 100mm (4") away from any hard surface.

2.21 Installation of Valves and Valve Boxes

- .1 All valve boxes to be installed flush with finish grade.
- .2 All valves to be installed horizontally and centred in the valve box for ease of accessibility for servicing.
- .3 All valve boxes to be blocked so that the valve box does not rest on the piping below.
- .4 Valve box sizes and configurations shall be selected to adequately accommodate single or multiple valves such as to allow adequate operation and space for servicing. Use square irrigation boxes only.
- .5 All wiring connection in valve boxes to be of sufficient length to permit removal of the top of the valve from the valve box.

2.22 Installation of Wire

- .1 Protect low-voltage wiring by installing beneath irrigation lines
- .2 All electrical connection to be made in an accessible valve box.
- .3 All zones and mainlines to have independent dedicated trace wire. Secure 14-gauge trace wire to all irrigation piping at 10-foot intervals. Solder tracing wire to all lateral irrigation piping. Do not cut and splice main trace wires to control valves.

2.23 Clean-Up

- .1 Any damage to paving, planting or any other structure due to settlement of improperly compacted trenches shall be promptly repaired at the contractor's expense.

- .2 No activities of backfilling or hard/soft landscaping shall cover up any valve boxes, manholes, or other utility line openings.

2.24 Inspection and Demonstration

- .1 Upon completion of the irrigation system, and before acceptance of the project by Municipal Services, the irrigation installer must demonstrate the complete system to a UBC Municipal Services Irrigation Technologist. A coverage test will determine if coverage of water to planting and lawn areas is complete and if any necessary adjustments are required. In the presence of the Project Landscape Architect and a UBC Municipal Services Irrigation Technologist, the irrigation installer shall set controllers in sequence, test through all zones, and make any necessary final adjustments. Adjacent pre-existing and operable irrigation systems must be made whole and included in the demonstration. The Project Manager must advise Landscape Architect in Municipal Services a minimum of forty-eight (48) hours prior notice to Municipal Services Landscape Architect is required before inspection and demonstration of the work..

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Scope**

- .1 This guideline addresses the materials, and equipment necessary for the supply, placement, and amendment of growing medium for landscapes.

1.2 **Related Work:**

- .1 Section 32 93 00 Plants
- .2 Section 32 93 05 Relocation of Existing Plant Material

1.3 **Definitions**

- .1 "On-Site Topsoil" refers to topsoils (native or commercially processed) on location at project site, or reallocated, stockpiled and transported from elsewhere on UBC Campus lands. [In principle, on-site topsoil will not be permitted for use in new landscapes in order to avoid the introduction of weed seeds into newly built landscapes. Permission, in writing, must be obtained in advance from Municipal Services for use of any on-site topsoil in new landscape projects.](#)

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Existing Conditions**

- .1 On-site topsoil designated to remain undisturbed in-situ, must be assessed, tested, amended, protected from compaction and weed infestation, and otherwise managed for the duration of the project as required.
- .2 If on-site topsoil has been determined to be infested with pernicious perennial weeds such as horsetail, vetch or morning glory, etc. it must be excavated to depth necessary to prohibit future recurrence and removed from UBC Campus. Alternative remedial strategies must be presented in writing and reviewed and approved in advance and in writing by UBC Municipal Services Head Landscape Technologist.
- .3 Identify the size and location of all existing services and sub-grades prior to the work.

2.2 **Testing**

- .1 [Testing on](#) growing medium and /or conserved topsoil [\(if permitted for use\)](#) shall be carried out by Pacific Soil Analysis Inc., at #5 - 11720 Voyageur Way, Richmond, B.C. (Ph. 604 - 273-8226), or an equal approved by Project Landscape Architect prior to closing of tender.
- .2 Separate tests and analysis shall be conducted for the following:
 - .1 All distinct types of growing media used on the project including imported soil, retained on-site topsoil [\(if permitted for use\)](#), relocated or mixed on-site media, any other distinct formulated soil substitute or mixture.
 - .2 All media formulated or designated for a special purpose including but not limited to planting, lawns, sports fields, on-slab, extensive or intensive green roofs, structural soils for street tree planting.
- .3 The test shall determine the characteristics and quantity of the amendments to be used to bring the growing media and/or on-site topsoil to an optimal chemical and physical condition for landscape use.

- .4 Sand shall be tested for sieve size analysis.
- .5 Soil testing must be completed and recommendations approved by Project Landscape Architect prior to installation of any plant material. Failure to do so may result in the rejection of the growing media and/or retained topsoil, removal of growing media or retained topsoil from the site at no cost to UBC, and replacement with approved growing media as required.

2.3 Product Handling and Storage

- .1 All materials to be handled and adequately protected to prevent damage or contamination.
- .2 Stockpile materials in bulk form in paved area(s) approved by Project Landscape Architect. Take all precautions to prevent contamination of basic materials from wind-blown soil particles, weed seeds and from insects. Contamination of the ingredients may result in their rejection for use. Where paved surfaces are not available prevent contamination of on-site soil or sub-soil or construction materials.
- .3 Store growing medium and/or excavated topsoil in a dry area or covered and protected from weed infestation, contamination, damage, water saturation, compaction or erosion.
- .4 Maintain any stockpiled growing medium, excavated topsoil and all related amendments pre-approved for use by Municipal Services free of weed infestation prior to installation and throughout the duration of the project.

2.4 Samples

- .1 Samples must be submitted, tested, and approved by the Project Landscape Architect in writing before the growing medium is amended. Failure to do so may result in the rejection of the growing medium, removal of the growing medium from the site at no cost to UBC, and replacement with approved growing medium.

2.5 Growing Media for Standard Applications

- .1 All growing media must conform to the Canadian Landscape Standard Current addition as well as the following guidelines and specifications applicable to projects on UBC Campus.
- .2 The following guidelines apply to standard applications where media are formulated for use on-grade, over sub-soil, and designated for application to on-grade lawns, trees and plantings as per Canadian Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 "Well Groomed" Area.
- .3 Growing medium will be composed of proportions of mushroom manure or mushroom manure / peat moss mix, silts and clays, and sand, which provides suitable medium for supporting intended plant growth. Amendments may be required based on the recommendations of the soil analysis.
- .4 Growing medium shall be free of pernicious weeds or their roots, sticks, building materials, wood chips, chemical pollutants and other substances at levels toxic to plants, and other extraneous materials which detract from the desirable physical and chemical properties for landscaping purposes. Excessive growth of weeds in a growing medium may be an indication that unacceptable levels of weed seeds or weed parts were present in the growing medium at the time of installation. Such a determination may result in a requirement that the Contractor remove and replace all affected medium and/or all weeds and weed roots and reduce the growth of weeds to acceptable levels.

- .5 Sand must be mixed into growing medium prior to placement. Rototilling of sand into installed growing medium is not acceptable.
- .6 Organic content shall be within the ranges as per Canadian Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 "Well Groomed" Area, for the intended application. This requirement may be met by mixing growing medium components or by topdressing and Rototilling in an approved type of organic matter, based on the recommendation from the soil testing laboratory. (See Section 32 93 00 Plants, 3.6.2 - Fertilizer Application and Soil Amendments).
- .7 Drainage of growing medium can be measured only after the growing medium is in place. Mixing and handling of growing medium shall be done in such a manner that the minimum saturated hydraulic conductivity as per Canadian Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 "Well Groomed" Area is achieved. Areas with compacted soil after installation must be cultivated to restore the uncompacted nature found throughout the project.

2.6 Special Purpose Media for Non-Standard Applications

- .1 Special Purpose Media includes all media for specialized application that requires formulation or amendment which diverges from the generalized specifications and tolerances shown above under Growing Media for Standard Applications and Canadian Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 "Well Groomed" Area. Special Purpose Media may include, but not be limited to: on-slab plantings, modular planters, extensive and intensive green roofs, and street tree plantings in pavement.
- .2 Complete specifications and details for Special Purpose Media shall be developed collaboratively with the Project Landscape Architect following the recommendations of a Soil Consultant, Structural Engineer, and related project consultants as required before inclusion in contract specifications and drawings.
- .3 Specifications and details for Special Purpose Media shall be reviewed and approved by the Project Landscape Architect.
- .4 Structural Soils used for the installation of trees in urban pavements, plazas and streets will be the preferred planting medium for this type of tree planting. Alternatively, Structural Cell technologies and associated medium may be used if authorized by the Project Landscape Architect in consultation with UBC Campus Arborist and Municipal Services Head Landscape Technologist.
- .5 Specifications and details for Specialized Media shall be provided by Project Landscape Architect in contract documents congruent in scope and equivalent with specifications above detailing Growing Media for Standard Applications and Canadian Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 "Well Groomed" Area.

2.7 Growing Media Amendments

- .1 Required amendments for any landscape growing media or soils, will be the result of:
 - .1 Recommendations from Soil Consultant made after growing media testing and analysis.
 - .2 The presence or absence of an irrigation system.

.2 Fertilizer and Chemical Ingredients:

Fertilizer and chemical ingredients may be required by the Project Landscape Architect based on growing media test results to be added to each growing medium to conform to the growing medium standards specified above, and/or as based on the Soil Testing findings as recommended by Soil Consultant.

- .1 Fertilizers must be those detailed in the landscape soil analysis report. The Landscape Contractor will not make any substitutions or change of application rates unless having obtained written approval of the Project Landscape Architect.

2.8 Preparation of Existing Grade

- .1 Verify that grades are correct. If discrepancies occur, notify Project Landscape Architect and do not commence work until instructed by Project Landscape Architect.
- .2 Eliminate uneven areas and low spots, ensuring positive and free drainage.

2.9 Placement

- .1 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 25 mm above surface. Dispose of removed material off site, at no expense to UBC.
- .2 Scarify entire area which is to receive growing medium to depth of 100 mm. Scarify those areas where equipment used for hauling and spreading has compacted soil.
- .3 No growing medium shall be loaded, transported or spread when it is so wet that its structure is likely to be altered, or risk of compaction exists.
- .4 Spread growing medium with adequate moisture in uniform layers over approved, unfrozen subgrade, where sodding and planting is indicated.
- .5 Manually spread growing medium to achieve final grades around trees, shrubs and obstacles.
- .6 Installed growing medium to 25 mm above design grades to allow for settlement.
- .7 Place the growing medium to the following dimensions:
- .1 Trees – Min. 600mm (24") deep. UBC Campus Planning requires the following minimum soil volumes:
 - Large (>10m canopy spread) 45 m3
 - Medium (+/- 10m canopy spread) 25 m3
 - Small (+/- 6m canopy spread) 10 m3
 - Very Small (+/- 3m canopy spread) 5 m3
 - .2 Shrubs – Min 450mm (18") depth.
 - .3 Groundcover - Min 300mm (12") depth.
 - .4 (Low and High Traffic) Lawns – Min 150mm (6") depth.

2.10 Finish Grading

- .1 Leave surfaces smooth, uniform and firm against deep foot printing.
- .2 Fine grade growing medium to 25 mm above finished grades shown on drawings. Eliminate rough spots and low areas to ensure positive drainage. Prepare loose, friable beds by means

- of cultivation and subsequent raking. Final grades to be approved by Project Landscape Architect prior to further work proceeding.
- .3 After planting, spread 100 mm layer of specified approved mulch evenly over all exposed growing medium finished grades, to the satisfaction of the Project Landscape Architect. Refer to Section 32 93 00 Plants for guidelines on mulch specification.

2.11 Acceptance

- .1 Project Landscape Architect must inspect growing medium in place and determine acceptance of material, depth of growing medium and finish grading, prior to plant installation.
- .2 Approval of growing medium may be subject to soil testing and analysis if any doubt exists concerning its conformity to the requirements as per Canadian Landscape Standard, Table 6-2: Properties of Growing Medium for Level 1 "Well Groomed" Area, or any of the subparagraphs under paragraph 2.1 of this Section.

2.12 Surplus Material

- .1 Dispose of materials not required by Project Landscape Architect off site, at no cost to UBC.

*****END OF SECTION*****

1.0 GENERAL

1.1 Scope

- .1 This guideline addresses the materials, methodology and services necessary for complete installation of seeded or hydro-seeded lawns and meadows, which includes the control of noxious and pernicious weeds within seeded lawns and meadows.

1.2 Related Work

- .1 Related Work in Other Sections:
 - .1 Section 32 80 00 Irrigation
 - .2 Section 32 91 00 Planting Preparation
 - .3 Section 32 93 00 Plants
 - .4 Section 32 01 90 Operation and Maintenance of Landscape

1.3 Pertinent Standards and Legislation

- .1 Conform to the requirements of the latest editions of the following standards and legislation:
 - .1 Canadian Landscape Standard – Current Edition
 - .2 British Columbia Standard for Turfgrass Sod
 - .3 British Columbia Weed Control Act
 - .4 Canada Seed and Fertilizer Act
 - .5 Canada Pest Control Products Act

1.4 Inspections and Approvals

- .1 Notify Landscape Architect (Municipal Services) at least forty-eight (48) hours before final review of seeded lawns and meadows is required. For acceptance by Municipal Services, all lawns and meadows must be alive and in a healthy, satisfactory growing condition at the time of inspection.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

- 1. Avoid creation of convoluted lawn or meadow areas that are less than 2 m wide, end in very narrow angles, punctuated with obstacles, or are oddly shaped that make servicing with riding mowers impossible. Boulevards or medians 2 m wide or less must be planted.

2.2 Approved Equals

- .1 All seed mixes and hydro-mulches as specified or pre-approved equals. Contact Head Landscape Technologist (UBC Municipal Services).

2.3 Warranty

- .1 All workmanship and materials covered under Work of this Section shall be warrantied for a period of one (1) full year from the date of Substantial Performance.

2.4 Materials

- .1 Lawn and Meadow Seed:

- .1 Seed mixtures shall be suited to the climate, growing medium, site orientation, sun exposure, terrain, establishment and lawn class designation or intended use under which they are to be grown.
- .2 Selections of seed mixtures should take into account the current infestations and impacts of Chaffer Beetle and associated damages by crows and raccoons. Designing with alternate groundcover or planting should also be considered. Consult with authorities, seed suppliers and Head Landscape Technologist (UBC Municipal Services) as required.
- .3 Professional consultation is required in selecting or designing special purpose mixes for naturalizing or restoration purposes.
- .4 The seed mixture shall be mixed, labeled and supplied by a recognized seed supplier. Labels shall include complete details including species names germination percentages, purity of analysis, year of production, and contact info for supplier.

2.5 Hydro-Seeding Materials

- .1 Hydro-mulch shall contain no growth or germination inhibiting factors, be dry, be free of invasive and other foreign materials.

2.6 Subgrade Preparation and Finishing

- .1 Obtain approval of Head Landscape Technologist (UBC Municipal Services) of subgrade and growing medium prior to seeding of lawns or grasses. Ensure that growing medium is placed to required depths and tolerances as specified and detailed in the Contract Documents and spread evenly over the approved subgrade. Ensure the growing medium is firm against footprints, loose in texture and free of all stones, roots branches etc. as required under Section 32 91 00 Planting Preparation.
- .2 Ensure finish grade surfaces are tamped with roller before seeding, and finish grades are congruent with project drawings as specified.
- .3 Grades:
 - .1 Lawn and grass meadow areas must be graded at slopes safe for mowing by maintenance crews and safe for all other Campus users. Maximum allowable slope for lawns and meadows is 5:1. Slopes over 5:1 are only permitted where pre-approved by Landscape Architect (UBC Municipal Services). (See also Section 31 22 00 Grading, 1.1.1)
 - .2 Crown or slope for surface drainage and eliminate all low spots or depressions.

2.7 Seeding and Hydro-Seeding

- .1 Scheduling:
 - .1 Must be carried out during periods when seasonal conditions are likely to ensure successful germination and continued growth of all species in the seed mix.
 - .2 All seeding should be conducted during calm weather, and shall be done on soil that is free of ground frost, snow, and standing water.

2.8 Maintenance

- .1 The maintenance period begins at the time lawns and meadows are planted and continues until successful establishment of the lawn or meadow and acceptance by Municipal Services.
- .2 Maintenance shall consist of all measures necessary to keep [lawn and meadows](#) healthy, in a vigorous growing condition and well rooted into the underlying soil.

2.10 Protection

.1 All [seeded lawn and meadow areas](#) shall be adequately protected with warning signs and fencing until lawn establishment and acceptance by Municipal Services. Fencing shall be maintained in good condition to provide a continuous barrier until Acceptance. Heavy clippings shall be removed immediately after mowing and trimming. If any seeded areas are damaged [with potholes, ruts, divets or uneven surfaces](#), they shall be repaired [to satisfaction of Municipal Services](#).

END OF SECTION

1.0 **GENERAL**

1.1 **Scope**

- .1 This guideline addresses the materials, methodology and services necessary for complete installation of sodded lawns, which includes the control of noxious and pernicious weeds within seeded lawns and meadows.
- .2 Due to the current prevalence of damages associated with Chaffer Beetle, the scope of sod installation should be limited if not suspended where practical in favour of seeding with resistant seed mixtures, or designing with alternate groundcover or planting. See Section 32 92 00, Turf and Grasses, 2.6.3.2.

1.2 **Related Work**

- .1 Related Work in Other Sections:
 - .1 Section 32 80 00 Irrigation
 - .2 Section 32 91 00 Planting Preparation
 - .3 Section 32 93 00 Plants
 - .4 Section 32 92 00 Seeded Lawns and Meadows

1.3 **Pertinent Standards and Legislation**

- .1 Conform to the requirements of the latest editions of the following standards and legislation:
 - .1 Canadian Landscape Standard – Current Edition
 - .2 British Columbia Standard for Turfgrass Sod
 - .3 British Columbia Weed Control Act
 - .4 Canada Seed and Fertilizer Act
 - .5 Canada Pest Control Products Act

1.4 **Inspections and Approvals**

- .1 Notify Landscape Architect (Municipal Services) at least forty-eight (48) hours before final review of sod is required.
- .2 For [acceptance by Municipal Services](#), all lawns and meadows must be alive and in a healthy, satisfactory growing condition at the time of inspection.

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **General**

- 1. Avoid creation of convoluted lawn areas that are less than 2 m wide, end in very narrow angles, punctuated with obstacles, or are oddly shaped that make servicing with riding mowers impossible. Boulevards or medians 2 m wide or less must be planted.

2.2 **Warranty**

- .1 All workmanship and materials covered in this Section shall be warrantied for a period of one (1) full year from the date of Substantial Completion.

2.3 Materials

- .1 Sod:
 - .1 Sod shall be nursery grown turfgrass sod, true to type, conforming to the B.C. Standard for Turfgrass Sod. Only "Non-Netted" Sod will be accepted.
 - .2 The quality grade of sod (based on B.C. Standard for Turfgrass Sod) shall be No. 1 Premium Grade grown on a screened alluvial sand base, cultivated on a sterilized soil base to ensure a weed free product. The maximum fines (silt and clay) in the alluvial sand base to be no more than 1% by weight.
- Sod to be:
 - .1 'Supreme' (30% Kentucky Blue, 30% Fescue, 40% Perennial Rye) as grown by Anderson Sod Farm, 10821 Farms Road, Mission, B.C., 604-826-2383.
 - .2 Or approved equal. Equivalency to be reviewed and approved by Head Landscape Technologist (UBC Municipal Services).
- .2 Weed Control: the use of toxic pesticides for cosmetic purposes is voluntarily suspended on UBC Campus. Manual weed control is the preferred method and may be the only permitted methodology. Remove and replace significantly affected sod. Consult with Head Landscape Technologist (UBC Municipal Services) for approval of any alternative organic weed control substances or methodologies.

2.4 Subgrade Preparation and Finishing

- .1 Obtain Project Landscape Architect approval of subgrade and growing medium prior to laying any sod.
- .2 Ensure finish grade surfaces are tamped with roller before laying sod, and finish grades are congruent with project drawings as specified.
- .3 Grades:
 - .1 Sodded lawns must be graded at slopes safe for mowing by maintenance crews and safe for all other Campus users. Maximum allowable slope for lawns is 5:1. Slopes over 5:1 are only permitted where pre-approved by Landscape Architect (UBC Municipal Services). (See also Section 31 22 00 Grading, 1.1.1). Areas to be sodded shall be at grades as shown at the time of sodding, less an allowance for the thickness of the sod.
 - .2 Crown or slope for surface drainage and eliminate all low spots or depressions.
- .4 If the surface of the growing medium is dry, lightly moisten the growing medium immediately prior to laying sod.

2.5 Sod Laying

- .1 Use full rolls where possible. No bits or sod remnants are allowed.
- .2 Only lay sod within acceptable weather conditions during March through mid-October. Do not lay sod during periods of high summer temperatures, or drought when no consistent, supplementary irrigation is available to retain sod and underlying medium in moist condition.

Do not lay sod during periods of heavy rainfall and when excessive puddling is apparent on site.

- .3 Lay sod in rows with ends staggered. Butt all sections closely. Do not overlap or allow gaps wider than 2mm between sections. Top of sod to be flush with adjacent walking surfaces.
- .4 Protect new sod from heavy foot traffic during laying. Place planks or plywood if necessary to prevent damage. Lay within 24 hours after delivery to prevent deterioration.
- .5 Lay sections on slopes at right angles to the direction of the slope. Stake sod into place with wood stakes driven flush with the surface in any locations having slopes steeper than 3:1 (NOTE: Sloped lawns over 3:1 are only permitted where pre-approved by Head Landscape Technologist (UBC Municipal Services). Interval spacing on stakes shall not exceed 500mm. Prior to pedestrian traffic being allowed onto the sod, and only after the sod is well rooted into the growing medium, pegs or stakes shall be removed or driven to an elevation 50mm below the finished surface.
- .6 Cut sod where necessary only with sharp tools.
- .7 Water thoroughly to penetrate the full depth of the growing medium as specified.
- .8 When sod has dried sufficiently, roll with 113kg. (250lb.) roller to obtain smooth uniform surface and ensure a good bond between soil and sod.
- .9 Erosion control netting shall be installed in sodded areas where required, erosion control mesh or netting shall be placed and secured with stakes or staples set firmly into the ground to a minimum depth of 150mm. Spacing of stakes or staples shall be adequate to ensure complete anchorage of the sod to the ground.

2.6 Maintenance

- .1 The maintenance period begins at the time sod is laid and continues [until successful establishment of the lawn and acceptance by Municipal Services](#)
- .2 Maintenance shall consist of all measures necessary to keep grass healthy, in a vigorous growing condition and well rooted into the underlying soil.

END OF SECTION

1.0 **GENERAL**

1.1 **Scope**

- .1 This guideline addresses the handling, care, installation, materials, warranty and replacement of plant material installed for new landscape and building projects on UBC Campus by Landscape Contractors.

1.2 **Related Work**

- .1 Section 32 93 05 Relocation of Existing Plant Material
- .2 Section 32 91 00 Planting Preparation
- .3 Section 32 92 00 Turf and Grasses
- .4 Section 32 92 23 Sodding
- .5 Section 32 01 90 Operation and Maintenance of Landscape

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Pertinent Standards and Legislation**

- .1 All materials and execution to conform to the latest edition of the following standards or as otherwise specified in contract documents:
 - .1 CLNA, Canadian Standards for Nursery Stock, current addition.
 - .2 Canadian Landscape Standard, current addition.
 - .3 ISA / ANSI, ANSI-A300, Standards for Tree Care Operations.

2.2 **Planting Layout and Selection**

- .1 Maintain existing vegetation where possible.
- .2 Show all utility lines on a legible but faded back layer on all planting and site plans from design through to record drawings.
- .3 Select and arrange plants with careful consideration to strengthening biodiversity, plant communities, space available to grow to mature size and form, shade and sun conditions of site, moisture requirements of plants, climate change, pests, fire resilience, drought tolerance and resiliency in the context of emergency municipal water restrictions, weed control, the safety of gardeners, and the limited capacity of groundskeepers to maintain an expanding and more complex landscape. Apply the following strategies:
 - .1 Select plants that are tolerant of seasonal moisture conditions, climate change and drought tolerance without additional irrigation. In plant list, provide one column indicating water requirements.
 - .2 Select plant palettes that reflect the broad range of woody and herbaceous plants that can be grown in our existing and future climate.
 - .3 Incorporate appropriate native plants to achieve aesthetic, environmental and social objectives.
 - .4 Factor site sun exposure and shade into plant selection and layout.
 - .5 Place woody plants no closer to the edge of a sidewalk, lawn area or curb than the maximum spread of the plant when mature (unless it is intended to be maintained as a hedge).

- .6 Base siting and spacing decisions on mature height and form of shrubs and trees. Select self-maintaining plants and trees that will grow to the size and form desired, and in the space available, without the requirement to prune.
- .7 Plant large growing shrubs as single specimens rather than in masses.
- .8 Do not plant large growing shrubs or trees immediately in front of building windows or adjacent to sidewalks. Arrange plants with higher moisture requirements and plants with lower moisture in their own distinct communities.
- .9 All plants within 1.5 meters from the building face should include plants selected from FireSmart BC's fire-resistant plant list (any zone) wherever possible.
- .10 Do not extend planting or lawns under building overhangs. Drip strips or other no-planted surfacing (other than water features) must be provided to extend away from building face to at least align vertically with outer edge of any building overhangs that are at a height or orientation that would exclude normal rainfall from reaching lawn or planting in question.
- .11 Extend groundcover plants under planting plan symbols to account for the actual size of shrubs when installed and to achieve coverage of ground plane until shrubs mature.
- .12 Do not use groundcovers on corners or in other places where people may be expected to trample them.
- .13 Arrange perennials and groundcovers in a way that does not leave bare patches of earth adjacent to sidewalks or lawn areas if they are dormant in winter and have no structural presence.
- .14 As a general principle, arrange plants informally or in communities as you might expect to see them growing in nature. Do not plant trees in lines or rows, except on streets, or any of the Malls where precedent has been established to do so.
- .15 Massing of plants, in terms of alignment and dimensions, should be such that plantings are accessible by maintenance staff for weeding, pruning trimming without causing undue damage to plantings.
- .16 Hedge plantings requiring regular shearing to maintain height, width or shape must be avoided.
- .17 Select plants for their robustness and capacity to endure urban and high pedestrian traffic conditions.
- .18 The planting of trees in metal tree grates is to be avoided and will only be supported in exceptional circumstances.
- .19 Select vigorous plants for steep slopes to achieve quick coverage, soil stabilizing capacity and limited maintenance requirements. (See Section 31 22 00 Grading regarding slopes)
- .20 Do not select plants that contain toxic substances or produce dusts, exudates or odours that cause irritation, chemical burns, poisoning or allergic reactions. See WorkSafe BC, Toxic Plant Warnings.
- .21 Select plant species that are known to exhibit a high degree of pest and disease resistance.
- .22 Whether lawn, groundcover or shrubs - careful consideration must be given to

gradients, adjacent surface materials and slopes, ease of maintenance, and safety of grounds staff.

- .23 Avoid plant species that spread into thickets with underground rhizomes. Where variances to this guideline are granted by Landscape Architect, Municipal Services, plants with these characteristics must be contained with a root barrier to prevent their spread.
- .24 Always specify the cultivars of species as required. Specify no plants identified by The Greater Vancouver Invasive Plant Council (GVIPC). See www.gvipc.ca/most_wanted.php
- .25 Do not plant suckering vines on building walls. Vines may be used when a trellis structure is provided on which vines can cling or twine.
- .26 Living wall planting systems are not permitted.
- .27 Where there is a transition between aggregate and lawn or planting, or lawn and planting, they must be defined and separated by landscape edging.

2.3 Tree Selection and Placement

- .1 In principle, tree species selected for use on UBC Campus should be:
 - .1 Low maintenance.
 - .2 Tolerant of local conditions.
 - .3 Resistant to branch failure and wind-throw.
 - .4 Pest and disease resistant.
 - .5 Structurally sound requiring no significant compensatory or remedial pruning.
 - .6 Free from problem characteristics such as:
 - Heaving root systems.
 - Significantly messy plant parts (i.e. leaves, fruit, seeds etc.)
 - Allergenic or objectionable properties (excessive pollen, dust or malodorous).
- .2 Individual trees selected for planting must be:
 - .1 Nursery trained with a single leader (exception: multi-stemmed species).
 - .2 Free of pests and diseases.
 - .3 Free of pernicious weeds in the rootball or container.
 - .4 Free of girdling roots.
- .3 Tree planted within 60 cm of walkway or paved surface must have a 45 cm deep root barrier installed according to manufacturer's specifications along edge of surfacing prior to addition of topsoil and tree planting.
- .4 Do not plant trees immediately in front of building windows.
- .5 Trees should be planted in accordance with the minimum setbacks from:
 - Lamp Standards – 3m
 - Driveways/Crossings – 1.8 meters
 - Street Corners – 5m
 - Fire Hydrants – 1.8 meters
 - Underground Utilities, Catch Basins/Valve Boxes – 1.5 meters
 - Stop Signs – 6 meters
 - Buildings – 3 meters for large spreading shade trees or conifers
 - Buildings – 2 meters for columnar trees
 - Buildings – 2 meters for small ornamental trees
- .6 Do not plant fruiting trees closer to paved or lawn areas than the maximum spread of the tree

canopy.

- .7 Select trees that will grow to the size and form desired, and in the space available, without the requirement to prune.
- .8 Trees that are planted in lawn areas should be located in such a way as to allow the passage of mowers 360 degrees around them to prevent the need for line trimmers (e.g. between tree and curb).
- .9 Trees should not be placed where:
 - .1 Branches will overhang buildings, light wells or air-intakes.
 - .2 Under overhead signs, canopies, or building overhangs.
 - .3 in front of entryways or in places that will obscure walkways, roadways or traffic signage.
 - .4 In significant conflict with site lighting structures or lighting dispersal pattern intentions.
 - .5 In locations that would subject the tree to excessive soil/root compaction due to pedestrian or vehicular traffic.
 - .6 Avoid planting areas with limited soil volume (narrow slivers in converging sidewalks, between roads and walkways, or in narrow roadway medians).
 - .7 Plan, budget and design to optimize soil conditions for root systems under pavements by utilizing Structural Soil or Suspended Pavements and Structural Cells.
- .10 [Adopt 10-20-30 rule to support tree biodiversity. No project is to include more than 10% of any one species, 20% of any one genus or 30% of any family.](#)

2.4 Coordination

- .1 Tree and plant selection, and planting design to comply with planting requirements specified in this document and in the Vancouver Campus Plan Design Guidelines.
- .2 Review any plant or tree substitutions during design or construction phases with UBC Landscape Architects (Municipal and C+CP). Written approval is required for any substitutions.

2.5 Delivery, Storage and Protection

- .1 Contractor to ensure all plant material and growing medium in which they are planted is free of damages, defects, noxious perennial weeds and is true to type as specified on plant list.
- .2 The contractor shall be responsible for the storage, protection and installation of all plants and associated material.
- .3 Verify existence and location of any on-site utilities. Contact the Project Landscape Architect immediately for directions as to procedure should any piping or utilities be encountered during excavation.
- .4 Protect existing equipment, sidewalks, landscaping reference points, monuments and markers. Make good all damage incurred during this work.
- .5 Erect temporary continuous barriers, and/or tree protection fencing where necessary to ensure safety of existing plants and trees. Refer to Section 32 01 93.01 Tree and Shrub Preservation.

2.6 Warranty

- .1 Warranty must stipulate that plant material will remain free of defects as per contract plant lists and landscape specifications, for one (1) full year from the date of substantial completion of the work.

2.7 Replacements

- .1 Replace all plant material found dead, or not in a healthy, satisfactory growing condition or which, in any other way, do not meet the requirements of the project or contract specifications, during and up to end of the warranty period.
- .2 The cost of replacements resulting from theft, accidental damage, vandalism, carelessness on the part of others shall not be borne by UBC.
- .3 All required replacements shall be plants of the same size and species as specified on the plant list and shall be supplied and planted in accordance with the drawings, specifications and change orders.
- .4 Replace defective or dead plants, trees, lawns or plantings as required during the 1 year maintenance and warranty period to the satisfaction of the Project Landscape Architect and UBC Municipal Services.

2.8 Planting Time

- .1 Do not plant during freezing and/or abnormally hot, dry weather.

2.9 Maintenance

- .1 Refer to Section 32 01 90 Operation and Maintenance of Planting for complete maintenance guidelines.
- .2 Any plants maintained as hedges must be level and not parallel with the ground.

2.10 Area of Plant Supply and Search

- .1 Before substitutions of plant material or plant size are considered, provide written documentation that the specified material is not available at nurseries throughout Pacific Northwest (Canada and United States).

Substitutions: If it is impossible to obtain the particular plant material listed on the Landscape Drawing, the Contractor may be permitted to suggest substitutions with types and variations possessing the same characteristics. The Contractor must request any substitutions of trees in writing at least three (3) months and shrubs and groundcover at least two (2) months prior to planting. Substitutions must be approved by the Project Landscape Architect in consultation with UBC Landscape Architect (C+CP) and Landscape Architect (Municipal Services).

2.11 Plant Material

- .1 Trees, shrubs, groundcovers, perennials, etc. shall be nursery grown in sizes and quantities shown on plant lists on landscape drawings and specification. Conform to the Canadian Landscape Standard and Canadian Standards for Nursery Stock.
- .2 Trees designated B&B shall be properly dug with firm, natural balls of soil retaining as many fibrous roots as possible, in sizes and shapes as specified in the Canadian Standards for Nursery Stock. Balls shall be firmly wrapped with non-synthetic, rottable burlap and secured with nails and/or heavy, non-synthetic rottable twine. The root collar shall be apparent at surface of ball. Trees with loose, broken, processed or manufactured root balls will not be accepted.
- .3 All plants, typical of their species or variety, must exhibit a normal habit of growth and shall be first quality, sound, healthy, vigorous, well branched, and densely foliated, free of disease,

- insect pests, eggs or larvae, healthy well-furnished root systems free of binding or girdling roots.
- .4 Plants must conform to the size specified in the plant list. Measurements specified are minimum size acceptable for each variety. Plants that meet the requirements specified in the plant list, but that do not possess a normal balance between height and spread will not be accepted. Plants for use when symmetry is required, or when planted in formal rows, shall be matched in form and size as nearly as possible. Do not prune prior to delivery.
 - .5 If the specified size of plants is not available, and alternate species or quantities or compensation are proposed, the Project Landscape Architect must [discuss with Landscape Architect, Municipal Services](#) in advance to obtain support for these remedies.
 - .6 As per Canadian Standards for Nursery Stock: tree caliper must be the determining measurement when the caliper exceeds 40 mm (1.5 in.). It must be measured no less than 150 mm (6") above the ground level for trees with a caliper up to 100 mm (4"). Trees 100 mm (4in.) and larger caliper are to be measured 300 mm (12 in.) above the ground level.
 - .7 All trees must have straight trunks with a single leader intact. Trees with multiple leaders, unless specified, shall be rejected. Trees with a damaged or crooked leader, bark abrasions, sunscald, disfiguring knots, insect or disease damage, girdling roots or cuts on limbs over 20mm (3/4") in diameter that are not completely closed must be rejected by Project Landscape Architect.
 - .8 Take precautions during digging, handling and shipping of plant material to avoid injury to plants and root systems.

2.12 Related Materials:

- .1 Tree stakes: dressed 50mm (2") diameter treated fir stakes, lengths as detailed. Number per tree as required to keep tree plumb and true during one (1) year warranty period.
- .2 Guywires: Trees up to 65mm (2.5") calliper - 14 gauge galvanized, multi-strand, twisted wire. Trees 65mm (2.5") to 75mm (3") calliper - 12 gauge wire, covered with new black garden hose, 2-ply, reinforced and of at least 13 mm (1/2") diameter, around leader at branch crotch.
- .3 Deadmen: 100x150 mm (4"x6") pressure preservative treated construction grade lumber or approved equivalent. Lengths to be determined on site.
- .4 Plastic Strapping: DeepRoot, Arbortie or approved equivalent. Strapping to be 19mm (2") wide, flat, woven polypropylene or nylon; 900 lb. break strength.
- .5 Mulch: Shall be [non](#)-composted bark mulch with [25mm](#) and minus Douglas Fir / Hemlock bark chips, dark brown in colour and free of cedar chips, soil, wood, stones, roots, plastic and other deleterious matter or pre-approved equal. Minimum compacted depth [100mm \(4"\)](#).
- .6 Fasteners: All fasteners hot dipped galvanized.
- .7 Fertilizers: Agricultural fertilizer of a formula indicted by soil test results of site soils and/or planting media specified for the project. Fertilizers shall be organic, slow-release compositions incorporated into the planting media wherever applicable.
- .8 Anti-Desiccants: if specified, are to be applied to plants in full leaf immediately before digging or as required by the Project Landscape Architect. Anti-Desiccants are to be sprayed so that all leaves and branches are covered with a continuous protective film.
- .9 Bio-stimulants: shall contain soil conditioners, VAM, and ectomycorrhizal fungi spores and soil

bacteria appropriate for existing soil conditions. Submit manufacturer's literature for approval.

- .10 [Edging: Heavy-duty commercial grade aluminum. Minimum 3/16" thick x 8" height c/w 18" long stakes.](#)

2.13 Planting Hole Excavations – Trees, Shrubs and Groundcovers

- .1 Trees, shrub, and groundcover beds are to be excavated to the depth and widths indicated on the drawings – neither too high nor too low. If the planting area under any tree is initially dug too deep, the soil added to bring it up to the correct level should be thoroughly tamped. If the planting area has not been sufficiently excavated, the tree must be replanted at correct level exclusive of required mulch.
- .2 The sides of the excavation of all planting areas shall be sloped at a 45 degrees. The bottom of all beds shall slope parallel to the proposed grades or toward any subsurface drain lines within the planting bed. The bottom of the planting bed directly under any tree shall be horizontal and tamped such that the tree sits and remains plumb.
- .3 Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not excavate compacted subgrades of adjacent pavement or structures.
- .4 Subgrade soils shall be separated from the topsoil, removed from the area, and not used as backfill in any planted or lawn area. Excavations shall not be left uncovered or unprotected overnight.
- .5 On steep slopes, the depth of the excavation shall be measured at the center of the hole and the excavation dug as shown on the drawings.
- .6 Detrimental soil conditions: The Project Landscape Architect is to be notified, in writing, of soil conditions encountered, including poor drainage that the contractor considers detrimental to the growth of plant material. When detrimental conditions are uncovered, planting shall be discontinued until instructions to resolve the conditions are received from the Project Landscape Architect.
- .7 Obstructions: If rock, underground construction work, utilities, tree roots, or other obstructions are encountered in the excavation of planting areas, alternate locations for any planting shall be determined by the Project Landscape Architect.

2.14 Planting Season

- .1 Plant only during the season or seasons which are normal for such work determined by weather conditions and as approved by the Project Landscape Architect.
- .2 Do not plant during freezing and/or abnormally hot, dry weather.

2.15 Tree Layout

- .1 Do not plant trees within the dripline of existing trees.

2.16 Planting Procedures

- .1 All plants to be installed maintaining original grades of bases as they were in the Nursery.
- .2 Loosen bottom of planting hole to depth of 150-200mm (6-8") prior to placing growing medium.
- .3 Plant bare root trees vertically with roots placed straight out in hole. Orient plant material to

give best appearance in relation to structure, roads and walks.

- .4 Place plant material to depths equal to the depth they were originally growing in nursery.
- .5 With balled and burlapped root balls, loosen burlap and cut away minimum top 1/3 without disturbing root ball. [This must be done before acceptance by UBC Municipal Services irrespective of any restrictions from doing so by plant nursery providers.](#) Do not remove burlap or rope from under root ball. Remove any excess soil on top of root ball such that root flare is at or slightly above finished grade.
- .6 With container stock, remove entire container without disturbing root ball. Non bio-degradable wrappings must be removed.
- .7 Tamp growing medium around root system in layers of 150mm (6") eliminating air voids. Frozen or saturated growing mediums unacceptable. When 2/3 of growing medium has been placed, fill hole with water. After water has completely penetrated into soil, complete backfilling.
- .8 Water thoroughly on the interior of the tree saucer until it is filled even if it is raining. A second watering may be necessary to ensure saturation of the root ball.
- .9 Prune out any dead or broken branches.
- .10 Remove all tags, labels strings, etc. from plant material.
- .11 Trees need to have any twine encircling their trunks cut at time of planting to prevent the girdling of the trunk.

2.17 Mulching

- .1 Mulch all tree, shrub and groundcover planting areas (See **2.12.5** above).
- .2 Ensure soil settlement has been corrected prior to mulching.

2.18 Guying and Staking

- .1 Guy and stake all trees immediately after planting according to current recommendations of the International Society of Arboriculture (ISA) and the ANSI A300 – Standards for Tree Care Operations. Plant material not guyed or staked immediately must be replaced if damaged.
- .2 Stake or guy a tree only when necessary for the specific conditions encountered and as per ISA Tree Staking Details or project drawing details. Staking may be required in unusual circumstances such as sandy soils or in extremely windy conditions, Poor quality trees with cracked, wet, or loose root balls, poorly developed trunk-to-crown ratios, or undersized root balls shall be rejected if they require staking, unless written approval to permit staking or guying as remedial treatment is obtained from the Project Landscape Architect. Trees that settle out of plumb due to inadequate soil compaction either under or adjacent to the root ball shall be excavated and reset. In no case shall trees that have settled out of plumb be pulled upright using guy wires.
- .3 Stakes, anchors wires or plastic strapping shall be of sufficient strength to maintain the tree in an upright position that overcomes the particular circumstances that initiated the need for staking or guying.
- .4 Guying: Fasten tree around leader at branch crotch to stake, pin or deadman in the ground, or

laterally to upright tree stake with galvanized wire protected by hose where wire wraps around leader and crotch as per manufacture's or drawing detail specifications. Alternate to wire use Deeprout, Arbortie plastic strapping or approved equivalent.

- .5 Trees to stand plumb upon completion of this operation.
- .6 Stakes and guys shall be removed at end of first growing season. Any tree that is not stable at the end of this period shall be rejected.

2.19 Maintenance Prior to Final Completion and Acceptance by Municipal Services

- .1 Maintain all plant material from date of planting until Final Completion of the landscape and acceptance by Municipal Services. Refer to Section 32 01 90 Operation and Maintenance of Planting for maintenance and operation after Substantial Completion.
- .2 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.
- .3 Supply equipment such as pumps, portable sprinklers systems, tanker trucks, hose and sprinklers required for watering operations.
- .4 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.

2.20 Reviews and Acceptance

- .1 At Substantial Completion, the Project Manager must schedule a review of the planting with Municipal Services Landscape Architect to identify any deficiencies. Provide minimum 48 hours notice.
- .2 Trees, plant material and plantings must adhere to all requirements included in this section, exhibit healthy growing conditions and be free from annual/perennial/invasive/noxious weeds, disease, insects and fungal organisms.
- .3 At Final Completion, the Project Manager must schedule a review of the planting with a UBC Municipal Services Landscape Architect to review satisfactory completion of the deficiencies. Provide minimum 48 hours notice.
- .4 Acceptance will not be forthcoming if tree plants, plantings and/or soil show any evidence of invasive or perennial weeds such as morning glory, creeping vetch, horsetail or couch grass.
- .5 Plant material insufficiently hardened-off prior to onset of frost and freeze may be rejected and require replacement if signs of frost damage, poor root development or winter desiccation are evidenced.
- .6 The Project manager must schedule an end-of-warranty inspection that includes the Project Manager, the Project Landscape Architect, the landscape contractor, the maintenance contractor (if different from landscape contractor) and Municipal Services Landscape Architect.
- .7 At the end of the Warranty period, trees, plant material and plantings must exhibit healthy growing conditions and be free from annual/perennial/invasive/noxious weeds, disease, insects and fungal organisms.

2.21 Maintenance During Warranty Period

- .1 Refer to Section 32 01 90 Operation and Maintenance of Landscape.

*****END OF SECTION*****

1.0 GENERAL

1.1 Scope

- .1 This guideline addresses the requirements for the transplanting of existing trees and plants, plus materials and equipment required to transplant and establish trees and plants in their new locations as shown on site development drawings.

1.2 Related Work

- .1 Section 32 01 93.01 Tree and Shrub Preservation
- .2 Section 32 91 00 Planting Preparation
- .3 Section 32 93 00 Plants

1.3 Consulting Arborists and UBC Building Operations ISA certified arborist

- .1 Where trees, or tree preservation strategies are anticipated as part of a development proposal, an ISC Certified Arborist must be retained as an integral member of the project consultant team. The Consulting Arborist is to advise on specific pre- and post-development strategies, and provide expert analysis, details and/or specifications required to optimize planned tree retention and preservation.
- .2 A UBC Municipal Services Arborist Technician will serve as UBC's representative in arboricultural matters and can advise on tree issues with consultants and UBC staff as required.

1.4 Coordination

- .1 Coordinate as early as possible in the conceptual and design development phases with a UBC Campus Arborist.
- .2 Coordinate throughout mobilization and construction phases of a project with a UBC Arborist Technician regarding any site changes, potential damages or pruning required on relocated trees retained.

1.5 References and Standards

- .1 Canadian Landscape Standard - current addition
- .2 International Society of Arboriculture (ISA), Planting Specification, Tree and Shrub Transplanting
- .3 International Society of Arboriculture (ISA), Best Management Practices - Tree Planting

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Tree Relocation and Protection Plans

- .1 For trees to be protected and/or retained on site, the Project Landscape Architect must provide Tree Protection/Relocation Plans indicating surveyed grades at base of trunks, DBH, extents of drip lines and location of Tree Protection Fencing. Specifications and cross-sectional details for applicable preservation strategies including, but not limited to, requirements covered in this general guideline must be included in construction documents.

2.2 Coordination, Inspection and Supervision

- .1 The Landscape Architect (C+CP), Project Landscape Architect, Project Consulting Arborist, and/or a UBC Municipal Services Arborist Technician shall coordinate as early as possible in the project to identify trees to be retained, protected, transplanted or removed and clearly establish tree relocation strategies for on-site or off-site locations.
- .2 Every effort should be made to coordinate transplanting to occur in the dormant season or otherwise optimize conditions for transplanting in conjunction with site development timing and priorities.
- .3 A qualified Landscape Contractor or authorized Tree Mover shall be responsible for transplanting of existing trees or shrubs to be relocated including preparation of site and coordination with Project Landscape Architect, Project Consulting Arborist and/or a UBC Municipal Services Arborist Technician.
- .4 The Project Landscape Architect, the Consulting Arborist and/or a UBC Municipal Services Arborist Technician must be on site to monitor the relocation operations as required. The Contractor must provide minimum 48 hours' notice prior to relocation operations.
- .5 During the construction phase, the Contractor responsible must contact a UBC Municipal Services Arborist Technician immediately regarding any site changes impacting tree or shrub relocation and preservation.

2.3 Site Conditions and Preparation

- .1 Protect all existing trees, shrubs, properties, services and buildings from any potential damages from tree relocation work. (Refer to Section 32 01 93.01 Tree and Shrub Preservation).
- .2 Consult with UBC Utilities regarding any underground services prior to commencement of work. Ensure work area is free from overhead, above ground and below ground hazards or utilities. Consult with UBC Building Operation and Utilities regarding any unforeseen hazards, structures or services prior to moving trees or shrubs.
- .3 Check target locations for relocating plant material to ensure adequate access, soil quality and drainage.
- .4 Ensure that soil texture, fertility and drainage at the new planting site(s) is acceptable, and that new transplant site provides analogous cultural conditions to original site. (Refer to Section 32 91 00 Planting Preparation).

2.4 Maintenance

- .1 Maintenance of all relocated/transplanted trees and plant material at either on-site, or off-site heel-in/holding compounds will be the responsibility of the Contractor for the duration of the project and maintenance period.
- .2 Maintenance of all relocated/transplanted trees and plant materials to permanent planting locations, will be the responsibility of UBC Building Operations unless otherwise specified.

2.5 Guaranty

- .1 Unless otherwise specified, the Contractor will not be required to guaranty transplanted trees and plant materials, but will be required to do all work as specified under the direction of the Project Landscape Architect in consultation with Project Consulting Arborist and/or a UBC Municipal Services Arborist Technician at the time of the plant moving.

2.6 Replacement

- .1 The Contractor shall be responsible for replacing any damaged existing trees and plant material to be relocated with the same genus, species, size and character at no cost to UBC.

2.7 Materials

- .1 Unless a tree or shrub is moved in one operation, directly to new site within a tree spade, rootballs must be firmly wrapped with non-synthetic, rottable burlap secured with heavy non-synthetic, rottable twine.
- .2 Balls must be firmly wrapped with non-synthetic, rottable burlap and secured with nails and/or heavy, non-synthetic rottable twine. The root collar shall be apparent at surface of ball. Trees and plant material with loose, broken root balls shall not be accepted.
- .3 Correctly sized wire baskets capable of accommodating the rootballs of trees and large shrubs may be used to facilitate movement, storage and rootball integrity.
- .4 Anti-desiccants are to be applied to plants in full leaf immediately before digging or as required by the Project Landscape Architect in consultation with Project Consulting Arborist and/or a UBC Municipal Services Arborist Technician. Anti-desiccants are to be sprayed so that all leaves and branches are covered with a continuous protective film. Anti-desiccant shall be an emulsion specifically for agricultural use, mixed and applied according to manufacturer's recommendations.
- .5 Anchors shall be Douglas Fir standard or better grade S4S lumber in the following size: 50 x 100 x 1200mm (2" x 4" x 48").
- .6 Tree wraps shall be 8 -10cm wide nylon strapping three (3) per tree, 0.75m in length, with galvanized metal eyes at either end.
- .7 Guy wire and safety sleeves shall be galvanized 11 gauge wire with brightly coloured survey plastic sleeves covering the bottom 1.5m of each section.
- .8 Turnbuckles shall be galvanized and a minimum body length of 150mm (6").

2.8 Fertilizer

- .1 Slow-release fertilizer such as 18-6-12 Osmocote or approved equivalent.

2.9 Complete Chip Mulch

- .1 Tree mulch shall be complete tree chip mulch, including parts of the leaf, twig, bark and stem wood. This product may be obtained from local tree contractors or UBC Municipal Services, generally free of charge. The mulch should be free of pests or diseases and should not contain Western Red cedar or Black walnut.
- .2 Provide a sample of the proposed tree mulch and its source for approval by the Consulting Arborist and/or a UBC Municipal Services Arborist Technician.

2.10 Planting Soil

- .1 Refer to Section 32 91 00 Planting Preparation for general specifications on use of native topsoils and commercial soil products.

- .2 Horticultural soil products may be mixed with existing soils to a maximum ration of 2:1 (new to old). The amended soil volume required for each tree will fill a void around the outside of the root ball 60cm in depth and equivalent to the radius of the root ball in width. [For example, a tree with a rootball 2m in diameter will require enough soil to fill a trench around the root ball 60cm in depth below existing grade and 1m wide. Additional soil will be required to raise the grade around the perimeter of root ball in its new location in order to form the watering saucers.

2.11 Period of Planting

- .1 Coordinate digging of plant material to be transplanted to ensure minimum time between digging and re-planting.
- .2 Trees and plant material designated for B&B, bareroot or as collected plants, shall not be dug or installed before dormancy or after bud break from late fall to early spring.
- .3 Transplanting outside of the dormant season may occur in special circumstances only in consultation with Project Consulting arborist and/or a UBC Municipal Services Arborist Technician.

2.12 Protection

- .1 Verify existence and location of any on-site utilities. Consult the Project Landscape Architect immediately for directions as to procedure should any piping or utilities be encountered during excavation.
- .2 Protect existing buildings, equipment, sidewalks, landscaping reference points, monuments and markers. Make good all damage incurred during this work.
- .3 Make every effort to protect all existing plants adjacent to any construction/tree relocation work.
- .4 Erect temporary continuous barriers where necessary to ensure safety of existing plants and trees. Refer to Section 32 01 93.01 Tree and Shrub Preservation for protection fencing specifications.

2.13 Layout, Digging, Transportation, Planting and Securing

- .1 Stake out the exact location for each tree or shrub transplant as shown on Landscape Plan.
- .2 In approved locations, dig tree pit holes that are deep enough to accommodate the depth of the root ball without settling beneath the existing grade. The diameter of the planting hole in the upper 60cm of soil should be approximately twice the diameter of the root ball selected for that location.
- .3 Ensure tree pits drain adequately. If drainage is poor, inform the Consulting Arborist.
- .4 Dig each plant to the specified root ball diameter using appropriately sized Tree Spade equipment and employing the best trade practices. For trees with stem calipers less than 12cm, minimum root ball diameters will be calculated at 15 times the stem caliper, measured 30cm above grade. [For example, a 10cm. caliper tree will have a root ball no less than 1.5m in diameter.] For trees with stem calipers greater than 12cm, minimum root ball diameters will use a multiplier of 12. [For example, a 20cm caliper tree will have a root ball diameter of no less than 2.4m.] For trees with stem calipers greater than 25 cm, use a multiplier of 10.

- .5 Root balls will be dug, where possible, with the tree stem centered in the root ball. If circumstances preclude obtaining the minimum rootball size with the stem centered on the root ball, the contractor will consult with the Project Consulting Arborist or a UBC Municipal Services Arborist Technician before proceeding.
- .6 If, in the opinion of the contractor, the stability of the root ball or the tree will be compromised in the new planting site, the contractor is instructed to basket the root balls and ensure that the root balls are adequately strapped in burlap prior to transport. The contractor must ensure that the root plates of the relocated trees are stable and the trees are windfirm in their new sites. The contractor has the discretion to utilize wire baskets and or staking materials and techniques (see below) as his judgment directs. Relocated trees must remain completely windfirm for the duration of the maintenance period (12 months).
- .7 Transport the plants immediately to the approved planting area and plant.
- .8 Tree Saucers:
 - .1 Make a saucer around each tree with a berm of soil approximately 150mm (6") higher than the top of the earth ball, 900-1200mm (36-48") from the base of the trunk of the tree to facilitate watering.
- .9 Tree Guying:
 - .1 Relocated trees must remain completely windfirm for the duration of the maintenance period (12 months). The contractor is directed to utilize whatever methods reflect the best trade practice of his industry to ensure the stability of the root ball. If, however, in the opinion of the contractor, guying of the tree is required, the following prescription is to be utilized.
 - .2 Equally space three anchors around the tree. Attach tree wraps approximately midway up the stem of the tree. Anchors should be placed at a sufficient distance to achieve a 45 degree angle on the guy. Anchors should be set at right angles to the guy wires and driven in to a depth sufficient to secure the guy (minimum of 80 centimeters).
 - .3 Secure the guy to the tree wrap rings and the anchor with a turnbuckle interposed between the two anchor points. Tension the guys once installed and position the protective sleeves. Provide three (3) guy wires per tree with a turnbuckle set in the centre of each wire.

2.14 Mulch and Fertilizer Application

- .1 Apply 12 – 14 centimeters of complete tree chip mulch to the area of the planting site [i.e. to an area twice the diameter of the root ball].
- .2 Apply fertilizer based on soil test results and incorporate into backfill soil or by surface application. In absence of soil test recommendations, apply approximately 250 grams (1/2 lb) of 18-6-12 Osmocote for each 5 centimetres of caliper per tree. Distribute the Osmocote over the top of the root ball area after mulching.

2.15 Watering

- .1 Immediately after mulching and fertilizing, apply approximately 181 liters (20 gallons) of water per tree at a moderate flow rate. Ensure that flow rate does not liquefy soils and destabilize tree.

2.16 Pruning

- .1 Prune off any broken or damaged branches to the outer margin of the branch collar. All pruning work to be done by an ISA Certified Arborist in consultation with the Project Consulting Arborist, or a UBC Municipal Services Arborist Technician.

*****END OF SECTION*****

1.0 GENERAL

1.1 UBC Energy & Water Services Jurisdiction

- .1 UBC Energy & Water Services (EWS) is responsible for design, operation, maintenance, and overall stewardship for each of the following underground utility services:
 - .1 Section 33 10 00 Water Utilities
 - .2 Section 33 51 00 Natural Gas Distribution
 - .3 Section 33 63 00 Steam Energy Distribution
 - .4 Section 33 49 00 Storm Drainage
 - .5 Section 33 30 00 Sanitary Sewerage Utilities
 - .6 Section 33 71 00 Electrical Utility Transmission and Distribution
 - .7 Section 33 61 00 District Hot Water Energy Distribution
- .2 The demarcation point of service defining UBC Energy & Water Services' responsibility is included in the respective sections as listed above.

1.2 UBC Energy & Water Services Contact Information

- .1 Engineering & Utilities:

6130 Agronomy Rd,
Vancouver, BC V6T 1Z3
Phone: (604) 822-9445
Fax: (604) 822-8833

Energy Conservation & Innovation:
2260 West Mall
Vancouver, BC V6T 1Z4
Phone: (604) 822-5301
- .2 Key Positions in Utilities include:
 - .1 Director, Engineering and Utilities
 - .2 Senior Manager, Electrical Utilities
 - .3 Senior Manager, Mechanical Utilities
 - .4 Mechanical Utilities Engineer
 - .5 Lead Trades: Head Electrician, Head Plumber, Head Steamfitter, Head Utilities Maintenance Engineer.

1.3 Designer and Contractor Responsibility

- .1 UBC Technical Guidelines establishes the minimum acceptable standards for the supply and installation of the underground utility services to the buildings on the campus. This is not a design manual. The designer is responsible to ensure that the standards stipulated herein are consistent with the project requirements and are adequate for the project design criteria. The designer shall define the project requirements in the project specification as part of the project tender document.
- .2 Where comments in UBC Technical Guidelines is interpreted to conflict with the industry Standards, Acts and Codes, the compliance with the Standards, Acts and Codes shall prevail and the designer shall bring these conflicts in writing to the attention of the responsible manager at UBC Energy & Water Services.

- .3 The consultant and/or contractor shall provide drawings in accordance with the Technical Guidelines. Within 60 days from backfill, the consultant and/or contractor shall provide a set of Red Line drawings to UBC Energy & Water Services. Upon completion of installation of any new or modified underground utility services and prior to a final walkthrough before hand over to owner, Record drawings of underground utility services shall be provided to *Infrastructure Development, Records*. Record drawings shall show utility service and/or infrastructure details as constructed including, for example, pipe or infrastructure facility size, material, invert and rim elevations, etc. Service profiles shall be provided in congested areas indicating location of all services. See Section 01 78 39 Project Record Documents for details. Upon completion, CCTV inspections must also be provided to UBC Energy & Water Services (see specifications 33 82 01 and 33 01 30.41 at <https://energy.ubc.ca/community-services/contractors-developers/>).
- .4 UBC Energy & Water Services has created checklists intended to guide projects through the steps and procedures required to successfully coordinate with UBC EWS and obtain approval for various construction activities/stages. The forms should be completed and submitted to UBC EWS prior to final completion and acceptance of the project. Note that these forms ONLY addresses coordination with mechanical utilities (water, sanitary, storm and gas) and District Energy. Coordination required for electrical utilities is not outlined in these forms and should be addressed separately. The forms (UBC Mech Construction Checklist and UBC DES Construction Checklist), along with other required connection and activation application forms for contractors and consultants can be downloaded here: <https://energy.ubc.ca/community-services/contractors-developers/>.

2.0 **UBC ENERGY & WATER SERVICES (EWS) DEVELOPMENT SUPPORT SERVICES**

2.1 **General**

- .1 Table 2.1.1 outlines the utility requirements assessment in the project approval process for core UBC buildings. Support services and development requirements are defined in terms of UBC Board of Governors approval status.

Table 2.1.1
Utility Requirements Assessment
in the Project Approval Process for Core UBC Buildings

Timing	Utility Planning and Design Work	Product	Lead Responsibility
Prior to Exec 2	As part of the siting process complete an engineering requirements assessment - Run the master servicing model - Complete GIS overlay analysis to identify all utilities requiring move or protection	Engineering and Services Requirement Document (based on general floorspace)	Campus & Community Planning - May refer to EWS for comment, but always provided for information

Timing	Utility Planning and Design Work	Product	Lead Responsibility
Prior to Exec 3/ Board 1	Utilities Concept Design	Engineering Sketch and Costing* (to be included in project design brief) * to include site plan and possible services connection locations *Project Manager / applicant to provide costing	Campus & Community Planning - Include EWS and project managers in working session to prepare concept design - Variances from Engineering and Services Requirements document must be approved by Managing Director, Building Operations & Associate VP, Campus & Community Planning.
Prior to Board 2	Utilities Schematic Design No later than halfway through the development of schematic design, an integrated design discussion should be held with Campus & Community Planning, EWS and Building Operations representatives	Engineering design drawings* * prepared by applicant team * must be part of Development Permit (DP) Application submission Preliminary service connection application information to be provided	Campus & Community Planning - Design drawings submitted through DP application circulated to EWS and Campus & Community Planning UA/Eng Services for comment in 10 working days - Campus & Community Planning to verify model analysis
Post Board 2	Drawing Review against Technical Guidelines	Service Connection Application with drawings and variance requests from either Engineering Services Requirements document or Technical Guidelines	Technical Guidelines variances approved by Managing Director, Building Operations and Managing Director, Infrastructure Development
Prior to Development Permit Issuance		Development Permit with Engineering Requirements Document attached	Campus & Community Planning for Development Permit

Timing	Utility Planning and Design Work	Product	Lead Responsibility
Engineering Clearance for Building and Streets and Landscape Permits* *Building permits address all onsite engineering works and services; Streets and Landscape permits address all offsite engineering works and services	Vancouver Coastal Health (VCH) Water Connection Permit Review of service connection design for Building Permit and / or Streets and Landscape Permit Applications	Permit from VCH Final Service Connection clearance for either: Staged Building Permit – Excavation / Shoring, Foundation and/ or Full (addresses onsite works and services) or Streets and Landscape Permits (addresses offsite works and services and public realm projects)	Applicants secure permit (or EWS for UBC utility infrastructure projects) EWS to provide Service Connection clearance to Campus & Community Planning EWS to provide Service Connection clearance to Campus & Community Planning
As part of Building Permit process	Site visit prior to backfill of below-grade works and services	Record drawings based on digitized red-line construction drawings, submitted to Infrastructure Development, Records by project manager (set of red line drawings to be provided within 60 days of backfill) Survey of inverts to check compliance with design (completed prior to walk-through) Photos of installation and sewer CCTV inspection reports submitted to Infrastructure Development, Records by project manager	EWS for walk-through of installation and review of red line construction drawings Working Group and Steering Committee for problem solving Final loading data for utilities to be provided by applicant (to Campus & Community Planning and EWS)

2.2 Underground Utility Record Drawings

- .1 Record drawings for all underground utility services must be obtained from Infrastructure Development, Records (Telephone: 604-822-9570).

2.3 Field Inspections

- .1 To verify or complement record drawing information, UBC Energy & Water Services will provide trades staff support to assist in verifying locations, condition, and features of existing underground utility services. Trades staff will be supported by UBC Energy & Water Services engineering and technical professionals.

- .2 Written requests (facsimile or email) shall be submitted as follows:
 - .1 For electrical service contact Senior Manager, Electrical Utilities.
 - .2 For gas, district hot water, water, sanitary, or storm contact Senior Manager, Mechanical Utilities.
- .3 UBC Energy & Water Services charges a \$300 fixed fee per utility service per site. For example, field inspections for water, electrical, sanitary sewer, and storm sewer underground utility services for a new development would cost \$1,200.

2.4 Shutdowns

- .1 UBC Energy & Water Services has sole authority and responsibility to perform shutdowns (or cross connections) of the systems within its jurisdiction. The cost for a service shutdown is based on time and materials, paid by the project.

2.5 Utility Service Connection Permits

- .1 A service connection permit is required for any connection to a utility service as defined in the following Sections in Division 33:
 - .1 Section 33 10 00 Water Utilities
 - .2 Section 33 51 00 Natural Gas Distribution
 - .3 Section 33 63 00 Steam Energy Distribution
 - .4 Section 33 49 00 Storm Drainage
 - .5 Section 33 30 00 Sanitary Sewerage Utilities
 - .6 Section 33 71 00 Electrical Utility Transmission and Distribution
 - .7 Section 33 61 00 District Hot Water Energy Distribution
- .2 The Service Connection Application must be completed and submitted to UBC Energy & Water Services per the instructions on the form. Refer to Energy & Water Services Forms at: <https://energy.ubc.ca/community-services/contractors-developers/>.
- .3 The Service Activation Request must also be submitted to UBC Energy & Water Services prior to any energization of systems. Refer to above link for *Activation* Request form.
- .4 Additional permits from the provincial Electric Safety Branch, Gas Safety Branch, Boiler Safety Branch, Plumbing permits (UBC C&CP) and the Construction Permit from Vancouver Coastal Health, are the responsibility of the project team.

2.6 Development Permit Approval by UBC Energy & Water Services

- .1 The Director, Engineering and Utilities, of UBC Energy & Water Services has sole authority to authorize underground utility service aspects of any development. Sign off of development permits by UBC Energy & Water Services is coordinated by Campus and Community Planning.

END OF SECTION

1.0 **GENERAL**

This section refers to the works that are unique to the requirements for cleaning of new and existing sanitary and storm sewer pipe and pipe culverts.

1.1 **Related Sections**

- .1 Section 33 00 10 Underground Utilities Services
- .2 Regulation - Traffic and Highway Bylaw
- .3 Section 33 82 01 CCTV Pipeline Inspection

1.2 **References**

- .1 This section must be referenced to and interpreted simultaneously with all other sections of the Technical Guidelines pertinent to the works described herein.

1.3 **Material Certification**

- .1 All materials to conform to this specification, to the latest edition of the appropriate specifications of the American Society for Testing and Materials (ASTM) or other standards expressly specified. All provisions in ASTM and other specified standards pertaining to materials, workmanship, finish, inspection and rejection form part of these specifications as far as they are applicable and providing that they are not inconsistent with this specification. This specification takes precedence over the ASTM specifications in case of a discrepancy or conflict. Materials incorporated into the Work but not specifically covered in the specifications are to be obtained from the Contract Administrator prior to installation.

1.4 **Work Regulations**

- .1 Work to conform to all applicable regulations of Work Safe BC Confirm training compliance in the following:
 - .1 Confined space entry procedures
 - .2 Atmospheric monitoring and ventilation methods
 - .3 Personal protective equipment
 - .4 Interpretation of Material Safety Data Sheets (MSDS)

1.5 **Terminology**

- .1 Flushing is defined as a maximum of three (3) passes of high pressure jetting equipment to allow for passage of CCTV or other forms of inspection equipment.
- .2 Cleaning is defined as the removal of all debris by means of high pressure jetting equipment including: gravel, sand, rocks (to 300mm in diameter), grease and other deleterious material.

1.6 **Submissions**

- .1 Submit the following information seven (7) days prior to the commencement of work:
 - .1 Provide schedule and sequence of flushing or cleaning activities
 - .2 Provide dates of training completion for all workers to the Engineer and a list of equipment required for confined space entry.

1.7 **Scheduling**

- .1 Schedule work to minimize interruptions to existing services.
- .2 Hours of work to comply with noise restriction bylaw unless granted exemption.

- .3 Maintain existing flow during sewer cleaning and debris removal unless directed otherwise in contract document.

1.8 Measurement for Payment

- .1 All units of measurement for payment will be as specified herein unless shown in the Form of Tender.
- .2 Sewer cleaning and sewer flushing will be measured in lineal metres. Payment will be made at the unit price bid in Form of Tender.
- .3 Measurement for sewer flushing and debris removal to be determined from plan distances and periodically confirmed by surface measured distances with a calibrated measuring devise.
- .4 Measurement for sewer cleaning and debris removal to be determined from plan distances and periodically confirmed by surface measured distances with a calibrated measuring devise.
- .5 Manhole cleaning will be made at a per unit rate as described in the Form of Tender.
- .6 Root cutting will be measured in hours. Payment will be made at the unit price bid in Form of Tender. Measurement will be determined from the difference in time between when the cutting tool is engaged at the face of the manhole to when it exits on completion of the root removal process.
- .7 Grease cutting and removal will be measured in hours. Payment will be made at the unit price bid in Form of Tender. Measurement will be determined from the difference in time between when the cutting tool is engaged at the face of the manhole to when it exits on completion of the grease removal process.
- .8 Debris disposal is considered incidental to associated cleaning and flushing work. No separate payment will be made for debris disposal.

2.0 PRODUCTS

2.1 Equipment

- .1 High velocity cleaning equipment to be capable of providing a minimum flow of 200 litres per minute (60 GPM) at 140 bar (2000 psi). Cleaning nozzle to be hydraulically or hydro-dynamically propelled and capable of producing a scouring action from 15 to 45 degrees. A variety of ancillary equipment and nozzles to be available including; standard flushing nozzles, high efficiency , spinning jet and plough jet to address all anticipated debris conditions. The equipment to include a water tank, pumps and hydraulically driven hose reel. Equipment to include a wash down gun for cleaning manholes and an approved back flow preventing device for water tank filling.
- .2 Debris removal equipment to consist of a vacuum pump complete with positive displacement pumps or fans producing a minimum of 700 l/s air movement. Equipment to be capable of removing debris at a minimum of 4.5 metres vertical head. Suction hose to be a minimum of 150 mm diameter. Debris tank to be water tight and capable of returning the liquid portion of the debris to the sewer.
- .3 Debris cutting equipment to be an accessory or attachment to hydraulic cleaning equipment. Equipment to be capable of removing heavy roots and solid debris such as encrustation and grease.

- .4 Backflow prevention valves for the purpose of drawing water from hydrants to have air gap and must be pre-approved by the Water Utility Operations Department.
- .5 All water used in the flushing or cleaning of storm sewers shall comply with BC Environmental Management Act and corresponding Municipal Sewage Regulation and be subject to de-chlorination with ascorbic acid or similar approved product prior to use.

3.0 **EXECUTION**

3.1 **Clean or Flush**

- .1 Clean or flush all pipelines as specified in contract documents. Notify Engineer immediately in the event that roots, grease or unusual quantities of debris is observed after three passes.
- .2 Notify all affected residences connected to the sanitary sewers in writing of proposed sewer cleaning and CCTV inspection process as specified in the contract documents. Notice to be distributed two (2) working days in advance of flushing. Notice to include Contractor's name and contact information.
- .3 Begin cleaning or flushing from the upstream sewer in the system and proceed downstream. Under no circumstances is the sewer cleaning or flushing process to proceed downstream until all contributing upstream sewers have been cleaned. Sewers to be cleaned or flushed in the direction of flow.
- .4 A manhole to be washed down with high pressure wand AFTER manhole inspection has been completed.
- .5 Remove debris by vacuum pumping at each manhole. Do not pass debris from manhole to manhole.
- .6 Dispose of debris at an approved landfill site
- .7 Comply with applicable Provincial and Municipal environmental laws in regard to the decanting of accumulated waste water with respect to spills and discharge of contaminants.
- .8 Decanting of liquid waste accumulated during debris removal is permitted at a controlled release rate of a maximum of 8 litres per second.

3.2 **Water Supply**

- .1 Water may be obtained from any UBC fire hydrant once permits are issued. Permit applications will be submitted to Permits & Inspection (Phone: 604 822-8228). Application and instructions are available at <https://planning.ubc.ca/planning-development/permits-and-business-licenses/building-and-trades-permits/trades-permits>
- .2 Dechlorinate all water used for cleaning and flushing storm sewers prior to discharge from tanker in accordance with Section 8 (1) of the Municipal Sewage Regulation.

3.3 **Root Removal**

- .1 Inform Contract Administrator prior to undertaking any root cutting or grease removal where cutting equipment is required.
- .2 Run root cutter through entire section of pipeline from manhole to manhole or end of pipe to end of pipe.
- .3 Select root cutting devise or grease removal nozzle of appropriately size and configuration for the diameter of the pipeline.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **System Description**

- .1 The University of British Columbia owns and operates its own water distribution system. The University Endowment Lands (UEL) Administration supplies water to the campus, while the UEL purchases water from Metro Vancouver. Ultimately two pipes feed UBC:
 - .1 24" (600 mm) water main on University Boulevard, which is the suction line supplying the UBC Water Pump Station located south of the Henry Angus Building. The discharge pressure from the pump station is set at 100 psi (689 kPa). This supplies UBC's "High-Pressure Zone."
 - .2 12" (300 mm) water main on 16th Avenue, which supplies UBC's "Low-Pressure Zone." The Low-Pressure Zone is separated from the High-Pressure Zone by seven pressure reducing valve (PRV) stations, one check valve and various normally closed gate valves.

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Responsibilities**

- .1 UBC Energy & Water Services (*EWS*) is primarily responsible for operation, maintenance, and overall stewardship of the water distribution system. Find the Guidelines' website's "Guidelines by Specification Division" link, and refer to Division 33, '*Standard Drawings and/or Detail Documents*' for the demarcation of UBC Energy & Water Services point of service for water supply to buildings, (standard dwg 1140-UT-04-WaterBldgDemarc.dwg). At the same web page, look for information on the demarcation of UBC Energy & Water Services point of service for water supply to irrigation systems, (standard dwg 1140-UT-05-WaterIrrigDemarc.dwg).
- .2 Key positions in UBC Energy & Water Services are described in Division 33, Section 33 00 10 Underground Utilities Services of UBC Technical Guidelines.
- .3 Unless otherwise agreed in writing, the project Designer is responsible for all design, permit, and inspection requirements of the B.C. Plumbing Code.
- .4 The design engineer shall obtain a construction permit from Vancouver Coastal Health for each new installation as well as for any modification of watermains in water transmission or distribution systems, including appurtenances like valves, standpipes or hydrants. These could be watermain projects for the replacement of old pipes, extension, upgrade or looping of the water network, or service connections. For details go to www.vch.ca/your-environment/water-quality/drinking-water/ under 'Water quality resources'.
- .5 The Project Designer must incorporate all specific requirements for Metering, Design and Materials and Execution of this section into the contract drawings in the form of job-specific notes. Only making reference to UBC Technical Guidelines in the drawings is not sufficient.

2.2 **Water Distribution Standards & Policies**

- .1 The latest revisions of the following standards shall apply to water distribution at UBC.
 - .1 UBC Land Use, Permitting and Sustainability Policy - UBC Policy UP12
<https://planning.ubc.ca/planning-development/policies-and-plans/campus-land-use-planning/land-use-permitting-and-sustainability-policy-ubc-policy>

- .2 B.C. Master Municipal Construction Documents (MMCD).
 - .3 B.C. Water & Waste Association (BCWWA).
 - .4 American Water Works Association.
 - .5 CSA Standards (as applicable).
- .2 Where there is a difference between these, Division 33, Section 33 10 00 Water Utilities and the referenced standards, UBC Technical Guidelines shall apply.

2.3 Water Service Connections

- .1 The first step to install new or substantially modified connections to the water distribution system at UBC is to complete a Utility Service Connection Application. This and other forms can be found at <https://energy.ubc.ca/community-services/contractors-developers/>.
- .2 Note that a Plumbing Permit is also normally required by Campus & Community Planning (C&CP) Regulatory Services as the regulatory authority for plumbing requirements of the B.C. Building Code.
- .3 Project design drawings shall provide building load for both peak domestic consumption in litres/second, and fire flow required in litres/second. UBC Energy & Water Services reserves the right to request the calculations used to estimate the peak consumption and fire flows.
- .4 Any new connections to the water distribution system will be reviewed for consistency with UBC Technical Guideline standards. UBC Camps & Community Planning will evaluate the added load using UBC's water distribution model at no cost to the project.
- .5 At the request of the project, a flow test will be performed at the adjacent hydrant to the proposed service connection and the test results are to be provided in writing.
- .6 The Designer shall obtain the Water service records by contacting the Records Clerk at Infrastructure Development, Records (telephone 604-822-9570) and develop proposed service connection location(s). Service connections may be possible to more than one water main fronting the site for large, complex buildings with the approval of UBC Energy & Water Services. For large academic buildings, this is normally required by UBC Energy & Water Services.

2.4 Metering

- .1 Water meters are required for all buildings as per the design requirements shown in the standard drawing 1140-UT-06B-WaterMeterStdMach10. If required, a remote reader shall be installed outside the building in an accessible location. For core campus buildings the design requirements are shown in standard drawing 1140-UT-07A-WaterMeterStdMag. See also Division 26 16 00 Section 2.4.
- .2 All irrigation systems independent of buildings are required to have a meter installed at the service connection. Meter antennas shall be installed on the lid of the irrigation vault or in some other accessible location.
- .3 As indicated on the drawing standards, meters and strainers are to be procured and supplied by UBC Energy & Water Services. The project will provide a purchase order for Energy & Water Services to purchase the meter hardware. There will be no additional markup or procurement fees.
- .4 If the manufacturer and designer confirm that a strainer is not required upstream of a meter, a spool piece with a 1.5"-2" port, isolation valve and hose bib shall be installed in place of the strainer.

2.5 Temporary Water Connections

- .1 Connections to UBC's fire hydrants are allowed with an approved Hydrant Connection Permit issued by Campus & Community Planning (telephone 604-822-2633). Instructions for applying are included in the Fire Hydrant Permit Application. Refer to https://planning.ubc.ca/sites/default/files/2019-11/FORM_UBC_FireHydrantApp.pdf
- .2 A temporary connection to a hydrant is only permitted for a maximum of 30 days. For all other temporary water connections, a Temporary Water Connection Permit for Construction must be obtained from <https://energy.ubc.ca/community-services/contractors-developers/> or call UBC Energy & Water Services (604-822-9445).

2.6 Service Connections and Water Mains

- .1 Water service connections shall be designed per UBC Energy & Water Services standard. Refer to Standard Documents – 1140-UT-03WaterEntry drawing.
- .2 All services should connect to the mainline distribution system at locations within roadways or utility corridors approved by UBC EWS.
- .3 The Project is responsible for permanent capping of un-used stub-outs at the connections to the main lines.
- .4 For Slab on Grade see 1140-UT-08WaterEntrySOG drawing.
- .5 If the building's main water station inside the mechanical room is on the roof, a 1.5 inch hose connection on the combined fire/domestic water service shall be installed at ground level in an accessible location.
- .6 Design consultants shall provide new irrigation service connection tie-in details including chamber location and size, pipe size, material, isolation valve (minimum 2" diameter off main), meter, strainer, backflow preventer and chamber drain connection to the storm system. When a solenoid valve is required to activate water flows, a water hammer arrestor shall be installed upstream of the solenoid valve. Refer to Irrigation Water Supply Vault Standard Drawing 1140-UT-11 for details. Also visit <https://energy.ubc.ca/community-services/contractors-developers/> for the required Irrigation Chamber Service Connection Application form.
- .7 Pipe shall be Class 50 ductile iron pipe manufactured to AWWA C151; cement mortar lined to AWWA C104 and coated 1 mil. thick asphalt.
- .8 Copper, up to 75 mm diameter, type K, joints brazed only.
- .9 Joints shall be single rubber gasket for push-on bell and spigot type joints to AWWA C111, Tyton or approved equal.
- .10 Flanged joints shall be AWWA C110; flat faced conforming to ANSI B16.1, Class 125.
- .11 Fittings shall be ductile to AWWA C110 or C153 suitable for pressure rating of 2415 kPa. Cement mortar lined to AWWA C104. Minimum design pressure for piping 1,210 kPa.
- .12 Bolts shall be medium carbon steel or Martensitic steel, ASTM A325 heavy hex finished, hot-dip galvanized to ASTM A153. Coarse threads shall have Class 2A tolerance before galvanizing. Bolt sizes to AWWA110.

- .13 Nuts shall be heavy steel hex carbon steel to ASTM A563 Grade C hot-dip galvanized to ASTM A153.
- .14 Tie rods shall be continuously threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC, hot-dip galvanized to ASTM A153.
- .15 Joint Restraint Devices:
 - .1 All pipe joints are to be restrained with wedge action restrainers meeting AWWA C111 or C153;
 - .2 For pipes 300 mm diameter and larger, boltless restrained joints, meeting AWWA C111 or C153, may be used with EWS approval;
 - .3 All fittings are to be mechanically restrained with wedge action restrainers meeting AWWA C111 or C153.
- .16 Much of UBC's existing water system is not fully restrained. When connecting to the existing system, if it cannot be verified that the pipe is fully restrained, design considerations are required to protect the existing infrastructure from any resultant thrust. Assume all existing pipes are **not** fully restrained unless directed otherwise by a UBC EWS Engineer.
- .17 Thrust blocks are required when impacts to the existing system cannot be eliminated with joint restraints.

2.7 Valves and Valve Boxes

- .1 Gate Valves shall be manufactured to AWWA C509, ductile iron body, resilient seated, non-rising stem, hub or flanged ends.
- .2 Stem seal shall be O-ring type. Valves to be complete with 50 mm square nut for underground operation. Manufacturer shall be Clow or equal approved by **UBC** Energy & Water Services.
- .3 Circular valve boxes shall be Nelson-type as manufactured by Terminal City or Dobney Foundry. Valve box riser pipe to be 150 mm diameter PVC DR35.
- .4 Isolation valves should be installed on each branch of all mainline tees and crosses or as approved by UBC EWS.
- .5 Mainline isolation valves should be located such that each service and hydrant lead can be isolated.
- .6 Maximum distance between isolating distribution valves to be 100 m.
- .7 Maximum depth of valve knuckle or extension rod top to be 600 mm.

2.8 Hydrants

- .1 Fire Hydrants to be 150 mm diameter Terminal City type C-71-P hydrants subjected to hydrostatic pressure test of 2070 kPa in compliance with AWWA C502.
- .2 Maximum hydrant to hydrant spacing is 100 m.
- .3 Minimum size of pipe connection 150 mm.
- .4 Fire hydrant shall have isolating valve not more than 6 m in front of it.
- .5 For hydrant installation requirements see standard dwg. 1140-UT-02FireHydrantDetail.dwg.

2.9 Heavy Equipment Loads on Buried Pipe

- .1 Loads on shallow buried pipe shall be evaluated in the design and construction planning phases. AWWA M41, Section 4.3 can be used as a guide for this evaluation.

3.0 EXECUTION REQUIREMENTS

3.1 Preparation

- .1 All work to follow MMCD Section 33 11 01.

3.2 Trenching

- .1 Trench alignment and depth as shown on Contract Drawings or as approved otherwise by a UBC EWS Engineer.

3.3 Granular Bedding

- .1 Minimum pipe cover to be 1.0 m.
- .2 For pipe bedding use clean granular pipe bedding conforming to MMCD Type 1 Granular Pipe Bedding gradation. Bottom thickness shall be a quarter of pipe diameter, or minimum 100 mm thick. Top shall be minimum 300 mm thick. Sides shall be minimum 225 mm to maximum 300 mm thick.
- .3 Place granular bedding material across full width of trench bottom in uniform layers to 100 mm depth.

3.4 Pipe Installation

- .1 Utility Separation: A minimum 3 m horizontal clearance is required from either sanitary sewer or storm sewer piping, when they run parallel to water main. If this clearance cannot be met, water piping can be installed closer with prior approval from UBC Energy & Water Services. Refer to MMCD Design Guideline Manual Section 1.4, and Vancouver Coastal Health's Water Supply System Construction Permit Guidelines and Application Form (see 2.1.4 this section). Installation may be approved provided water pipe is installed above sanitary or storm sewer piping with minimum vertical clearance 0.5 m and water main joints are wrapped. When crossing sanitary sewers at 90° angle, the water pipe shall be encased with 20 MPa concrete of minimum thickness 150 mm. If concrete is not desirable, joints of the water main can be wrapped with heat shrink plastic or packed with compound and wrapped with petroleum tape in accordance with the latest version of the AWWA Standards C217, and C214 or C209.
- .2 Minimum 750 mm clearance is required from all other services. Minimum 3 m. clearance to building footing or per MMCD General Design guidelines clause 1.3.
- .3 When crossing electric duct bank (crossing shall be done at 90°), run pipe with minimum vertical clearance 150 mm from the bottom of electric duct bank. If crossing of electrical ductbank cannot be done in this manner, then encase water pipe in one larger plastic pipe projecting minimum 500 mm from either side of electric ductbank.
- .4 Test and/or bleed points consisting of Corporation cocks, sized to achieve minimum flushing velocity of 0.8 m/s in accordance with AWW C651, to be provided where shown on Contract Drawings or as required by Utilities Mechanical Engineer for pressure testing and flushing.

- .5 Requirements for piping into the building's mechanical room as per drawing 1140-UT-01 Water Station Schematic.
- .6 Requirements for replacing cast iron or asbestos cement watermain at utility excavations are to be as shown in drawing 1140-UT-09 Water Mains at Excavations. Where water pipes cross under wall foundations, they must be built of ductile iron for a distance of at least 3 metres on either side of the wall, to avoid settlement cracking.
- .7 When excavating over existing A/C or cast iron watermain, only controlled density backfill shall be used. No compaction is permitted.

3.5 Valve Installation

- .1 Valves must be adequately restrained to resist pullout force when closed. Valve restraint systems should include calculated restrained joint lengths on each side of the valve or gravity or dead man thrust blocks or other solutions as approved by UBC EWS.

3.6 Hydrants

- .1 For Hydrants not in service, place an orange painted sign, 30 cm x 30 cm, lettered "Not in Service" on the main port. Remove when water main is accepted by a UBC EWS Engineer.

3.7 Thrust Blocks

- .1 As stated in Section 2.6, thrust blocks are required when joint restraints cannot eliminate thrust impacts to the existing system, or as directed by UBC EWS Engineers.
- .2 Thrust block design considerations must be based on fitting type, water pressure and soil conditions.
- .3 Place concrete thrust blocks between valves, tees, wyes, plugs, caps, bends and undisturbed ground as shown on the Contract Drawings or as directed by a UBC EWS Engineer.
- .4 Thrust blocks to undisturbed soil shall be provided, complete with bearing area and block volume.

3.8 Pipe Surround and Backfill

- .1 Upon completion of pipe laying and before backfilling, Contractor shall notify for inspection UBC Energy & Water Services Head Plumber (604-816-9364). Notification for inspection shall be provided minimum 48 hours in advance.
- .2 After inspection of work in place, surround and cover pipes.
- .3 Trench backfill is to be as per MMCD specifications or as approved by UBC EWS.

3.9 Cleaning and Preliminary Flushing

- .1 Water may be supplied from UBC fire hydrants upon application for a Hydrant Permit.

3.10 Testing and Flushing Procedures

- .1 Contractor shall notify a UBC EWS Engineer and UBC Energy & Water Services Head Plumber 24 hours in advance of testing. (Fax: 604-822-4416). Use the Utility Service

Activation Request form.

- .2 Perform all tests in presence of a UBC EWS Engineer or the UBC Energy & Water Services Head Plumber.
- .3 Testing Procedure & Report as per MMCD Section 33 11 01
- .4 A concise, written and signed report shall be provided to UBC Energy & Water Services.

3.11 Disinfection and Flushing

- .1 Perform disinfection procedure and residual chlorine test in presence of a UBC EWS Engineer or the UBC Energy & Water Services Head Plumber.
- .2 Maintain water chlorinating level (free chlorine concentration mm. 25 mg/L) in new piping for minimum 24 hours.
- .3 Before connection to UBC water system, flush piping clean until maximum free chlorine concentration is less than 0.3 mg/L. Any flushed water must be de-chlorinated.

3.12 Testing New Mains

1. After disinfection and flushing, the new main is filled with potable water and sampled for total coliform and E. coli bacteria (bug test) every 350 m.
2. If a sample fails the test, the main shall be flushed and the sampling repeated. If flushing does not result in an acceptable test, the main should be disinfected again.

3.13 Shutdowns & Connections

- .1 Shutdowns must be requested in writing adhering to UBC's campus-wide standard shutdown procedures. Obtain a Service Shutdown Request form from: <http://buildingoperations.ubc.ca/resources/policies-procedures-forms/> and Utility Service Activation Request form from: <https://energy.ubc.ca/community-services/contractors-developers/>.
- .2 Operating valves on the water distribution system shall only be performed by UBC Energy & Water Services.
- .3 Connections to existing waterworks system may be made by Contractor with approved design, proper notification and UBC EWS approval.
- .4 Notify a UBC EWS Engineer and UBC Energy & Water Services Head Plumber (604-816-9364) with a minimum 24 hours in advance of scheduled connection.
- .5 Make connections in presence of a UBC EWS Engineer or the UBC Energy & Water Services Head Plumber. To prevent damage to existing utilities, excavate the last 300 mm over utility by hand.
- .6 Hot tapping is generally not accepted. If there are exceptional circumstances, hot tapping may be requested in writing, and done only with prior written permission from a UBC EWS Engineer.
- .7 Records of pipe sizes and inverts shall be provided to UBC Facilities, Records; and to *UBC Energy & Water Services*; in accordance with Sections 01 78 39 Project Record Documents and 33 00 10 *Underground Utilities Services* of these guidelines.

3.14 Building Excavation & Shoring Anchors

1. Excavation and shoring anchors shall be located a minimum 1 m clearance to all existing underground utilities.
2. Anchor systems within 3m of finished grade in areas of interest (such as crossing a near-term future worksite) shall be de-tensioned upon completion of work, or as approved by the Director of Energy & Water Services. These anchors of interest shall be identified through the design phase and building permit process with co-ordination from UBC Energy & Water Services, UBC Properties Trust, UBC Facilities including the UBC Facilities Technical Review Team, and others.
3. De-tensioned or removed anchor systems must be certified in writing following completion of work by a Geotechnical Engineer registered with EGBC.
4. Record Drawings must be submitted to Energy & Water Services for any active anchor systems retained tensioned in-place and any de-tensioned anchor systems abandoned in-place following completion of work.
5. Co-ordinate with UBC Technical Guidelines Division 07 (Thermal and Moisture Protection) for waterproofing requirements around de-tensioned anchor systems.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 338201s CCTV Pipeline Inspection (see <https://energy.ubc.ca/community-services/contractors-developers/>)
- .2 330130.41s Cleaning of Sewers (link as above)

1.2 **System Description**

- .1 The campus has a dedicated storm drainage system which discharges to the ocean on the north. The south discharges to Booming Ground Creek and to the Fraser River.

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Responsibilities**

- .1 UBC Energy & Water Services (EWS) is primarily responsible for operation, maintenance, and overall stewardship of the storm sewers in cooperation with the following departments/organizations:
 - .1 UBC Health, Safety, & Environment.
 - .2 UBC Sustainability.
 - .3 UBC Properties Trust.
 - .4 UBC Campus and Community Planning.
 - .5 UBC Facilities.
- .2 The demarcation of UBC Energy & Water Services point of service is defined in the standard drawing 1120-UT-01-StormDemarc.dwg found under Division 33 section listings here: http://www.technicalguidelines.ubc.ca/technical/divisional_specs.html.
- .3 The Project Designer must incorporate all specific requirements for design and materials and Execution of this section into the contract drawings in the form of job-specific notes. Only making reference to UBC Technical Guidelines in the drawings is not sufficient.

2.2 **Stormwater Objectives and Standards**

- .1 The latest revisions of the following standards shall apply to storm sewers at UBC.
 - .1 B.C. Master Municipal Construction Documents (MMCD).
 - .2 Metro Vancouver's Sewer Use Bylaw latest edition.
 - .3 UBC Environmental Protection Policy #6 (<http://universitycounsel.ubc.ca/policies/index/>).
 - .4 UBC Sustainability Development Policy #5 (<http://universitycounsel.ubc.ca/policies/index/>).
 - .5 Fisheries Act.
 - .6 BC Ministry of Health.
 - .7 UBC's Integrated Storm-water Management Plan (ISMP).
- .2 The following guidelines should be considered in design and construction of stormwater systems:

- .1 Best Management Practices (BMP) Guide for Stormwater, Greater Vancouver Sewerage and Drainage District Liquid Waste Management Plan. Search the <http://www.metrovancouver.org> website.

2.3 Storm Sewer Connections

- .1 The first step to install any new or substantially modify connections to the storm sewer system at UBC is to complete a Utility Service Connection Application. This and other forms can be found at <https://energy.ubc.ca/community-services/contractors-developers/>.
- .2 Campus Planning and Development's Regulatory Services also require a Plumbing Permit to meet provisions of the B.C. Building Code Plumbing Provisions.
- .3 Any new connections to the storm sewer system will be reviewed for consistency with the Storm Drainage Master Servicing Plan, and if necessary the stormwater engineering model will be updated and run by UBC Energy & Water Services at no cost to the project.
- .4 The Designer shall obtain the Storm service records by contacting the Records Clerk at Infrastructure Development, Records, and develop proposed service connection location(s).
- .5 Service connections may be possible to more than one storm sewer main fronting the site.

2.4 Stormwater Management Plan

- .1 As part of the site design submission, a Stormwater *Management* Plan is required if one of the following conditions is met:
 - .1 The development site is 0.5 hectares (5,000 m²) or more.
 - .2 The development involves one or more new buildings.
 - .3 Net increase in stormwater runoff is 50 l/s or more based on 10 year return period and 10 minute duration storm (use Environment Canada's latest IDF curve for YVR/Vancouver International Airport found at https://climate.weather.gc.ca/prods_servs/engineering_e.html).
 - .4 There are features of the development which could lead to stormwater quality problems such as parking facilities.
- .2 If a Stormwater Management Plan is required, the Designer shall provide a written document which clearly summarizes:
 - .1 The storm flow design computations which shall include, but not necessarily be limited to, a figure indicating the catchment area and land use condition, along with a list of all design parameters and resulting design flows for the storm system. The design flows and hydraulic grade line must be indicated for all pipe reaches.
 - .2 Description of potential stormwater contaminants and how stormwater quality will be controlled.
- .3 The Stormwater Management Plan need not be a large document, and the effort should be in proportion to the size and complexity of the development. For example, a single building development may adequately summarize stormwater design in one or two pages.
- .4 A copy of the Stormwater Management Plan shall be provided to the following:
 - .1 Green Infrastructure Engineer – Campus & Community Planning (Fax: 604-822-6119).
 - .2 Manager, Mechanical Utilities - UBC Energy & Water Services (Fax: 604-822-8833).

- .3 Director, Sustainability - UBC Land & Building Services (Fax: 604-822-6119).
 - .4 Manager - UBC Health, Safety, & Environment (Fax: 604-822-6650).
 - .5 Landscape Architect Planner - Campus & Community Planning (Fax: 604-822-6119).
 - .6 Landscape Architect – UBC Facilities (Phone: 604 822-7913).
- .5 The storm water management plan must be discussed with and approved *by* the UBC Green Infrastructure Engineer and UBC Energy and Water Services.
- .6 Approval of the Stormwater Management Plan is confirmed with authorization of the Development Permit.

2.5 Storm Sewer Design

- .1 Control of stormwater quality shall be addressed in the Stormwater Management Plan. Best Management Practices (BMP's) shall be implemented to protect stormwater runoff quality. A reference document for applicable BMP's is Metro Vancouver's Best Management Practices Guide for Stormwater. This document should also be consulted for associated design information.
- .2 The Designer is encouraged to incorporate methods of biofiltration into the site design to assist with water quality treatment. This includes such features as grassed swales, vegetated buffer strips, french drains, engineered wetlands, etc. Engineered BMP's described above may be reduced or eliminated if adequate biofiltration measures are incorporated into the site design. If biofiltration is proposed for a development, it shall be included in the Stormwater Management Plan.
- .3 The Rational Method shall be applied for the design of all drainage systems servicing an area of 1 hectare or less. The hydrograph method shall be used for catchment areas exceeding 1 hectare. Hydrograph modeling shall also be applied where stormwater detention facilities are incorporated into the storm system. All hydrograph modeling shall be completed using either Visual OTTHYMO or a SWMM based program compatible with XP-SWMM2000.
- .4 The storm service system shall be designed within the project site and to the receiving trunk sewer to convey the peak 1:10 year return period storm flows. The storm duration that results in the highest peak flow should be used for design. In most cases, the sewer system shall be sized to ensure that the maximum hydraulic grade line elevation remains within the pipe. Under unique circumstances, surcharging below ground surface may be permitted provided it can be demonstrated that no risk to buildings or property result.
- .5 Rainfall intensity-duration-frequency (IDF) curves and associated rainfall data for all storm flow calculations are to be based off Environment Canada's latest IDF curve for YVR/Vancouver International Airport (found at https://climate.weather.gc.ca/prods_servs/engineering_e.html).
- .6 The Designer shall select a time of concentration (Tc) and run-off coefficient (R) which are appropriate for the proposed development. The "Tc" shall be the sum of the inlet time and travel time. In most cases, the inlet time shall be 10 minutes when the impervious surface flow path length to the storm inlets is 100 meters or less.
- .7 Storm water shall flow only by gravity into the UBC storm system. Only under unique circumstances will pumped storm water be considered. Perimeter drains can be pumped into the UBC storm system, but a request for a permission to do so shall be submitted to UBC Energy & Water Services with an explanation why the storm water cannot be discharged by gravity, the proposed pump capacity (L/s) at operating head (kPa), a diagram showing pump

curve with superimposed piping system curve at operating flow and head and sump dimensions with elevations at which pump starts and stops. Sump volume between pump start and stop elevations shall be sized so that the maximum number of On/Off cycles does not exceed six per hour.

- .8 When extending the existing trunk lines, sufficient size, depth and slope of the sewer shall be maintained to facilitate the future extension of service in accordance with the Storm Drainage Master Servicing Plan.
- .9 All storm sewer piping shall be designed with a minimum velocity of 0.6 m/s when flowing full or half full, based on the Manning's formula. Special provisions must be provided for supercritical flow or where the velocity exceeds 3.0 m/s to ensure structural stability and durability concerns are addressed.
- .10 The minimum slope shall be 1.0% for CB leads, 0.2% for storm mains smaller than 600 mm in diameter, and 0.1% for storm mains 600 mm in diameter and larger.
- .11 All catch basins, lawn drains and other inlet structures shall provide a sump and trash hood in accordance with MMCD standard drawings.
- .12 An American Petroleum Institute (API) Oil Water Separator or equivalent product such as Lafarge's Stormceptor chamber shall be incorporated at the most downstream point of the on-site storm drainage system for all parking facilities providing 20 or more parking stalls. The system shall be appropriately sized and include a bypass to reduce flushing of contaminants during elevated flows.
- .13 For underground parkades, drains should not be connected to the storm drainage system but rather to a 'Parkade Drainage Treatment System' (PDTS) and then discharge to the building sanitary sewer system. UBC has adopted the standards of the City of Vancouver's Bulletin 2008-007-EV/PL, latest revision.
- .14 Manholes at maximum 100 m spacing shall be installed at each branch connection and each change of direction. Top of manholes shall be 150 mm above the ground in all landscaped areas, otherwise flush with surface. Pipe shall be straight between manholes.
- .15 A minimum pipe size of 200 mm shall be used for gravity service mains in residential areas and 250mm in research/industrial areas. Service connections with a minimum pipe size of 150mm may be used with written approval from UBC EWS.
- .16 MMCD inspection chambers are not allowed on the storm sewer systems under UBC Energy & Water Services jurisdiction.
- .17 The downstream sewer pipe shall be equal or larger diameter. However, an exemption may be obtained with UBC Energy & Water Services' approval. For storm drainage hydraulic details, refer to Section 4.0 for the MMCD Design Guideline manual.
- .18 Where drop manholes are required, drops shall be outside, with clean-outs. For standard details refer to MMCD manhole installation standards.
- .19 Catch basins shall be spaced to service a maximum area of 500 m² on grades up to 3%. For grades exceeding 3% the spacing shall be reduced to an area of 350 m². Special consideration shall be given at low spots to ensure that adequate capacity is provided. A minimum pipe size of 150 mm shall be used for CB leads.

- .20 The maximum service length, between the building face and the first storm sewer connecting manhole, shall be 75 m. Service connections less than 20m length shall connect to sanitary mains as per MMCD Section 33 03 01 or as approved by UBC EWS.
- .21 All services should connect to the mainline distribution system at locations within roadways or utility corridors approved by UBC EWS.
- .22 A minimum 750 mm, pipe wall to pipe wall, horizontal clearance is required where the storm sewer is installed within a common trench with the sanitary sewer. If the invert of the sanitary sewer varies significantly from the storm sewer, the Designer shall give special consideration to the horizontal spacing. Clearance from building footings shall be approved by EWS and be a minimum of 3 m per MMCD General Design guideline clause 1.3.
- .23 When crossing electric duct bank, run pipe below electrical duct bank with minimum 150 mm vertical clearance from the bottom of electric duct bank. Crossing angle shall be between 45° and 90°.
- .24 Provide positive slopes away from entrances and exits (not less than 4%) to adequate storm drains or gratings that will allow a ponding depth of at least 100 mm. (This will, in normal cases, give sufficient lead time to remedy flooding situations before interior floor finishes are damaged). Install continuous gratings in lieu of catch basins and drains where broad sheets of water are anticipated to flow down pathways and roads towards entrances. Where possible provide alternate means for water to escape if a drain is plugged such as overflow scuppers, secondary French drains, etc.
- .25 All regional-level drainage detention facilities shall be designed as per UBC's Integrated Rainwater/Stormwater Management Plan, or as approved by the Director of Sustainability & Engineering and the Director of Energy & Water Services. A detention facility is considered regional-level detention storage if:
 - .1 It is located downstream of any storm sewer main as indicated in the UBC Standard Drawings Division 33 Utilities - 1120-UT-01 Storm Demarcation drawing; and
 - .2 It is identified as such in the UBC Integrated Rainwater/Stormwater Management Plan.
- .26 An oversized pipe may be used for building-level drainage detention, but is not permitted for regional-level detention storage unless approved by the Director of Sustainability & Engineering and the Director of Energy & Water Services. An oversized pipe is considered a detention facility if it includes a device or feature designed to control the discharge from the pipe. Maintenance access for an oversized pipe detention facility is required at the inlet, outlet, and at all pipe connections into the detention pipe.

2.6 Materials

- .1 Unless otherwise approved by UBC Energy & Water Services only the following pipe material shall be used for the gravity storm sewer system:
 - .1 PVC, class SDR 28 (required for 150 mm diam. and smaller) and SDR 35.
 - .2 Concrete (reinforced C76 required for all pipes 600 mm in diameter and larger).
 - .3 Corrugated HDPE having a minimum pipe stiffness of 320 kPa may be permitted under unique circumstances.
 - .4 PVC piping is preferred for all piping 300 mm in diameter or smaller.

3.0 **EXECUTION REQUIREMENTS**

- .1 Storm sewer works and appurtenances shall be installed in accordance with the current MMCD standards and specification, unless otherwise noted.
- .2 Minimum cover on all storm sewers shall be 1.0 meters in accordance with the MMCD standards. Where no future main line extension or connection of services, lawndrains, or catch basins is required, and where no traffic road exists or in future will exist, minimum cover may be reduced to 600 mm with special approval.
- .3 Site grading and surface inlets shall be located to ensure that stormwater is contained and controlled within the boundaries of the site.
- .4 Washout from concrete trucks and spray washing of exposed aggregate pavement shall conform to Metro Vancouver's Best Management Practices for Stormwater Guide (Appendix H Construction Site Erosion and Sediment Control Guide) BMP CP10.
- .5 All pipe surround material shall consist of clean granular MMCD Type 1 bedding.
- .6 Trench backfill is to be as per MMCD specifications or as approved by UBC EWS.
- .7 For purposes of cleaning and flushing, water may be supplied from UBC fire hydrants upon application for a Hydrant Use Permit. Refer to <https://planning.ubc.ca/planning-development/permits-and-business-licenses/building-and-trades-permits/trades-permits>.
- .8 As per Energy & Water Services' supplementals (see item 1.1), UBC Technical Guidelines Sections 33 82 01 and 33 01 30.41. A concise, written and signed report and video inspection shall be provided to UBC Energy & Water Services.
- .9 Prior to covering the pipe, all installed and bedded pipe shall be inspected by *UBC Energy & Water Services*. The Contractor shall provide written notification to a UBC EWS Engineer and the EWS Head Plumber with minimum of 24 hours notice.
- .10 Records of pipe sizes and inverts shall be provided to the Records Manager, Infrastructure Development (Phone: 604-822-7217); and also to the UBC Energy & Water Services, in accordance with Sections 01 78 39 Project Record Documents *and* 33 00 10 *Underground Utilities Services* of these guidelines.
- .11 Where notification requirements are not met, services may need to be re-excavated for inspection and/or testing upon request of UBC Energy & Water Services.

END OF SECTION

1.0 **GENERAL**

1.1 **System Description**

- .1 The University of British Columbia owns and operates its own natural gas distribution system. All parts of the system are non-interruptible (firm gas) service, except the supply to the steam plant.
- .2 There are three pressure zones within North Campus part of the system (north of 16th Avenue) as follows:
 - .1 1.8 kPa (7" water) low pressure.
 - .2 34 kPa (5 psig) medium pressure.
 - .3 83 kPa (15 psig) high pressure.
 - .4 414 kPa (60 psig) high pressure.
 - .5 The UBC Okanagan campus operates low and medium pressure zones.
- .3 The south campus (south of 16th Avenue) operates at 83 kPa (12 psig).
- .4 Steel gas piping system throughout UBC Campus has a complete cathodic protection system.

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 **Responsibilities**

- .1 UBC Energy & Water Services (EWS) is primarily responsible for operation, maintenance, and overall stewardship of the natural gas distribution system. The demarcation of UBC Energy & Water Services point of service is as shown on Gas Meter standard drawing found under Division 33 section listings here:
http://www.technicalguidelines.ubc.ca/technical/divisional_specs.html.
- .2 Where there is no gas meter for a given building, UBC Energy & Water Services demarcation point is the last valve outside the building wall.
- .3 UBC Energy & Water Services is not responsible for any part of the gas piping or equipment inside buildings.
- .4 For all natural gas pipeline and service projects, the Project Designer must incorporate all specific requirements for metering, design and materials and execution of this section into the contract drawings in the form of job-specific notes. Only making reference to UBC Technical Guidelines in the drawings is not sufficient.

2.2 **Natural Gas Distribution Standards**

- .1 The latest revisions of the following standards shall apply to natural gas distribution at UBC:
 - .1 UBC Sustainability Development Policy #5
(<http://universitycounsel.ubc.ca/policies/index/>).
 - .2 B.C. Gas Safety Act.
 - .3 Canadian National Gas Code.
 - .4 National Association of Corrosion Engineers (NACE)
 - .5 CGA Standard (as applicable).
 - .6 CSA Standard (as applicable).

2.3 Natural Gas Service Connections

- .1 The first step to install any new or substantially modified connections to the natural gas distribution system at UBC is to complete a Utility Service Connection Application. This and other forms can be found at <https://energy.ubc.ca/community-services/contractors-developers/>.
- .2 Any new connections to the gas distribution system will be reviewed for consistency with UBC Energy & Water Services standards.
- .3 Project design drawings shall provide building load (list of appliances with nameplate capacities in m³/hour) and required pressure.
- .4 The Designer shall obtain the gas service records by contacting the Records Clerk at Infrastructure Development, Records, and develop proposed service connection location(s). Service connections may be possible to more than one gas main fronting the site.

2.4 Metering

- .1 Natural gas meters are required for all buildings. All meters shall be temperature compensated. Gas meter design requirements are as shown in Standard Documents - GasMeterStd.dwg, the location of which is referenced in section 2.1.1 above. Revenue gas meters shall have reading in m³, shall be provided with PFM regulator, ISO 9001 (smaller meters) or with electronically compensated pressure and temperature (larger meters).
- .2 The mean atmospheric pressure for PFM (Pressure Factor Measurement) is 100.71 kPa for all revenue natural gas meters on UBC Campus.
- .3 As indicated on the drawing standard, the meter assembly is to be procured and supplied by UBC Energy & Water Services at the project's expense. The project will provide a purchase order for Energy & Water Services to purchase the meter hardware. There will be no additional markup or procurement fees.
- .4 The project is responsible for providing any required protection, such as installing a lockable enclosure and/or bollards as per UBC Energy & Water Services approval.

2.5 Seismic Protection

- .1 The decision whether to install seismic shutoff valves is the responsibility of the project consultants. Buildings which meet the following criteria may not benefit significantly by installing a seismic shutoff valve:
 - .1 Building is structurally designed for current seismic codes.
 - .2 Restraints installed on all gas equipment (e.g. water heaters, air heating units) and piping.
 - .3 Flexible connections installed on all gas equipment.
- .2 Buildings which use natural gas for emergency power or other emergency needs are recommended not to install seismic valves.
- .3 When installed, the following valves are required: California Seismic™ (formerly Koso™) valves for horizontal orientation: Safe-T-Quake valves for vertical orientation. Seismic gas valve shall be supported with two (2) brackets secured to a building wall or equivalent.
- .4 Regardless, UBC Energy & Water Services requires that seismic restraints be used on all gas equipment (i.e. water heaters) and main gas piping in the building.

- .5 UBC Energy & Water Services requires that flexible gas connections be used on all gas equipment in the building.

2.6 Design and Materials

- .1 Design piping pressure: 415 kPa (60 psig).
- .2 Connections shall be to the highest available pressure.
- .3 New underground piping shall be SDR11 Series 125 Polyethylene, manufactured to CAN 3-B137.4M86. New underground valves shall be PSV polyethylene shut off valves with butt fusion outlet ends, to accommodate SDR 11 pipe, confirming to ASTM D-2513. Pipe fittings shall be butt heat fusion polyethylene manufactured to ASTM D-3261-85.
- .4 New aboveground piping up to shall be minimum Schedule 40, ASTM A53 steel piping. Up to, but not including the gas meter assembly, all piping shall be painted yellow. All piping up to 2" size shall be socket welded, manufactured to ASTM A182. New piping over 2" may be butt welded. All aboveground valves shall be bronze plug-type shutoff valves with threaded outlet ends to accommodate A53 steel pipe, and conforming to ASTM B62.

2.7 Permits

- .1 Permits by B.C. Gas Safety Branch and inspections/witness by B.C. Gas Safety Inspector of pressure testing and purging are the sole responsibility of the project.

2.8 Notification

- .1 The Mechanical Utilities Engineer (Telephone: 604-822-3274) and Utilities Head Plumber (Telephone: 604-822-5986) shall be notified in writing 24 hours in advance of any planned pressure testing of a new gas service pipe. Failure to provide notice may result in installed services to be re-excavated for inspection.

3.0 EXECUTION REQUIREMENTS

- .1 Minimum soil cover shall be 600 mm.
- .2 Warning tape at 300 mm below grade level shall be provided.
- .3 Minimum 1.0 m wall to wall horizontal clearance is required from all other services. Clearance from building footings shall be approved by EWS and be a minimum of 3 m per MMCD General Design guideline clause 1.3.
- .4 When crossing electric ductbank, run pipe above electrical ductbank with minimum vertical clearance 150 mm from the top of electric ductbank. Crossing angle shall be 90° degree. If crossing of electric ductbank cannot be done in this manner, then encase natural gas pipe in one larger plastic pipe projecting minimum 500 mm from either side of the electric ductbank.
- .5 Contractor shall provide and install a top tracer wire attached to underground polyethylene pipe.
- .6 Continuity of the existing cathodic protection system shall be maintained when any additions or replacements are undertaken.

- .7 Hot tapping may be done only with written permission from the Mechanical Utilities Engineer, UBC Energy & Water Services. Phone: 604-822-3274.
- .8 Purge pipe with nitrogen after new service pipe is installed.
- .9 For pipe bedding use clean granular pipe bedding, graded gravel, 10 mm (minus), MMCD type:
 - .1 Bottom bedding shall be a quarter of pipe diameter or 100 mm thick, whichever is larger. Top bedding shall be minimum 300 mm thick. Side bedding shall be a minimum 225 mm to maximum 300 mm thick
 - .2 Trench backfill is to be as per MMCD specifications or as approved by UBC EWS.
- .10 No trees shall be planted within 1,200 mm of underground gas piping.
- .11 Shutdowns must be requested in writing adhering to UBC's campus- wide standard procedures. Refer to <http://www.buildingoperations.ubc.ca/resources/policies-procedures-forms/>.
- .12 Connections to existing gas distribution system may be made by a qualified and EWS approved Contractor with a UBC EWS approved design.
- .13 See also Energy & Water Services' Natural Gas Service Installation work procedure, at <https://energy.ubc.ca/community-services/contractors-developers/>.
- .14 Gas distribution valves and meter stations on the UBC Energy & Water Services system may only be operated by UBC Energy & Water Services.
- .15 Records of pipe sizes and inverts shall be provided to Infrastructure Development, Records; and to UBC Energy & Water Services; in accordance with Sections 01 78 39 Project Record Documents and 33 00 10 Underground Utilities Services of these guidelines.

*****END OF SECTION*****

1.0 **GENERAL**

1.1 **Introduction**

- .1 The University of British Columbia has collated two reports that FVB (FVB Energy Inc.) prepared: Technical Design Basis Document – for Hot Water Energy Transfer Stations and for Hot Water Distribution Piping System. FVB prepared these documents to outline the design basis for the building connections of Energy Transfer Stations (ETS) and required building secondary side modifications for the conversion to a medium temperature hot water district energy system; as well as to outline the technical guidelines or design basis of the new hot water District Energy System (DES). This section will serve as the general technical reference guide on which all design would be based. No significant changes to this concept shall be made without the approval of UBC Energy and Water Services (EWS). DES pipe installation work is restricted to Logstor - trained and certified contractors only.

A copy of such certification must be attached to the bid.

1.2 **System Description**

- .1 The University of British Columbia (UBC) has a medium temperature hot water district heating system at the Vancouver (Point Grey) UBC North Campus.
- .2 The hot water is being distributed to each customer/building on the campus through a two-pipe (one supply and one return) buried distribution piping network. The hot water is used for building heating and domestic hot water heating. The purpose of the energy transfer station is to transfer the energy transported from any Heating Plant through the distribution network to the customer via heat exchangers to satisfy the buildings' heating needs. The energy transfer stations therefore replace the steam converters in existing buildings or the traditional boiler or furnace system and hot water heaters in new buildings. The building heating system design for new buildings is open to the designer as long as the system meets the basic requirements of the District Heating system.
- .3 The medium temperature hot water system operates at a maximum supply temperature of 120°C on peak design days and a maximum return temperature of 75°C. The design pressure for this system is 1,600 kPa.
- .4 The DH system employs a variable flow and supply water temperature strategy that will vary both parameters based on outside air temperature and load demand. Each building will be connected to the distribution system indirectly through an energy transfer station. The actual load delivered to each customer is controlled by modulating motorized control valve(s) located on the distribution system side (or primary DH side) of the energy transfer station. This variable flow and temperature reset strategy is to aid in maximizing the efficiency of the entire system.

1.3 **Energy Transfer Station (ETS) Basic Equipment**

- .1 An energy transfer station is made up of heat exchanger(s), isolation valves, strainers, control package – including controller, control valve(s), temperature sensors, and energy metering package – including flow meter, temperature transmitters, and energy calculator.

1.4 **Definition**

- .1 **Building Energy Transfer Station (ETS)** – The building ETS is an interconnection between the DH system and the consumer's hot water heating and domestic hot water systems. The ETS is an indirect connection to the customers' systems via heat exchangers. The ETS consists of isolation and control valves, controllers, measurement instruments, an energy meter, heat exchanger(s), pipe, pipe fittings, and strainers.

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- .2 **Campus Energy Center (CEC)** – Main District Heating Plant located in its own building at the corner of Health Sciences Mall and Agronomy Road.
 - .3 **DH** – The District Heating system
 - .4 **DES- The District Energy System (same as above)**
 - .5 **Design Engineer** – The entity that is responsible for the design of the energy transfer stations or distribution piping system.
 - .6 **Design Pressure** – The design pressure shall be the maximum allowable working pressure as defined in ASME B31.1 Power Piping Code.
 - .7 **Development/Owner's Engineer** – The entity hired by the owner to oversee and review the work by the contractor and Design Engineer.
 - .8 **Distribution Piping System (DPS)** – The network of main piping lines connecting the DH Energy Centre to the service line piping. The direct buried supply and return distribution lines for the hot water system will be Logstor prefabricated, pre-insulated steel pipes.
 - .9 **DHW** – Domestic Hot water
 - .10 **DPS Leak Detection System (LDS)** – Logstor designed System that consists of measuring sections and measuring instruments for surveillance of the integrity of the pipe system. The LDS is designed to detect moisture within pipe insulation, system deviations and disorders and the location of moisture and/or disorders.
 - .11 **Energy Meter** – The energy meter is made up of a flow meter, two matched pair of temperature sensors, and an energy calculator/integrator. The meter will continuously display operating parameters (i.e. flow, demand, temperatures, etc.) on the LCD screen. This information is used for metering and billing purposes. The meters are to be integrated with Owner's ION metering system.
 - .12 **Heat Exchanger (HX)** – The heat transfer equipment is used in extracting heat from one system and passing it to another system. Heat exchangers are used between the DH system and the customer heating systems.
 - .13 **Heating Plant** – The District Heating source, to which the distribution network connects.
 - .14 **Interconnecting Pipe** – The interconnecting pipes run from the main isolation valves inside the building wall to the ETS heat exchangers located in the customer's mechanical room.
 - .15 **Medium Temperature Hot Water (MTHW)** – Treated water used in the heating distribution and service line network. MTHW systems are designed for maximum design supply temperatures of 120°C.
 - .16 **Operating Pressure** – The operating pressure is the pressure at which the system normally operates.
 - .17 **Owner** – The entity, University of British Columbia (UBC), with whom the contractor has entered into the agreement and for whom the work is to be provided.
 - .18 **Service Line (pipe)** – The service lines run from the branch fittings on the main distribution pipes to a maximum of 3 meters inside the building wall. A set of isolation valves are normally installed at the point where the service line penetrates the building wall.
 - .19 **Strainer** – Strainers are required at both the hot and cold side inlets of all heat exchangers to protect the heat exchangers from any suspended particles and debris. The primary side strainers will also protect the control valves and flow meters.

1.5 Building Connections

- .1 The heating ETS for the customers will be designed so that each building can be “indirectly” connected to the main distribution system. This means that each building’s internal heating and domestic hot water systems (secondary side) are isolated from the DH distribution system (primary side) by means of a brazed plate (or double wall plate & frame for DHW) heat exchanger(s).
- .2 The basic ETS will consist of the isolating valves, heat exchangers, actuated control valves, a digital controller, and an energy meter. The controller is used to sense the heat load demanded by the building and satisfies the heating demand by modulating the two- way control valves located on the primary side return of the ETS. This modulating action allows either more or less heat to be made available for transfer to the building’s internal heating system.
- .3 New buildings must utilize a cascading of the space heating heat exchangers and domestic hot water (DHW) heat exchangers as this is beneficial to improve the return water temperatures.
- .4 General arrangement is found in Standard Documents (see 2.1.1). Also see Division 23, Section 23 21 00 Hydronic Systems – Piping & Equipment.

2.0 GENERAL REQUIREMENTS

2.1 Responsibilities

- .1 UBC Energy & Water Services (EWS) is primarily responsible for operation, maintenance, and overall stewardship of the district energy hot water distribution system. The demarcation of UBC Energy & Water Services point of service is normally up to and including the first isolation valve inside the building. Energy & Water Services also owns and maintains any energy meters.
- .2 New building design and construction, in regards to the District Heating System tie-in and the ETS configuration, must be coordinated with UBC EWS. UBC EWS must give approval of the consultants and contractors for the design, installation and commissioning of these systems.
- .3 Key positions in UBC Energy & Water Services are described in Division 33, Section 33 00 10 Underground Utilities Services of UBC Technical Guidelines.
- .4 Unless otherwise agreed in writing, the project Designer is responsible for all design, permit, and inspection requirements of Technical Safety BC (TSBC) and all other regulatory bodies involved.
- .5 The project Designer must incorporate all specific requirements for metering, design and materials and execution of this section into the contract drawings in the form of job-specific notes. Only making reference to UBC Technical Guidelines in the drawings is not sufficient.
- .6 Shutdowns must be requested in writing adhering to UBC's campus-wide shutdowns procedures. Refer to Service Shutdown Request at <https://buildingoperations.ubc.ca/resources/policies-procedures-forms/>
- .7 Operating valves on the district hot water energy distribution system shall only be performed by UBC Energy & Water Services.

2.2 District Hot Water Energy Distribution Standards and Policies

- .1 DES Codes and Standards
 - .1 The design, fabrication and installation of the distribution system shall be in accordance with the laws and regulations of the Province of British Columbia, CSA B51 and ASME B31.1. All primary side ETSs must be designed and registered with Technical Safety BC. Stress analysis should be performed at 120°C for both supply and return piping.
 - .2 In addition, the distribution system shall be designed and installed in accordance with the latest editions of the applicable Codes and Standards from the following authorities:
 - British Columbia Building Codes, Technical Safety BC
 - American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - Air Conditioning and Refrigeration Institute (ARI)
 - American Society of Mechanical Engineers (ASME)
 - American Society of Testing and Materials (ASTM)
 - American National Standards Institute (ANSI)
 - American Water Works Association (AWWA)
 - American Petroleum Institute (API)
 - Instrument Society of America (ISA)
 - Underwriter's Laboratories (UL)

- National Electrical Manufacturer's Association (NEMA)
- National Fire Protection Association (NFPA)
- American Standards Association (ASA)
- American Welding Society (AWS)
- Canadian General Standards Board (CGSB)
- Canadian Standards Association (CSA)
- Manufacturers Standardization Society (MSS)
- European Standards EN253, 1434, 448, 488, & 489.

As well as UBC Sustainability Development Policy # 5:

[\(https://universitycounsel.ubc.ca/board-of-governors-policies-procedures-rules-and-guidelines/policies/\)](https://universitycounsel.ubc.ca/board-of-governors-policies-procedures-rules-and-guidelines/policies/).

.2 ETS Codes and Standards

.1 The design, fabrication and installation of the energy transfer stations shall be in accordance with the laws and regulations of the Province of British Columbia. All primary side ETSs must be designed and registered with Technical Safety BC. Stress analysis should be performed at 120°C for both supply and return piping.

.2 In addition, the energy transfer stations shall be designed and installed in accordance with the latest editions of the applicable Codes and Standards from the following authorities:

- ASHRAE Standard 90.1 - Energy Standards for Buildings
- British Columbia Building Code
- CSA B51 –Boiler, Pressure Vessel, and Pressure Piping Code.
- CSA C22.1-2002 – Canadian Electrical Code, British Columbia Electrical Safety Code and Bulletins, and regulations of the local inspection authority.
- Safety Standards for Electrical Equipment, Canadian Electrical Code, Part II.
- The Environmental Protection and Enhancement Act enforced by British Columbia Environment.
- ANSI/ASME B31.1 Power Piping Code and piping system to be registered with Provincial Boiler Safety Authority.
- ANSI/ASME Boiler and Pressure Vessel Code, Section VIII.
- American Society of Testing and Materials (ASTM)
- Underwriter's Laboratories (UL)
- Canadian General Standards Board (CGSB)
- Canadian Standards Association (CSA)
- Manufacturers Standardization Society (MSS)
- Technical Safety BC

As well as UBC Sustainability Development Policy # 5:

[\(https://universitycounsel.ubc.ca/board-of-governors-policies-procedures-rules-and-guidelines/policies/\)](https://universitycounsel.ubc.ca/board-of-governors-policies-procedures-rules-and-guidelines/policies/)

2.3 District hot water energy Distribution Service Connections

.1 The first step to install any new or substantially modified connections to the district hot water energy distribution system at UBC is complete a Utility Service Connection Application. This and other forms can be found at <https://energy.ubc.ca/community-services/contractors-developers/>.

.2 Any new connections to the district hot water energy distribution system will be reviewed for consistency with UBC Energy & Water Services standards as defined in the UBC Technical Guidelines.

.3 The Designer shall obtain the District hot water energy service records by contacting the Records Clerk at Infrastructure Development, Records Section (Telephone: 604-822-9570) and develop proposed service connection location(s).

3.0 **DISTRICT HOT WATER ENERGY DISTRIBUTION DESIGN OVERVIEW AND CONCEPTS**

3.1 Design Requirements for DPS

.1 **Pipe Velocities**

Buried Mains & Mains in Tunnels	2 – 3.5 m/sec
Max. Water Velocity in Service Lines	2 m/sec

.2 **Temperatures**

<i>System Rated</i> Supply Temp.	120°C
<i>System Operating</i> Supply Temp.	70°C
Max. Return Temp.	75°C
Min. Return Temp.	35°C
<i>System Operating delta-T</i>	30°C

.3 **Pressures**

System Design Pressure	1,600 kPa
System Operating Pressure	1,450 kPa
System Test Pressure	1.5 x Design Pressure

.4 **Buried Piping**

Normal Depth of Bury	900-1200 mm
Minimum Depth of Bury	600 mm
Minimum Trench Slope for Drainage	0.50%

.5 The design conditions listed below are general in nature and are to be used for preliminary line sizing. Major extensions or additions to the system should be sized based on a detailed system hydraulic model.

.6 **TSBC Registration**

.1 All aspects of the DPS shall be designed and registered with TSBC.

.7 **Thermal Expansion & Pipe Stress**

.1 The recommended method to design for pipe stress resulting from thermal expansion is through the use of compensators, expansion pipe sold by Logstor ,expansion bends and U- loops.

.8 **Seismic Considerations**

.1 The piping design will incorporate the requirements of TSBC to meet the seismic loading outlined in the latest version of the BC Building Code.

.9 **Water Hammer**

.1 For larger systems or systems with pipe velocities exceeding 3.5 m/s, design consideration should be given for water hammer. The piping design will consider the necessity of water hammer control.

.10 **Hydro Test and Flushing**

.1 Design consideration should be given for every DPS section Flushing and Hydro Testing before it is connected to existing Close Loop. It should be either reflected in DPS drawings or written instructions to the Contractor.

.11 **DPS Zoning**

.1 DPS shall be designed and constructed with adequate amount of Zone Isolation Valves. This is to minimize the negative impact of heat loss in case of necessity to isolate DPS section for upgrade or repair.

.12 **DPS Vents and Drains**

- .1 The piping design should incorporate air vent valves at every highest point of DPS to avoid air pockets. All buried high point vents and drains to be a pre-insulated branch tee with service valve and valve to be a forged valve. Boehmer or equivalent. The vent to be a min size of 38mm. Consideration should be given to provide means of draining for every DPS Zone. Drain valves at the end of Service Lines may serve the purpose and should not be missed.

.13 **DPS Leak Detection System (LDS)**

- .1 DPS LDS should comply with **EN 14419** of latest edition:
- .1 Design Engineer (DE) should provide a detailed wiring diagram of LDS to contractor and EWS before DPS assembly takes place. Specification of measuring wires assembly instructions, should accompany the wiring diagram.
- .2 Specification of LDS assembly check with description of equipment required to be provided by DE. DE also to provide guidelines for LDS functional test procedure, description of equipment required for above test, specification of a fault simulation test and data for acceptable test values.

3.2 Design Parameters for ETS

.1 **Piping Sizing Criteria¹**

- .1 Pressure Gradient Used to Determine Max. Water Velocity in Service Lines: Based on 250 Pa/m Pressure Gradient.

.2 **Pressures**

ETS Primary Side Operating ΔP	150 – 550 kPa
Customer Side Design Pressure	$\leq 1,600$ kPa
Customer Side Operating Delta P	As required
System Test Pressures	1.5 x Design Pressure

.3 **Temperatures**

		DES Rated Conditions	ETS Selection Criteria
District Heating Side	Supply Temp ² .	120°C	70°C
	Return Temp.	<55°C	<40°C

- .1 ETS HX's shall be selected at 70°C EWT from the DES, but be rated to 120°C. See section 4.1.4 for more details.
- .4 Low Temperature buildings are preferred to maximize the ΔT and improve system performance (see UBC Technical Guidelines Section 23 05 00 2.1.1).
- .5 The design conditions listed above are general but conform to industry standard and will be used for preliminary line and equipment sizing.

¹ Indicated criteria are recommended in accordance with ASHRAE pipe design flow ranges.

² Temperatures will be reset based on outside air temperature for energy conservation purposes. The coolest water possible will be delivered to the customer that will still meet the customer's heating criteria and needs.

3.3 Hot Water General

- .1 Optimization of the hot water distribution system delta T (ΔT) is critical to the successful operation of the DH system. Therefore, the customer's ΔT must be monitored and controlled. In order to optimize the DH system ΔT and to meet the customer's hot water demand, the hot water flow rate from the DH plant will vary. Varying the flow rate to satisfy demands saves pump energy for the DH system.
- .2 New buildings' HVAC systems shall employ variable flow hot water heating systems to heating coils which forms an integral part of the HVAC systems by means of two-way modulating valves or three-way mixing valves only (diverting three-way valves lower the delta T and therefore are not recommended). The aforementioned design strategy is strongly recommended as it will save energy costs for UBC.
- .3 The energy calculations shall be performed via the energy meter based on input from the flow meter and two temperature sensors.

3.4 Pressures

- .1 The DH primary system is designed for a maximum allowable working pressure of 1,600 kPa. Equipment (valves, fittings, etc.) installed for the ETS locations will, where applicable, be selected to minimum ANSI Class 150. The ΔP at each service connection will vary depending on its location in the distribution system.
- .2 The Design Engineer shall request the estimated available distribution pressures for each ETS connection from the Owner's Engineer. These pressures typically include an estimate for 10 metres of interconnecting piping downstream of the main isolation valves at the building penetration. A minimum of 150 kPa will be allocated for the critical customer, which includes the ETS equipment and interconnecting piping. Customers closer to the heating plant may be able to support a higher allowable pressure drop. Final calculation of all internal pressure drops are the responsibility of the Design Engineer.

.1 Static Pressure

- .1 The DES system has to be sufficiently pressurized at the plant to overcome the elevation difference in the system and to avoid boiling (or flashing) from occurring at the high points. In addition, some further margin is required to minimize the effect of operating disturbances, such as cavitation and pressure surges (i.e. transient pressures). Higher static pressure requirements will limit the maximum allowable dynamic pressure in the system set by the design pressure of 1,600 kPa. This again could put unnecessary limitations on the system capacity.
- .2 Thus, it is generally recommended to install ETSs at the basement or ground floor level to ensure that the building elevations do not put unwanted static pressure limitations on the system.

4.0 MAJOR EQUIPMENT DESCRIPTION

The ETS includes equipment the necessary pipes, heat exchangers and associated controls and energy meters. This equipment should be located inside the customer building mechanical room in the basement. See Figure 1 and Figure 2 below as an example of a typical ETS located at an exterior wall near the DPS mains in the street.

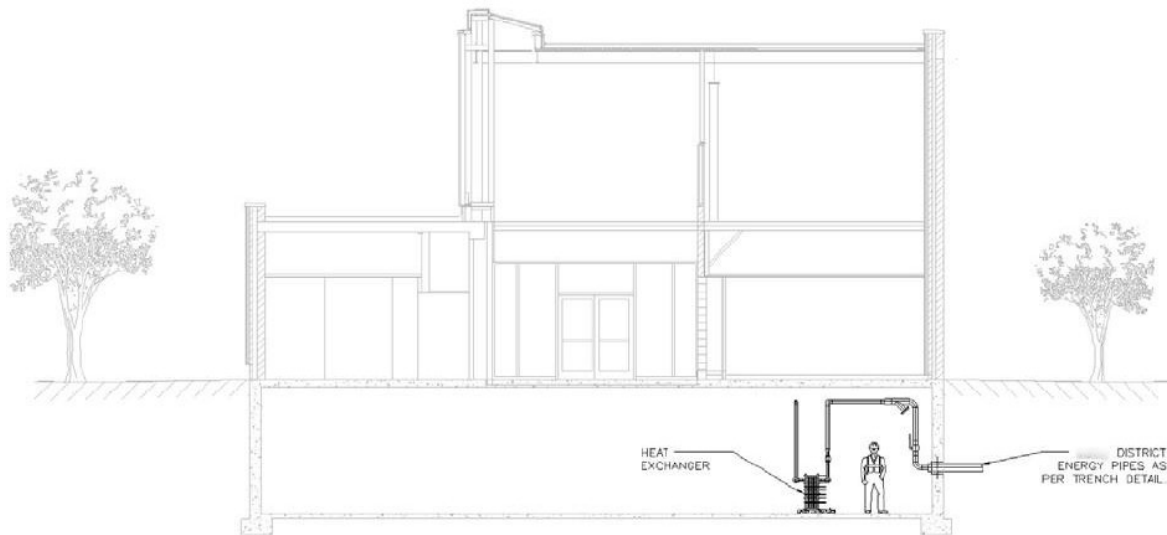


FIGURE 1 TYPICAL ETS INSTALLATION IN BUILDING BASEMENT

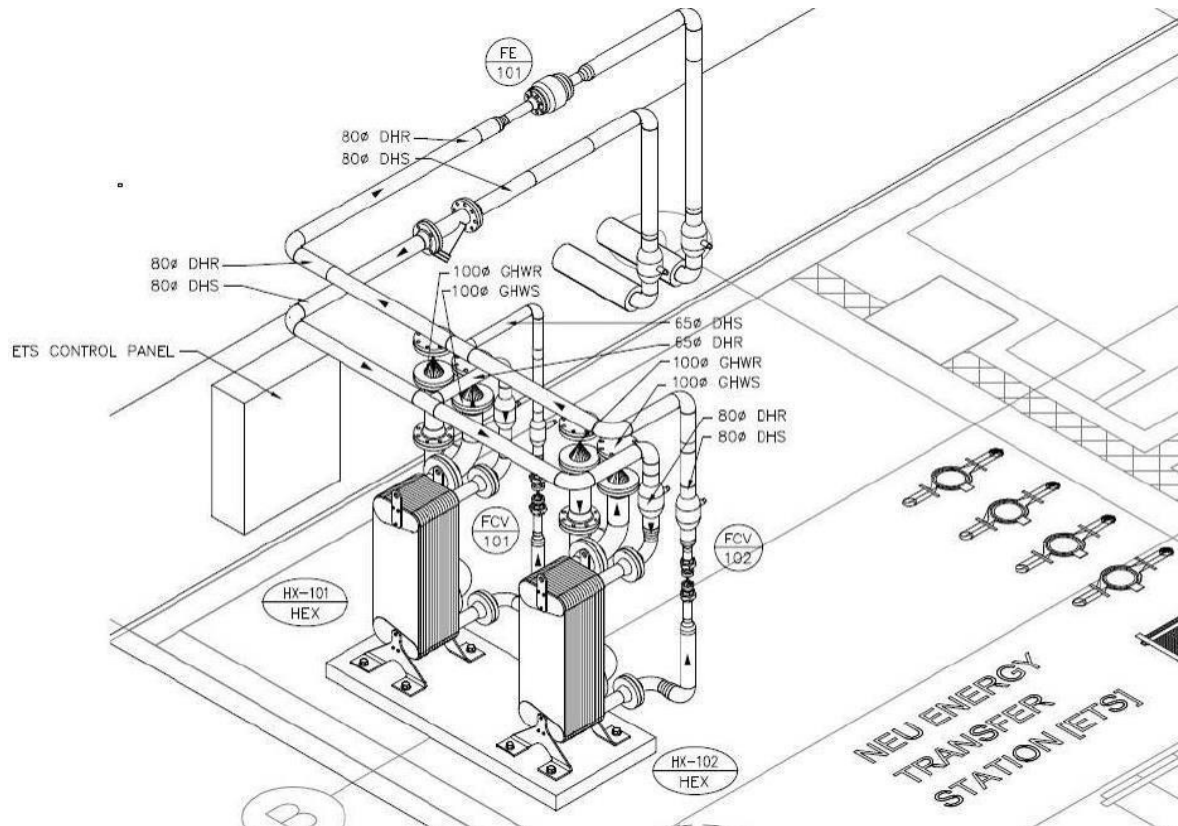


FIGURE 2 TYPICAL ETS (DETAIL)

4.1 Heat Exchangers

- .1 Heat exchangers will be used on connections to all buildings to separate the existing building heating system from the DES (i.e. indirect connection). The optimum selection of each HX will be analyzed on the basis of:
 - .1 Sizing each unit's capacity to match the load and load turn-down as close as possible.
 - .2 Critical nature of the load/operation.
 - .3 Temperature and pressure conditions.
 - .4 Available space in mechanical room.
 - .5 Allowable ΔP on both sides of HX.
- .2 Brazed Plate heat exchangers for space heating, and double-wall brazed plate or double walled plate and frame with end plate leak detection for domestic hot water are required for this application. Shell & tube heat exchangers should not be used. Also see Division 20, Section 20 00 05 Mechanical General Requirements, 2.3.3.
- .3 **New buildings with coincidental heating and domestic hot water requirements (i.e. Student residences) shall utilize a cascaded design.**
- .4 The following table summarizes the selection criteria:

.1 **Space Heating Heat Exchanger Selection Criteria New Buildings⁴**

Hot Side Conditions			Cold Side Conditions		
Inlet Temp	Outlet Temp	Max. ΔP	Inlet Temp	Outlet Temp	Max. ΔP
70°C	40°C	50 kPa	35°C	46°C	35 kPa ⁴

- .2 Each HX will be sized for a maximum 5°C approach on the hot side (DH side) outlet to cold side inlet. Higher customer return temperatures and ΔT s will have an adverse impact to the overall system operation and performance.

.3 **Domestic Hot Water Heat Exchanger Selection Criteria**

Hot Side Conditions			Cold Side Conditions		
Inlet Temp	Outlet Temp	Max. ΔP	Inlet Temp	Outlet Temp	Max. ΔP
70°C	35°C	50 kPa	5°C	60°C	50 kPa

.4 **Cascaded Domestic Hot Water Pre-Heat Exchanger Selection Criteria**

Hot Side Conditions			Cold Side Conditions		
Inlet Temp	Outlet Temp	Max. ΔP	Inlet Temp	Outlet Temp	Max. ΔP
70°C	35°C	50 kPa	5°C	55°C	50 kPa

- .5 Note: The Cascaded DHW Pre-heat exchanger is to be sized for the full flow from both Hot water and DHW heat exchangers with a maximum ΔP of 50 kPa on the DH side. See standard drawings for further details.

⁴ May vary at each building location. Existing building allowable pressure drop to be reviewed on a case- by-case basis. Generally, since existing pumps are expected to be reused, the pressure drop should be selected to match the pressure drop of existing equipment.

- .6 The design pressure on the hot side (DH) of the HX will be 1,600 kPa. On the cold side, the design pressure will be determined by the building hot water system pressure. The maximum cold side pressure will be 1,600 kPa.
- .7 All heat exchangers shall have a Valid CRN for British Columbia with a supplied Manufacturers Data report (MDR).

4.2 Hot Water Control Parameters

- .1 As stated previously, the DH supply temperature may vary between 70°C and 120°C. The supply water temperature is lowered outside the peak conditions for the purpose of conserving energy. The secondary return temperature must be no higher than 50°C for new buildings. The objective of the control system is to provide as cool a supply temperature as possible that will still meet the customer's capacity requirements while maximizing the ΔT between the District Heating Supply and Return (DHS&R) distribution piping. The minimum DH supply temperature is limited to 70°C in summer in order to meet the requirements of the domestic hot water systems whose storage tanks must be maintained at minimum 60°C to prevent bacteria growth (i.e. Legionella) in the system.

4.3 Control & Measuring Equipment Performance

- .1 Each ETS will have a control & metering panel responsible for calculating energy consumed at each ETS and maintaining proper temperature relationships between the DH system supply and each building. It is recommended to use two control valves i.e. 1/3 & 2/3 split range for flow rates larger than 5 L/s for larger turn down. Alternatively, a 50/50% split can be used if higher redundancy is desired.

4.4 Energy Meters

- .1 It is critical that high-quality integrated energy meters are used to achieve optimum metering accuracy and performance. Magnetic (preferred) or ultrasonic flow meters are recommended to be used at each building ETS. In addition, the integrated meters comprise of matched pair platinum temperature sensors and a sealed factory programmed integrator (i.e. calculator). These meters meet existing international standards (OIML R75 and EN1434) for thermal energy metering, as well as the Canadian standard (CSA C900). Magnetic (preferred) and ultrasonic flow meters have relatively low pressure drops, good range ability and accuracy while requiring very little maintenance. Also, the minimum straight run requirements are greatly reduced (5 diameters upstream and 3 diameters downstream) as compared to some other types of meters.

4.5 Networking Communications

- .1 The Communication network will provide the communication link between each customer ETS and the plant. This will allow remote monitoring, control of each ETS. Metering will be connected to the Campus wide ION network.
- .2 The Communication network will be routed through UBC's IT network and connected into the campus wide BMS system. Siemens and ESC are preferred vendors.

4.6 DPS Leak Detection System (LDS) EN 14419

- .1 LDS should be assembled as per DE instructions with Logstor components. After finishing of each measuring section, it should be tested for:
 - .1 Continuity of measuring wires
 - .2 No electrical contact or moisture between the wires and pipes

-
- .2 Upon assembly of LDS zone, the System functional test is to be conducted with fault simulation.
 - .3 All data is to be recorded and presented to DE and EWS complete with as-built drawings with leak detection resistance listed for each joint.
 - .4 After 4 weeks of operation LDS functional test should be repeated by contractor and result to be recorded. Test is to be witnessed by EWS representative.
 - .5 Before extending or renovating of existing LDS the actual state of System should be measured and documented:
 - .1 Wiring ohmic resistance from conductor to conductor
 - .2 Isolation resistance from conductor to pipe.

4.7 Differential Pressure sensor

- .1 An electronic differential pressure sensor will be fitted between the inlet and return on the primary side. It must be capable of being read locally as well as have an output to allow it to be read remotely (network connection). (Endress and Hauser or Rosemount are preferred.)

5.0 **MAJOR EQUIPMENT SPECIFICATIONS**

5.1 **Piping Material**

.1 **Buried District Energy Distribution Piping EN253**

SCOPE: This section specifies prefabricated and pre-insulated piping for direct burial installation as a hot water DES. Fluid temperatures are limited to the range 4°C to 120°C.

.1 **System Function**

- .1 The DES shall be installed as a fully welded and bonded system in which the steel carrier pipe, insulation and outer casing are bonded together to form a solid unit. This solid unit when buried is completely sealed from soil and water ingress and hence provides superior longevity and performance. It is critical for owners to find suppliers of complete buried systems rather than applying a significant effort in assembling components from multiple suppliers to provide a completely sealed system. Piping System shall conform to EN253 standards (Logstor or approved equal).
- .2 The system comprises a steel carrier pipe, polyurethane foam insulation with integral copper alarm wires, and an outer casing of high density polyethylene. The system shall be designed such that the expansion movements of the steel carrier pipe are transferred to the outer casing via the foam insulation. The elements of the bonded pipes shall be manufactured to expand and move together. The movements are restricted by the friction between soil and jacket pipe, which acts as the anchorage for the pipe system. Generally external anchors are not required.
- .3 Expansion is allowed for as determined by the stress analysis (see Section 3.9 for methods used to reduce pipe stress due to thermal expansion).

.2 **District Energy Distribution Piping in Tunnels and in Buildings**

SCOPE: This section specifies welded piping that is insulated on site for installation in the existing tunnel system and in buildings. Fluid temperatures are limited to the range of 4°C to 120°C.

.1 **System Function**

- .1 The distribution piping system shall be installed as a fully welded system.

.2 **Tunnel & Building Pipe Material**

- .1 All tunnel and building distribution piping will be designed, constructed, and tested in accordance with ASME B31.1 Power Piping Code. In general, all tunnel and building distribution piping is of welded carbon steel construction (A53 schedule 40 typical and standard weight in the larger pipe dimensions).
- .2 Mechanical groove joint piping systems will not be accepted in this service.
- .3 Piping will be designed, specified, constructed, installed and registered with TSBC.
- .4 The transition from the buried EN253 pipe to standard weight tunnel or building piping will occur after the wall penetration.

.3 **Tunnel and Building Pipe Leak Detection**

- .1 There will be no leak detection system in the tunnel piping portion. Termination of the leak detection system in the buried piping will be determined at the design phase in consultation with EWS as well as the best method of communication to the monitoring center.
- .2 The leak detection system terminates upon entry into each building.

5.2 Heat Exchangers

.1 Brazed Plate Heat Exchanger – Space Heating

- .1 Heat exchangers shall consist of thin corrugated Type 316 stainless steel plates stacked on top of each other and brazed together. Brazing material shall be copper. Every second plate shall be inverted so that a number of contact points are created between the plates. The plate patterns are to create two separate channels designed for counter flow.
- .2 Plate thickness shall be of a minimum of 0.4mm. The plate pack shall be covered by Type 316 stainless steel cover plates.
- .3 The flanged connections shall be located in the front or rear cover plate. Flanged nozzle connections shall conform to ASA standards, and shall be of the pressure rating design indicated below.
- .4 Heat exchangers shall be supplied with removable insulation jackets, support stands and brackets. Stainless steel or OEM.
- .5 The heat exchangers shall be designed for the following continuous operating pressures and temperatures: 1,600 kPa and 120°C, hot water
- .6 Heat exchangers must be mounted according to manufacturer's requirements.
- .7 The heat exchanger characteristics shall be as per the attached schedule.
Standard of Acceptance: Xylem, Alfa Laval or equivalent

.2 Double Wall Plate & Frame Heat Exchangers – Domestic Hot Water

- .1 Frame shall be carbon steel with baked epoxy enamel paint. The frame shall be designed without additional welds and reinforcements. The carrying and guide bars shall be bolted to the frame, not welded. The carrying and guide bar surface in contact with the plates and roller shall be made of, or clad with a corrosion resistant material such as stainless steel. The bolts shall be greased with molybdenum grease and protected with plastic sleeves.
- .2 Connections shall be a flanged connection. Flanged connections shall conform to ASA standards.
- .3 The double wall plates shall be composed of two plates pressed together simultaneously and laser welded at the port. Failure of one plate or weld shall result in an external detection without inter-leakage. The plates shall be corrugated Type 316 stainless steel. Metal to metal contact shall exist between adjacent plates. The plates should have no supporting strips and should be pressed in one step. The part of the plate in contact with the carrying and guiding bars shall be reinforced to prevent bending and twisting during the handling of the plates. The plates shall be fully supported and fully steered by the carrying bar and guided by the guide bar to prevent misalignment in both vertical and horizontal directions. Plate design shall permit the removal of any plate in the pack without the need to remove all of the other plates ahead of it.
- .4 Plate thickness shall be of a minimum of 0.4mm.
- .5 The use of spiral wound gaskets on all primary flanged faces is required.
- .6 The heat exchangers shall be designed for the following continuous operating pressures and temperatures: 1,600 kPa and 120°C, hot water.
- .7 The heat exchanger capacities shall be as per design specifications. Standard of Acceptance: Xylem or equivalent.

.3 Double walled Brazed Plate Heat Exchangers - Domestic Hot Water

1. Heat exchangers shall consist of thin corrugated Type 316 stainless steel plates stacked on top of each other and brazed together. Brazing material shall be copper. Every second plate shall be inverted so that a number of contact points are created between the plates. The plate patterns are to create two separate channels designed for counter flow.
- .2 Plate thickness shall be of a minimum of 0.4mm. The plate pack shall be covered by Type 316 stainless steel cover plates.

- .3 The flanged connections shall be located in the front or rear cover plate. Flanged nozzle connections shall conform to ASA standards, and shall be of the pressure rating design indicated below.
- .4 Heat exchangers shall be supplied with removable insulation kits and supports (stands and, brackets if required etc.). The insulation shall consist of Freon free insulation (polyurethane foam) and ABS plastic cover at a minimum.
- .5 The heat exchangers shall be designed for the following continuous operating pressures and temperatures: 1,600 kPa and 120°C, hot water
- .6 Leak detection holes must be visible on the front cover plate of the heat exchanger and must not be covered.
- .7 Heat exchangers must be mounted according to manufacturer's requirements.
- .8 The heat exchanger characteristics shall be as per the attached schedule. Standard of Acceptance: Xylem, or equivalent.

5.3 Controls & Measuring Equipment

.1 Description

- .1 The controls are made up of programmable controllers, temperature sensors, outdoor sensors, control valve stations and other miscellaneous instrumentation. The controls and energy metering systems shall be integrated and compatible with the existing building automation system (BAS) and with a compatible communication protocol to perform the functions described in this section. All devices and equipment shall be approved for installation by the Owner and/or Owner's Engineer.
- .2 All controls shall be BACnet compatible.

.2 Products

- .1 The controls supplier shall select the appropriate control component to match the required service conditions. The control valves type selected shall meet the minimum design requirements described in the following sections.
- .2 The minimum test for control valves and flow meters shall be hydrostatic test in strict accordance with the requirements of ASME Section VIII, Division 1, or Section III, Class 3.
- .3 Hydrostatic test pressure shall be 1.5 times the design pressure using calibrated pressure gauges.

.3 Control Valves

- .1 Control valves are to be sized by control supplier according to design specification herein. Water valves shall be sized on the basis of minimum 50% of available differential pressure or minimum 75 kPa (11 psi) pressure drop. Pressure drop for valves shall be submitted for review, including all CV values.
- .2 Valves shall be equal percentage type, two-way, single-seated, and equipped with characteristic type throttling plug, #316, stainless steel stem and seat. Provide with necessary features to operate in sequence with other valves and adjustable throttling range as required by the sequence of operations.
- .3 Valves shall be able to handle a minimum of 345 kPa (50 psi) differential pressures for modulating service with range ability greater than 100:1. Actuator selection shall be for close-off pressures greater than 690 kPa (100 psi). Arranged to fail-safe as called for tight closing and quiet operating. Leakage shall be less than 0.1% of Cv. **Standard of Acceptance: Siemens or equivalent.**
- .4 All two way controls valves shall be slow closing to prevent water hammer.

.4 Electric Actuators

- .1 Provide 24 VAC control valve actuators which are 0-10 VDC or 4-20 mA input proportional with spring return as needed by control sequence and designed for water service valve bodies.
- .2 Operator shall be synchronous motor driven with minimum 750 Newtons of thrust and force sensor safe.
- .3 Control stroke time shall be less than 30 seconds. Actuator shall include a manual clutch that enables manual positioning of valves during power failures and servicing. Upon restoration of power, actuator will automatically reposition itself without intervention. Actuator shall have self-lubricating bearings to minimize maintenance requirements. Indication of position shall be visible at all times. **Standard of Acceptance: Siemens SKB/SKC/SKD or equivalent.**

.5 Energy Metering Components

- .1 The energy meter is made up of a flow meter, two temperature sensors, energy calculator, and plug-in modules. A read-out unit makes it possible for the operator to observe the operating parameters. The energy meter shall be furnished with an output (e.g. Lonworks) for integration with control panel with remote communication capability.
- .2 DES meters shall be network connected for remote monitoring only. The Division 20 contractor shall provide all necessary communication equipment to ensure effective remote monitoring is achieved. Refer to standard drawing E4-6c.
- .3 Energy Calculator shall comply with OIML R75 and EN1434, with accuracy: +/- $(0.15 + 2/\Delta t)$ % and water temperature range 1°C – 160°C and 30 seconds flow calculation intervals. The meter shall have a permanent memory (EEPROM). The meter display shall show the following items:
 - Accumulated thermal energy: MWh
 - Accumulated water flow: m³
 - Actual thermal power: kW
 - Actual water flow: l/h or m³/hr
 - Supply temperature: °C
 - Return temperature: °C
 - Temperature differential: °C
 - Peak thermal power: kW P
 - Peak water flow: l/h or m³/hr P
 - Hour Counter: HRS
- .4 The meter shall be factory calibrated and supplied with verification certificate.
Standard of Acceptance: Endress & Hauser (magnetic) and Kamstrup Ultrasonic or equivalent.
- .5 The flow meter shall be magnetic or ultrasonic in compliance with OIML R75 and **EN1434**, with accuracy +/- 1.0% of rate within flow range of 0.3 to 9 m/s and minimum rangeability 1:30. Fluid temperature range shall be 4 to 120°C and fluid pressure range full vacuum to 1,600 kPa. Factory calibrated **Standard of Acceptance: Endress & Hauser (magnetic) and Kamstrup Ultrasonic or equivalent.**
- .6 The meter shall be factory calibrated and supplied with calibration certificate.
Standard of Acceptance: Endress & Hauser (magnetic) and Kamstrup Ultrasonic or equivalent.
- .7 Resistance Temperature Detectors (RTDs) shall be 4-wire PT500 Pocket Sensor

(Paired) with connecting head performance .04°C Δt deviation (pairing). **Standard of Acceptance: Endress & Hauser (magnetic) and Kamstrup Ultrasonic or equivalent.**

.8 Sequence of Operations

.1 General

.1 The general control strategy to be implemented for the new Energy Transfer Stations shall be the supply temperature reset based on the outside air temperature. In addition, a reset function based on return temperature shall be employed to ensure that the District heating return temperatures are maintained as low as possible.

.2 Standard Heating Supply with Return Limiting

.1 During normal operation, the secondary supply temperature shall be set from a temperature reset schedule based on outside air temperature (OAT). The schedules are to be system specific.

.2 The secondary return temperature shall not exceed the maximum return temperature limit. Should this happen, the supply temperature set point shall be reset down until the secondary return temperature drops below the maximum values. The return water limiting function shall override the minimum supply temperature function. The maximum return limit will be building specific.

.3 Domestic Hot Water (DHW)

.1 The controller shall be programmed to fully close the DHW control valve when the recirculation pumps on the secondary side shut off. When the recirculation pumps are turned back on, the controller will be programmed with a 20 second delay, prior to opening the DHW control valve.

.2 During normal operation, the customer domestic hot water supply temperature shall fix set point, initially at 60°C (adjustable range 40 to 65°C.) The controls shall have a Maximum limit (adjustable, initially set at 65°C) when the control valve will go to closed position.

.4 Alarms

.1 The DDC system shall monitor hot water supply and return temperatures. If temperatures exceed high or low limits, an alarm shall be recorded at the operator's workstation.

.6 Leak Detection System Equipment

.1 LDS equipment should be Logstor approved. Ordinary electrical wire or any other kind of unauthorized wire is not allowed to form any part of the LDS assembly.

5.4 Valves – Primary Side Isolation Valves

.1 Design

.1 Valve construction design and tested to EN488 specification

.2 Valve design to be fully welded

.3 Design to be suitable for above and below ground service

.4 For service in district heating, valve shall be suitable for 120 degrees C and 232 psi pressure

.5 Minimum rating PN25 to allow for testing at 1.5 times for system expansion.

.6 Full or reduced bore

.7 Weld ends to schedule 40 for above ground and EN253 for buried service

.8 If flanged ends are required, flanges to be to ANSI

.9 Above ground valves should have a 60 mm extension to allow for insulation

.10 Provide top of stem position indication with a visible groove

.11 Operator – Lever operated up to 6", gearbox for 8" and up

.2 Materials

- .1 Body, only forged materials are accepted, ASTM A106 or A352LF2
- .2 cold pressed steel is not acceptable
- .3 Ball, stainless steel
- .4 Seat PTFE with minimum 25% glass reinforced
- .5 Seat to be spring supported, individual coil springs are preferred
- .6 Stem, stainless steel
- .7 O-rings, EPDM

.3 Buried service

- .1 Valves for buried service to be pre-insulated with polyurethane foam and PE outer protection as per EN253
- .2 Pre-insulation to have leak detection wiring
- .3 Valve should have an integral welded extension to an agreed height
- .4 A minimum of 2 O-rings at the bottom and 2 O-rings at the top of the stem are required to prevent water ingress into the stem assembly
- .5 The assembly should provide an internal mechanical travel stop in the stem extension
- .6 A parallel square nut is to be provided
- .7 Gear operator required for valves size 8" and up (portable)

.4 Valve testing

- .1 All valves to be Hydro shell tested at 1.5 times the rated pressure
- .2 All valves to be seat tested; both seats to be tested at max. 1.1 times the rated pressure
- .3. Acceptable leakage rates for seat tests are to API 598 or rate A of EN12266

5.5 Gaskets

- .1 The use of flexitalic gaskets on all primary flanged faces is required.

6.0 **DISTRICT HEATING PRIMARY PIPING**

6.1 **References**

- .1 ANSI/ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose.
- .2 ANSI/ASME B31.1- [2004], Power Piping.
- .3 ANSI/MSS SP-58-[2002], Pipe Hangers and Supports – Materials, Design, and Manufacture.
- .4 ASME B16.34-1996 - Valves - Flanged, Threaded, and Welding End
- .5 ASME B31.5 – 2001, Refrigeration Piping and Heat Transfer Components.
- .6 ASTM A47/A47M-99(2004), Ferritic Malleable Iron Castings.
- .7 ASTM A53/A53M-05, Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .8 ASTM A105/A105M-05, Carbon Steel Forgings for Piping Applications.
- .9 ASTM A106/A106M-04b, Seamless Carbon Steel Pipe for High Temperature Service.
- .10 ASTM A108-03, Steel Bar, Carbon & Alloy, Cold-Finished.
- .11 ASTM A126-04, Gray iron Castings for Valves, Flanges, and Pipe Fittings.
- .12 ASTM A181/A181M-01, Carbon Steel Forgings for General-Purpose Piping.
- .13 ASTM A193/A193M-05, Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
- .14 ASTM A194/A194M-05b, Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High Temperature Service, or both.
- .15 ASTM A216/A216M-04, Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
- .16 ASTM A234/A234M-05a, Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .17 ASTM A278/A278M-01, Gray Iron Castings for Pressure-Containing Parts for Temperatures Up To 650°F (350°C).
- .18 ASTM A307-04, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- .19 CAN/CGSB-14.5-[M88], Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- .20 CSA B51 - 03 Boiler, Pressure Vessel, and Pressure Piping Code.
- .21 MSS SP-67-2002a, Butterfly Valves.
- .22 MSS SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .23 MSS SP-71-1997, Grey Iron Swing Check Valves, Flanged and Threaded ends
- .24 MSS SP-72-1999, Ball Valves with Flanged or Butt-Welding Ends for General Service.
- .25 MSS SP-80-2003, Bronze Gate, Globe, Angle and Check Valves.
- .26 MSS SP-85-2002, Cast-Iron Globe and Angle Valves Flanged and Threaded Ends.
- .27 MSS SP-58-[2002], Pipe Hangers and Supports – Materials, Design, and Manufacture.
- .28 EN253 Pre-insulated Bonded Piping Systems (European Standard)
- .29 EN448 Pre-insulated Fitting Assemblies (European Standard)
- .30 EN488 Pre-insulated Steel Valve Assemblies (European Standard)
- .31 EN489 Joint Assemblies on Pre-insulated Pipes (European Standard)
- .32 DIN 1626, Steel Quality St 37.0 (ASME-A53 Grade B Equal)
- .33 ISO4200/DIN2458 – Plain End Steel Tubes, Welded and Seamless - Measurements and weights
- .34 ANSI/ASME B31.1 – (Latest), Power Piping.
- .35 ANSI/ASME B31.9 – (Latest), Building Services Piping.
- .36 ANSI/ASME Boiler and Pressure Vessel Code-(Latest):
- .37 Section 1: Power Boilers.
- .38 Section V: Nondestructive Examination.
- .39 Section IX: Welding and Brazing Qualifications.
- .40 CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding.
- .41 CSA B51-03, Boiler, Pressure Vessel and Pressure Piping Code.
- .42 CAN/CSA-W117.2-01, Safety in Welding, Cutting and Allied Processes.

- .43 CSA W178.1-02, Certification of Welding Inspection Organizations.
- .44 CSA W178.2-01, Certification of Welding Inspectors.
- .45 CGSB 48.2-92, Spot Radiography of Welded Butt Joints in Ferrous Materials.
- .46 AWS B2.1:2005, Welding Procedure and Performance Qualification.
- .47 AWS C1.1M/C1.1-2000, Recommended Practices for Resistance Welding.
- .48 AWS W1:2000, Welding Inspection.
- .49 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
- .50 CSA W59-03 Welded Steel Construction.

6.2 Pipe Welding

- .1 District heating (primary) side shall be an all-welded piping system in accordance with ANSI B.31.1 and CSA B51. The building (secondary) side piping shall be a welded system in accordance with ANSI B.31.9. If grooved piping is used in the existing building secondary systems, it can be used as an acceptable alternate. However, it is strongly recommended that all risers be welded for maximum system integrity.
- .2 Welding qualifications to be in accordance with CSA B51 or ASME B31.1 section 127.5.
- .3 Qualified and licensed welders shall possess a certificate for each procedure to be performed by the authority having jurisdiction.
- .4 Registration of welding procedures shall be in accordance with CSA B51 or ASME B31.1 Section 127.5.
- .5 Submit welder's qualifications to Owner's Representative.
- .6 Joint Fit-up
 - .1 Valves welded into the system shall be open as the welding is carried out.
 - .2 The geometry of pipe weld joints (i.e. joint preparation and root opening) shall be in accordance with the tolerance specified by the weld joint sketches contained in the welding procedures submitted to the Owner's representative.
 - .3 In cases where the internal misalignment exceeds 1/16", the component with the wall extending internally shall be trimmed so that the adjoining internal surfaces are approximately flush. This trimming must not result in a piping component wall thickness less than the minimum design thickness. The change in contour shall not exceed 30 degrees
- .7 Transition, Different outside diameters
 - .1 When pipes of different outside diameters are to be welded together, either of the following two procedures shall be followed:
 - .1 Taper the outside diameter of the larger pipe by grinding or machining before welding to the outside diameter of the smaller pipe. The taper angle must not exceed 30°.
 - .2 Fill the weld joint with weld metal, flush with the outside surface of the pipe having the larger diameter. The weld metal transition between the larger and smaller pipe shall have a slope not exceeding 1:3, which may be obtained by grinding. *

6.3 Valves

- .1 Install isolating valves at all branch take-offs, at each piece of equipment and elsewhere as indicated. All primary isolation valves to be welded. Welding to valves must be done in accordance with the manufacturers' recommendations in order to prevent body distortion and to maintain tight shutoff characteristics of the valve.
- .2 Isolation Ball Valves:
 - .1 NPS 2" to 8": Working Pressure 1.6 MPa (232 psig) at 120°C, Sch. 40 Butt Weld ends to match pipe, steel body, stainless steel ball and stem, Teflon seat, reduced bore, class 300 lever actuator for valves NPS ≤6" within 2.44m (8 ft.) of floor. Provide gear operated actuator with handwheel for valves NPS ≥8" and chain wheel above 2.44m. Acceptable materials: Arinah Services – Broen Ballomax, Meridian Valves – Vexve, Armour Valve – Bohmer.

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- .3 Drain and Air Vent valves:
 - .1 NPS ½" to 2": Threaded, 2000 psig WOG, ball valve, cold non-shock, 150 psig saturated steam steel body, RTFE seats and seals, blow-out proof steam design, lever handle, Acceptable material: Apollo 72-100, NIBCO T-590-CS-R-66.
 - .4 Strainers:
 - .1 Install strainers at both secondary and primary side heat exchangers inlets in locations to allow easy access for removal of screen.
 - .1 NPS ≤2": Cast steel, Y-pattern, shall be flanged with stainless steel 5/32" perforated screen with 30 mesh (0.5mm), Class 300 for 1.6 Mpa (232 psig) and 120°C. Acceptable Materials: Spirax Sarco, SSI Equipment Inc
 - .2 NPS ≥2½": Cast Steel body flanged Y-pattern, stainless steel 5/32" perforated screen with 30 mesh (0.5 mm). Screen area shall be minimum three times area of inlet pipe. Class 300 for 1.6 MPa (232 psig) and 120°C. Acceptable Materials: Spirax Sarco, SSI Equipment Inc.
 - .2 Provide drain ball valve and piping to a point 400 mm from the floor. The pipe end shall be provided with a threaded forged steel cap.
 - .3 Outlets for branch connections:
 - .1 Full Size; Standard Weight, Welded tee
 - .2 One size smaller: Standard Weight, welded reducing tee, or saddle welds.
 - .3 Two or more sizes smaller;
 - .1 NPS ≤2" – Thread-o-let or reducing tee.
 - .2 NPS ≥2½" – Weld-o-let or reducing tee.

6.4 Gauges

- .1 Thermometers:
 - .1 Industrial, Bi-metal Dial, 100 -125 mm size, adjustable angle, aluminum case, 13 mm NPT stainless steel separate well, front recalibrator.
 - .2 Unit: Dual Scale °C/°F scale
 - .3 Accuracy: within ±0.5 degrees of reading.
 - .4 Range: Applicable range & span will be selected according to process conditions.
 - .5 Maximum 2 deg. per division.
 - .6 Acceptable materials: Winters, Wika, Weiss
- .2 Pressure Gauges:
 - .1 Dial type, 110 mm diameter, 304 stainless steel case and ring, phosphor bronze tube, brass or stainless-steel movement, glass or acrylic window. 13mm NPT process connection.
 - .2 Liquid filled
 - .3 Unit: Dual scale kPa/PSI
 - .4 Accuracy: within 1.0% of full scale.
 - .5 Range: 1.5 times the process system operating pressure.
 - .6 Accessories: N/A
 - .7 Acceptable materials: Winters, Wika, Weiss
- .3 Interior Piping:
 - .1 Piping
 - .1 To ASTM A53 Grade B.
 - .2 NPS ≤1 ½": Sch. 80, ERW or seamless, plain ends.
 - .3 NPS 1 ½" and over: Standard Weight, ERW or Seamless, beveled ends,
 - .2 Fittings:
 - .1 NPS ≤1 ½": Class 3000, forged steel screwed ends and socket weld ends, to ASTM A181.
 - .2 NPS ≥2": Standard Weight, forged steel, bevel ends, to A234, Grade WPB..
 - .3 Coupling, caps, plugs:
 - .1 NPS ½" to 2": Class 2000, screwed ends or socket weld ends, to ASTM A181.

- .4 Nipples for drains, vents, pressure gauges:
 - .1 NPS ½" to 2" : Sch. 80, screwed, to ASTM A53, Grade B.
- .5 Unions:
 - .1 NPS ≤2": Class 3000, socket welded ends, forged steel, steel-to-steel ground joint, to ASTM A181.
- .6 Flanges:
 - .1 NPS ≤2": Class 150 / 300, raised face, socket welded ends, to ASTM A105 and ANSI B16.5.
 - .2 NPS ≥2½": Class 150 / 300, raised face, weld neck (bored to suit pipe) to ASTM A105 and ANSI B16.5.
 - .3 Flange to match class and rating of flange supplied with equipment
- .7 Bolts and nuts (low strength):
 - .1 NPS ≤2": bolts, carbon steel, semi-finished with heavy hex nuts, to ASTM A307, Grade B.
 - .2 NPS ≥2½": Stud bolts, carbon steel, semi-finished with heavy hex nuts, to ASTM A307, Grade B.

7.0 Inspection and Testing

.1 General

- .1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2, CGSB 48-GP-2M, and approved by Design Engineer. To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
- .2 The Design Engineer shall review and approve the contractor's pressure testing procedures at least 72 hours prior to carrying out any testing.

.2 Inspections

- .1 Unless otherwise approved by the Design Engineer, all joints in the piping systems shall remain uncovered until all tests are completed and the systems have been inspected and approved by the Engineer or Inspector.
- .2 DPS Leak Detection System assembly checks should be carried out continuously during the construction work.

.3 Hydrostatic Testing

- .1 Hydrostatic testing shall be performed in accordance with the requirements of ANSI B31.1., Owner's specifications, and the contractor's Inspection and Test Plan. Test pressure shall be 1.5 times the system design pressure.
- .2 Hydro test water shall be clean, filtered fresh or city water. There shall be no leakage in the pipeline.
- .3 All District Heating primary piping shall be hydraulically tested after installation and before painting, insulating, and concealing in any way, at a minimum test pressure of 2400 kPa for 4 hours without a drop in pressure. The secondary heating shall be hydraulically tested at 1.5 times design pressure or a minimum of 690 kPa (100 psi) as per ANSI B31.9.

- .4 Any equipment not capable of withstanding the designated test pressure shall be isolated. Flow meters, heat exchangers, and control valves are to be removed and spool pieces installed before commencing pressure tests.
- .5 The Design Engineer shall make the contractor responsible for obtaining all approvals from jurisdictional bodies for the carrying out of pressure tests on piping with joints not exposed for visual examination.

.4 Radiographic Testing

- .1 20% of all primary welds shall be radiograph tested. If any welds are shown to fail a second test will be required with radiograph of 100% of welds.

8.0 Cleaning and Flushing

- .1 The Design Engineer shall review and approve the contractor's flushing procedure.
- .2 Primary piping shall be flushed, with a chemical flush and then with potable water, to remove all foreign material from the inside of all piping to the Design Engineer's approval. Flushing velocity shall be a minimum of 1.5 m/s.
- .3 Typical acceptable system water concentrations:
 - Iron levels should be below 2 ppm.
 - Hardness should be below 2 ppm.
 - Chloride levels should be maximum 250 ppm if 316 SS Heat Exchanger plate material is used or 50 ppm for 304 SS.
 - pH level of 9.5-10
- .4 Water is to be tested by a water treatment analyst during the cleaning and flushing procedure.
- .5 The Contractor shall take all necessary precautions to prevent damage to the pipe, insulation, or structures from the cleaning operation. Flow meters, heat exchangers, and control valves are to be replaced with spool pieces.
- .6 The contractor shall install and remove all temporary piping and supports to introduce and dispose of flushing water at a safe discharge.

9.0 Commissioning

- .1 Prior to the commissioning of the DH system, both primary and secondary sides must be flushed and cleaned to the satisfaction of the Owner. The strainers shall be cleaned. Heat exchangers will only be allowed to be commissioned pending verification of the proper strainer screen and mesh have been installed at the inlets to the heat exchanger (s). The proper strainer screen/mesh sizes are as per the following:
 - .1 Braze Plate heat exchangers: 1/8" stainless steel perforated screen with 0.5mm (30) mesh.
 - .2 Plate heat exchangers: 3/64" stainless steel perforated screen.
- .2 After satisfactory water quality analysis by a qualified water treatment contractor, system start-up and commissioning may commence. A certification from the water treatment contractor will verify that the water quality is acceptable.

10.0 Accessibility

- .1 All equipment, strainers, control valves, heat exchangers, energy meters and sensors shall be installed with Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated by Owner's representative.
- .2 Provide unions or flanges for ease of maintenance. Install as required. All equipment, and control valves to be provided with union or flanges for easy removal and replacement.

11.0 DES Piping Installation

- .1 The district Energy System (primary) side shall be an all-welded piping system in accordance with ANSI B.31.1 and CSA B51

12.0 Pipe Welding

- .1 Welding qualifications to be in accordance with CSA B51 and ANSI/ASME B31.1. Qualified and licensed welders shall possess a certificate for each procedure to be performed from the authority having jurisdiction.
- .2 Registration of welding procedures shall be in accordance with CSA B51 and ANSI/ASME B31.1.

13.0 Valves

- .1 Install isolating valves at all branch take-offs, and elsewhere as indicated. All primary isolation valves to be welded. Welding to valves must be done in accordance with the manufacturers' recommendations in order to prevent body distortion and to maintain tight shutoff characteristics of the valve. Valve specifications can be found under major equipment specifications.

14.0 Inspection and Testing

- .1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2, CGSB 48-GP-2M, and approved by Design Engineer. To ANSI/ASME Boiler and Pressure Vessel Code Section V: Non destructive Examination. Inspections to be performed by a Third Party testing agency.
- .2 The Design Engineer shall review and approve the contractor's pressure testing procedures at least 72 hours prior to carrying out any testing. Unless otherwise approved by the Campus Chief Engineer or TSBC Inspector, all joints in the piping systems shall remain uncovered until all tests are completed and the systems have been inspected and approved by the Campus Chief Engineer or TSBC Inspector.
- .2 DPS Leak Detection System assembly checks should be carried out continuously during the construction work.

15.0 Burying of DES Pipe prior to Pressure test (special Circumstances)

- .1 The contractor may cover (by insulating and / or burying) Central or District hot water heating piping prior to the final pressure test, provided that all of the following conditions are complied with:
 - .1 Pressure piping shall be within the scope of, and constructed to ASME B31.1 Power Piping. In addition the pressure piping shall be limited to Central or District heating piping systems only, limited to Hot Water service only where the design pressure does not exceed 1600 kPa (232 psig) and the design temperature does not exceed 120 degrees Celsius (248 degrees Fahrenheit and limited to the hydrostatic method of pressure testing only.
 - .2 Contractor shall submit and obtain registration of the piping design from Technical Safety BC prior to construction.
 - .3 specification shall include the details of how the piping shall be buried.
 - .4 The contractor shall submit and obtain acceptance of a documented pressure test procedure from Technical Safety BC, prior to conducting the pressure test. The procedure shall meet the requirements of ASME B31.1, and, shall include an extended holding time for the test and include the method(s) to detect a leak.
 - .5 The Contractor shall also provide a documented procedure for the method to uncover and locate any leak that may occur during the hydrostatic testing of insulated and / or buried piping.
 - .6 Insulated and/ or buried pressure piping that shows any evidence of leakage during the pressure test shall be uncovered to the extent required to locate the leaking

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- area and to effect repairs. The repairs shall meet the requirements of ASME B31.1. The repaired area shall be subject to a pressure test following completion of the repair.
- .7 Unlisted materials shall not be utilized for construction of the pressure piping unless all of the requirements of ASME B31.1 para 123.1.2 are fully complied with, prior to fabrication of the pressure piping.
 - .8 The piping to be pressure tested shall be verified by the Owner's Inspector to be constructed in compliance with BC Regulation 104 / 2004, CSA B51 Boiler, Pressure Vessel and Pressure Piping Code, ASME 831.1 Power Piping Code, the owners specification, and the registered design prior to the pressure test.
 - .9 Upon completion of a successful pressure test, a Construction Data Report for Piping Systems Constructed Inside British Columbia (form 1329) shall be completed and executed as follows:
 - .1 Signed and dated under the Certificate of Compliance by a licensed Contractor, and
 - .2 Signed and dated under Certificate of Inspection section by the Owners Representative and by a Safety Officer employed by TSBC , subsequent to a successful completion of the hydrostatic pressure test
 - .3 A copy of the report shall be submitted to Technical Safety BC
 - .2 The Contractor shall document the criteria that must be met prior to covering the pressure piping by any means (including by insulation and / or burying). The criteria shall include but not limited to:
 - .1 The Contractor shall provide free access to the designated Owners Inspectors and to a Safety Officer to perform any inspections deemed necessary, prior to covering the pressure piping.
 - .2 The Contractor shall notify and obtain prior acceptance of a Safety Officer prior to covering the piping.
 - .3 iii. The piping shall been constructed in compliance with the design, material, fabrication, assembly, examination and testing requirements of the ASME 831.1, and shall be constructed in accordance with the design that has been registered with TSBC.
 - .4 All fabrication, assembly, erection activities and non-destructive examinations required by ASME B31.1 Table 136.4 (including visual weld inspection), and any required repairs, shall be completed prior to the final pressure test
 - .5 A Safety Officer may request any pressure piping be uncovered, at any time and the contractor shall comply with such a request.

16.0 Hydrostatic Testing

- .1 Hydrostatic testing shall be performed in accordance with the requirements of ANSI B31.1., Owner's specifications, and the contractor's Inspection and Test Plan.
- .2 Test pressure shall be 1.5 times the system design pressure. Hydro test water shall be clean, filtered fresh or city water. There shall be no leakage in the pipeline.
- .3 All District Heating primary piping shall be hydraulically tested after installation and before painting, insulating, and concealing in any way, at a minimum test pressure of 2400 kPa for 4 hours without a drop in pressure.
- .4 Any equipment not capable of withstanding the designated test pressure shall be isolated. Flow meters, heat exchangers, and control valves are to be removed and spool pieces installed before commencing pressure tests.
- .5 The Design Engineer shall make the contractor responsible for obtaining all approvals from jurisdictional bodies for the carrying out of pressure tests on all piping with joints and visual examination as per B31.1.

17.0 Radiographic Testing

- .1 100% of all primary buried welds shall be radiograph tested.
- .2 20% of all primary non buried welds shall be radiograph tested. If any welds are shown to fail a second test will be required with radiograph of 100% of welds.

18.0 Cleaning and Flushing

- .1 The Design Engineer and Campus Chief Engineer shall review and approve the contractor's flushing procedure.
- .2 Primary piping shall be flushed, with a chemical flush and then with potable water, to remove all foreign material from the inside of all piping to the Design Engineer's approval. Flushing velocity shall be a minimum of 1.5 m/s.
- .3 Typical acceptable system water concentrations:
 - Iron levels should be below 2 ppm.
 - Hardness should be below 2 ppm.
 - Chloride levels should be maximum 250 ppm if 316 SS Heat Exchanger plate material is used or 50 ppm for 304 SS.
 - pH level of 9.5-10
- .4 Water is to be tested by a water treatment analyst during the cleaning and flushing procedure.
- .5 The Contractor shall take all necessary precautions to prevent damage to the pipe, insulation, or structures from the cleaning operation. Flow meters, heat exchangers, and control valves are to be replaced with spool pieces.
- .6 The contractor shall install and remove all temporary piping and supports to introduce and dispose of flushing water at a safe discharge.

19.0 Commissioning

- .1 Prior to the commissioning of the DES system, the system must be flushed and cleaned to the satisfaction of the Owner.
- .2 After satisfactory water quality analysis by a qualified water treatment contractor, system start-up and commissioning may commence. A certification from the water treatment contractor will verify that the water quality is acceptable.

20.0 Accessibility

- .1 All buried valves shall have a 10" valve box with cast lid. Lid to have the identification letters DES permanently etched on with welded letters. Valve boxes in brick shall be square with a round lid. Acceptable materials: Dobney Foundry MR10-18B or equivalent.





Most Common installation



Installation in Brick

21.0 Chemical Addition

- .1 Contractors are required to add the appropriate quantity of chemical to the district piping to prevent corrosion. The Chemical type to be used must be confirmed prior to introducing to the system to prevent adverse effects of mixing chemicals. Alternative options are available providing prior arrangements have been made with Campus Chief Engineer.

*****END OF SECTION*****

1.0 GENERAL

1.1 System Description

- .1 There are few buildings left serviced by steam and those are serviced by steam from the Bio Energy Research and Demonstration Facility. Saturated steam is generated at 827 kPa (120 psig) for distribution to the remaining steam line running north lower mall and east up University Blvd.
- .2 There is a condensate return as part of UBC's steam distribution system. Wherever the term "steam distribution" is used, it applies to both steam supply and condensate return piping and appurtenances unless otherwise specified.
- .3 Most of the steam/condensate system is gradually being replaced by a District Energy Hot Water system. Also see Division 23, Section 23 21 05 District Hot Water Heating System.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Responsibilities

- .1 UBC Energy & Water Services (EWS) is primarily responsible for operation, maintenance, and overall stewardship of the steam distribution system. The demarcation of UBC Energy & Water Services point of service is normally up to and including the PRV at each consumer. Energy & Water Services also maintain the condensate tank and pumps, whereas the steam distribution with the consumer's premises is outside EWS jurisdiction. Also refer to Condensate Pump and Tank Standard Drawing located on web page (https://technicalguidelines.ubc.ca/technical/divisional_specs.html) under Division 33's section listings.
- .2 Key positions in UBC Energy & Water Services are described in Division 33, Section 33 00 10 Underground Utilities Services of UBC Technical Guidelines.
- .3 Unless otherwise agreed in writing, the project Designer is responsible for all design, permit, and inspection requirements of Technical Safety BC (TSBC).
- .4 The project Designer must incorporate all specific requirements for metering, design and materials and execution of this section into the contract drawings in the form of job-specific notes. Only making reference to UBC Technical Guidelines in the drawings is not sufficient.

2.2 Steam Distribution Standards and Policies

- .1 The latest revisions of the following standards and policies shall apply to steam distribution at UBC:
 - .1 B.C. Boiler and Pressure Vessel Act and ASME B31.1 Power Piping Code; TSBC.
 - .2 UBC Sustainability Development Policy #5 (<https://universitycounsel.ubc.ca/board-of-governors-policies-procedures-rules-and-guidelines/policies/>).
 - .3 CSA standards as applicable.

2.3 Steam Distribution Service Connections

- .1 The first step to install any new or substantially modified connections to the steam distribution system at UBC is complete a Utility Service Connection Application. This and other forms can be found at <https://energy.ubc.ca/community-services/contractors-developers/>.
- .2 Any new connections to the steam distribution system will be reviewed for consistency with UBC Energy & Water Services standards as defined in the UBC Technical Guidelines. If necessary the steam distribution engineering/flow model will be updated and run by UBC Energy & Water Services at no cost to the project.
- .3 The Designer shall obtain the Steam service records by contacting the Records Clerk at Infrastructure Development, Records Section (Telephone: 604-822-9570) and develop proposed service connection location(s).

2.4 Steam Distribution Design and Materials

- .1 Steam Piping
 - .1 Maximum operating pressure shall be 1,030 kPa (150 psig), A106 Grade B seamless.
 - .2 Schedule 40 is required for pipe sizes over 2", and Schedule 80 is required for pipe sizes 2" and smaller.
 - .3 Fittings shall be A234 WPB, Schedule 40 for pipe sizes over 2", and #3000 forged-steel, socket welded for pipes 2" and smaller.
 - .4 Flanges shall be #150 raised-face, weld neck (bore to suit pipe), A105, Grade 1.
 - .5 Pressure bolting shall be A194, Grade B7.
 - .6 Support lugs shall be carbon steel.
 - .7 No cast iron or copper based metal fittings or valves are acceptable.
 - .8 All valves upstream of PRV's, including PRV bypass valve, shall be at least #150 rated and socket welded for pipe sizes 2" and smaller. Greater than 2" shall be flanged or butt welded.
 - .9 Attachment to condensate main piping shall be a tee. Optionally a Sockolet™ shall be used for pipes 2" or smaller, or Weldolet™ if greater than 2".
- .2 Condensate Piping
 - .1 Maximum operating pressure shall be 1,030 kPa (150 psig), A106 Grade B seamless. Design temperature must be a minimum of 200C (400° F).
 - .2 Schedule 80 is required for all pipe sizes in consideration of corrosion.
 - .3 Fittings shall be A234, WPB and #3000 F/S socket welded for pipes 2" and smaller.
 - .4 Flanges shall be #150 raised-face, weld neck, extra heavy (XH) A105, Grade 1.
 - .5 Pressure bolting shall be A194, Grade B7.
 - .6 Support lugs shall be carbon steel.
 - .7 No cast iron or copper based metal fittings or valves are acceptable.
 - .8 Beginning with the last condensate return valve leaving a building, all valves shall be at least #150 rated and socket welded for pipe sizes 2" and smaller. Greater than 2" shall be flanged or butt welded.
 - .9 Attachment to condensate main piping shall be a tee. Optionally a Sockolet™ shall be used for pipes 2" or smaller, or Weldolet™ if greater than 2".
- .3 Isolating valves are required in all mains and branches (incoming and outgoing) for steam and condensate.
- .4 Double block and bleed is mandatory inside steam manholes on all main steam, main condensate, and small bore piping (including steam traps).

- .5 Steam meters are required for all newly construction or substantially modified buildings at UBC. Steam meters shall be installed inside buildings, and located upstream of the pressure reducing valves (PRV). For core buildings use Endress & Hauser and for billable buildings use Foxboro. Refer to Standard Documents – 1130-UT-05-SteamMeterStd-Foxboro.dwg and 1130-UT-SteamMeterStd-Endress.dwg, the locations of which are referenced in section 2.1.1 above. As indicated on the drawing standard, the meter, computer, and transmitter are to be procured and supplied by UBC Energy & Water Services. The project will provide a purchase order for Energy & Water Services to purchase the meter hardware. There will be no additional markup or procurement fees.
- .6 Condensate return shall be a pumped, open system and shall conform to UBC's condensate pump system standard - refer to Standard Documents - CondPumpStd.pdf.
- .7 A copy of design approval by TSBC shall be provided to UBC Energy & Water Services Manager, Mechanical Utilities (Senior Mechanical Engineer) and Campus Chief Engineer.
- .8 A copy of hydrostatic tests required by TSBC shall be provided to UBC Energy & Water Services Manager, Mechanical Utilities and Campus Chief Engineer.
- .9 Manholes shall be constructed with one or two side openable tops.
- .10 Insulation of piping, valves and expansion joints shall conform to UBC Energy & Water Services requirements (available upon request submitted to UBC Energy & Water Services).
- .11 All underground steam and condensate piping shall be installed in inverted concrete channel with removable lid, all joints sealed with tar. Perforated cast iron drainpipe, connected to the storm sewer shall be installed under all steam distribution trenches.
- .12 Steam trap assemblies inside steam manholes shall conform to UBC Energy & Water Services Standard. Refer to Standard Documents - SteamTrapStd.pdf.
- .13 Welding: procedures and welder certification as per ASME B31.1 applies to all steam and condensate piping, equipment, and pipe supports. There shall be no splatter, arc strikes, or center punch marks on piping.
- .14 Zinc coated components shall not be in contact (welded, bolted, or loose) with any part of the piping.
- .15 Substances containing chlorine or which will decompose to hydrogen chloride (i.e. coating to prevent adhesion of weld splatter) shall not be applied to any part of the piping.

3.0 EXECUTION REQUIREMENTS

- .1 Minimum soil cover to be 700 mm.
- .2 Minimum 750 mm horizontal clearance required from all other services, except for condensate.
- .3 Cross electrical duct-bank above and leave vertical space for any future expansion. Crossing angle shall be 90° degree. If future expansion is not required, leave minimum 200 mm vertical clearance from the top of electrical duct-bank and place minimum 50 mm Temperlite overlapping minimum 250 mm on each side.
- .4 The insulation of piping, valves and expansion joints shall conform to these requirements:

- .1 Steam pipes to be insulated with 2" thick "Temperlite"*, c/w minimum 0.016" thick corrugated aluminum jacketing.
- .2 Condensate pipes to be insulated with 1-1/2" thick "Temperlite", c/w minimum 0.016" thick corrugated aluminum jacketing.
- .3 "Temperlite" insulation should stop minimum 2" before any flange joint to allow easy removal of bolts/nuts. Where the insulation stops, it should be tapered at 45° angle and clad with smooth aluminum end caps.
- .4 All valves and expansion joints should be insulated with removable heat jackets fabricated from 1" thick "Fibrox" mat on stainless steel mesh, covered with #1702 silicone cloth. Each heat jacket should cover at least 2" of adjacent "Temperlite" insulation on both sides of the valves or the expansion joint.
- .5 Pipe-covering protection saddles shall be used for high temperature service ($\geq 50^{\circ}\text{C}$), Model Grinnell Fig. 161 or equal.
- .6 On completion of the job, the surface temperature is to be inspected in six locations with a heat gun and records provided to Mechanical Utilities Engineer.

* UBC Energy & Water Services may consider alternative insulating material with similar or better properties.

- .5 When steam pipes are not installed in concrete channel, use pipe bedding and backfilling as follows:
 - .1 For pipe bedding use clean granular pipe bedding, graded gravel, 19 mm(-), MMS type 1:
 - .1 Bottom thickness shall be a quarter of pipe diameter but minimum 100 mm.
 - .2 Top shall be minimum 300 mm.
 - .3 Sides shall be minimum 225 mm to maximum 300 mm.
 - .2 For trench backfill, native backfill may be used if free of rock greater than 100 mm.
- .6 Shutdowns must be requested in writing adhering to UBC's campus-wide shutdowns procedures. Refer to Service Shutdown Request at <https://buildingoperations.ubc.ca/resources/policies-procedures-forms/>.
- .7 Operating valves on the steam-condensate distribution system shall only be performed by UBC Energy & Water Services.

END OF SECTION

1.0 GENERAL

1.1 Related UBC Guideline

- .1 Division 26 through 33

1.2 Coordination Requirements

- .1 UBC Energy and Water Services
- .2 UBC Building Operations

1.3 Power

- .1 The University owns and operates the power system consisting of 60 KV underground and overhead distributions, and 12 KV underground distributions.
- .2 The University purchases power in bulk form from BC Hydro. The two 60 KV lines feed two substations, one located on the South Campus and one on the Main Campus.
- .3 The Main Substation supplies in turn a 12 KV indoor switching station.
- .4 The 12 KV systems is distributed underground in a combined duct and manhole system which services throughout the major portion of the North Campus and a portion of the South Campus.
- .5 The 12 KV system is nominally rated at 12,480 volts, 3 phase, 3 wires, Wye System low resistance grounded.
- .6 The design limits shall be basic impulse level 95 KV and design fault 300 MVA symmetrical.
- .7 The power distribution is a Dual Radial System with 500 MCM low resistive grounded single conductor crosslink polyethylene for 12 KV system.
- .8 For a General Distribution Diagram of the 12 KV feeders, refer to Division 26, Standard Drawing E1-1 (https://technicalguidelines.ubc.ca/technical/divisional_specs.html). Also, refer to 5.4.3.1 Design Development Brief.

1.4 Communication

- .1 The Campus communication systems in most areas of the campus is owned and operated by the University. Project requirements shall be coordinated between the User, the Consultant and the Cable Facilities Services by the Project Manager.

1.5 Central Building Alarm – A Division, Building Operations, UBC

- .1 The University operates a Building Management System (BMS) to provide control and alarm monitoring for all primary mechanical and electrical systems.
- .2 The panels are usually located in the building mechanical rooms to capture the necessary alarm event. This event is transmitted across the BMS network to the appropriate display terminals.

1.6 UBC Standard Forms

- .1 The following standard forms apply to all utilities for this project, as applicable:

- .1 UBC Application for Service Shutdown.
- .2 UBC Application for Service Connection.
- .3 I-B-07 - Clearance Permits.
- .4 I-B-33 - Test and Work Permits.
- .5 UBC Utilities Manhole Entry Permit 1.

*****END OF SECTION*****

1.0 GENERAL

1.1 Related UBC Guidelines

- .1 Section 33 71 00 Electrical Utility Transmission and Distribution

1.2 Coordination Requirements

- .1 UBC Energy & Water Services
- .2 UBC Building Operations

1.3 Description

- .1 UBC requirements for Duct Banks and Manholes.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Design Standards

- .1 Work shall comply with requirements of:
 - .1 WorkSafe BC.
 - .2 BC Safety Authority.
- .2 All civil work including duct banks, manholes and cast-in-place and precast concrete shall comply with UBC Technical Guidelines, BC Hydro Standards, or Master Municipal Construction Documents (MMCD) as applicable.

2.2 Trenching

- .1 Prior to any trenching the duct runs shall be surveyed and staked out. Approval of the staked runs shall be obtained from the Consultant.
- .2 All trenching, excavating, and backfill shall be done to MMCD specifications. Backfill and bedding materials shall be supplied by the Contractor. Trench bottom shall be continuous, firm and shall provide uniform support to the ducts.
- .3 Backfill materials shall be free of rocks larger than 75mm diameter, wood, cinders, ash, and frozen materials. Top surface shall be landscaped to match the existing ground and any road surfaces shall be made good to match existing conditions.

2.3 Other Services

- .1 There are existing services and may be additional runs of other services such as electrical, telephone, water, sewers, gas, oil, drainage, etc. Exercise the maximum care to avoid interference or damages to these. Refer to Underground Utility Services.

2.4 Requirements for Ducts

- .1 Ducts shall be rigid PVC, encased burial type duct conforming to the specific of CSA standard C22.2 No. 211.1 "Rigid Types EB1 and DB2 / ES2 PVC Conduit". Ducts shall be 125mm (5") for all ducts between manholes.

- .2 Ducts shall be:
 - .1 Power services: minimum: 6 – 125 mm (5") between manholes and 4 – 100 mm (4") into buildings. Larger size may be required by CSA or UBC Energy & Water Services.
 - .2 Communication services: minimum 4 - 125 mm (5") between manholes and 4 -100 mm (4") into buildings.
- .3 Ducts shall be sized on the drawings.
- .4 Ducts shall be buried at a minimum depth of 900 mm. Duct runs shall be evenly sloped toward duct terminations for drainage.
- .5 Ducts shall terminate with bell mouth ends.
- .6 All duct bends shall be long sweep "Utility" bends manufactured to utility pulling specifications.

2.5 Requirements for Manholes

- .1 Manholes shall be 1830 mm x 3300 mm x 2000 mm high inside dimensions or as specified by UBC Energy & Water Services.
- .2 Manhole shall be complete with cast manhole cover, frame and brick assembly between manhole and manhole lid.
- .3 Materials shall include:
 - .1 Pre-cast Manhole Assembly.
 - .2 Manhole Frame.
 - .3 Manhole Cover.
 - .4 Spacer Rings.
 - .5 Pulling Irons.
 - .6 Ground Rods.
 - .7 Sump Cover.
- .4 Manholes shall be constructed to the following UBC Utility Standards:
 - .1 E 3-1 Standard Electrical Precast Manhole.
 - .2 E 3-2 Standard Electrical Manhole Pour in Place.
 - .3 E 3-3 Additional Reinforcing for Pour in Place Electrical Manhole.
 - .4 E 3-4 Standard Electrical Manhole Cover & Riser Details.
 - .5 E 3-5 Standard Electrical Manhole Sump Detail.
 - .6 E 3-6 Typical Manhole Grounding & Details.
 - .7 E 3-7 Typical Manhole Separation.
- .5 Pre-cast Manhole using BC Hydro 4212 Chamber may be substituted as an alternate.
- .6 Concrete shall not be placed in foundations until the soil breaking has been reviewed by the Engineer.
- .7 All manholes shall have a sump with positive drainage. Manhole drains shall be connected to the storm water system.
- .8 Testing costs for compaction and concrete tests shall be paid for by the project.

2.6 Requirements for Concrete Encased Duct Bank

- .1 All Service Ducts shall be concrete encased.
- .2 All Civil Work associated with Duct Banks shall be to BC Hydro and MMCD Specifications.
- .3 Duct Banks shall be constructed in accordance with UBC Standards Drawings:
 - .1 E2-1 Standard Concrete encased Electrical Duct.
 - .2 E2-3 Standard Electrical Duct Bank.
 - .3 E2-4 Electrical Ductbank Clearances to Steam Distribution Lines.
- .4 Forms must be used on the walls of the duct bank.
- .5 Duct connectors shall be staggered so they are never adjacent to another coupling. Manufactured intermediate spacers shall be used throughout the length of the duct run every 2 meters.
- .6 Concrete shall have maximum 200 mm (3/4") aggregate, minimum 20 MPA strength at 28 days, and shall contain "Anti-Hydro" mixed as recommended by the additive Manufacturer.
- .7 Immediately after installation, ducts shall be tested for blockages and cleaned as necessary. Prior to completion the ducts shall be swabbed and mandrel led.
 - .1 The civil contractor shall ensure the quality of installation of all ducts by passing a mandrel or test slug sized not less than indicated in the table below and through the entire length of all installed conduits and in both directions:

Duct Diameter (mm)	Mandrel Diameter min. (mm)
75	69
100	91
125	114

- .2 The civil contractor shall provide written verification of mandrel tests to UBC Energy & Water Services upon successful completion.
- .3 The civil contractor shall identify and remediate any portions of installed ducts that do not easily permit passage of the mandrel or test slug.
- .8 A 10 mm (1/4") pulling line shall be installed in all ducts.

2.7 Requirements for Warning Tape During Construction

- .1 During construction a warning tape (yellow) imprinted "CAUTION BURIED ELECTRICAL LINE" shall be installed at all duct banks and buried conduit.
- .2 Warning tape shall be laid in the trench midway between duct bank and finished grade.

END OF SECTION

1.0 **GENERAL**

This section refers to the works that are unique to the requirements for inspecting new and existing sanitary and storm pipes and pipe culverts by closed circuit television. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.1 **Related Sections**

- .1 Section 33 00 10 Underground Utilities Services
- .2 Traffic Regulation "Traffic Control Manual for Works on Roadways" (second edition), published by MoT.
- .3 Section 33 01 30.41 Cleaning of Sewers

1.2 **References**

- .1 These specifications must be referenced to and interpreted simultaneously with all other Standards and Specifications pertinent to the works described herein.
- .2 Reference standards, specification or publications:
 - .1 Water Research Centre (WRc) publication Manual of Sewer Condition Classification (MSCC), Third Edition, 1993 including Addendum - February 1996.
 - .2 NAAPI Manual of Sewer Condition Classification, Second Edition, 2007.
- .3 Nomenclature
 - .1 CCTV Closed Circuit Television
 - .2 JPEG Joint Photographic Experts Group
 - .3 MPEG Movie Photographic Experts Group
 - .4 S-VHS Super VHS format video
 - .5 DVD Digital Video Disk
 - .6 MSCC Manual of Sewer Condition Classification (WRc. – 3rd edition)

1.3 **Submission of Certification**

- .1 Submit a copy of the CCTV operator's current NAAPI certification certificate to the Contract Administrator at least one week prior to the start of the CCTV inspection operations.
- .2 Submit copies of certificates for each CCTV operator working on the contract.

1.4 **Work Regulations**

- .1 Work shall conform to all applicable regulations of WorkSafe BC. The Contractor shall confirm training compliance in the following:
 - .1 Confined space entry
 - .2 Ventilation
 - .3 Atmospheric monitoring
 - .4 Personal protective equipment
- .2 The Contractor shall provide dates of confined space training completion for each worker and a list of equipment required for confined space entry.

1.5 **Scheduling of Work**

- .1 Schedule work to minimize interruptions to existing services.

- .2 Maintain existing flow during inspection survey unless flow reduction measures required (see Clause 3.11).

1.6 Measurement for Payment

- .1 All units of measurement for payment will be as specified herein unless shown otherwise in Form of Tender
- .2 CCTV pipeline inspection will be measured in lineal metres. Payment will be made at the unit price bid in Form of Tender.
- .3 Measurement will be determined by calibrated electronic measure along the sewer from the inside wall of manhole to inside wall of manhole or end to end of sewer pipe for all sections except where a blockage or obstruction occurs.
- .4 For sections of pipe where a blockage or obstruction occurs, measurement will be from the start of inspection (inside wall of manhole) to the point of abandonment of survey.
- .5 For sections of pipe with the WRc. condition code CU (camera underwater) that has a continuous distance greater than five (5) metres, the measurement above will be reduced by the distance in excess of the five metres.
- .6 Bypass pumping for each situation as described in the Form of Tender will be made as lump sum.

2.0 PRODUCTS

2.1 Equipment

- .1 A Survey Vehicle, containing a separate area for viewing, recording and controlling of the CCTV operation is required as follows:
 - .1 Viewing and control area to be insulated against noise and extremes in temperature. External and internal sources of light to be controlled to ensure the light does not impede the view of the monitor screen. Proper seating accommodation shall be provided to enable one person, in addition to the operator, to clearly view the monitor screen.
 - .2 All equipment utilized within the pipeline shall be stored outside the viewing, recording and control area.
 - .3 Vehicle to be equipped with a telephone for communication with the Engineer for the duration of the work.
 - .4 Electrical power for the system to be self-contained. External power sources from public or private sources will not be permitted.
- .2 Survey Equipment shall have sufficient cables to view the lengths of pipe as specified.
 - .1 Survey unit shall be a self-propelled crawler type with a means of transporting the CCTV camera in a stable condition through the pipeline.
 - .2 Each unit shall carry sufficient numbers of guides and rollers such that, when surveying, all cables are supported away from pipe and manhole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.
 - .3 Each unit shall interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipeline condition and header reference location information.

- .3 The camera shall be capable of producing high quality colour imagery and provide complete inspections and view of all laterals and deficiencies.
 - .1 The camera shall be a "Pan & Tilt" type having the capability of panning the pipe at 360° and tilt capability of 270°.
 - .2 The camera shall be equipped with an inclinometer to record the slope of inspected pipe.
 - .3 The live picture is to be visible with no interference and capable of registering a minimum of 360 lines of resolution at the periphery.
 - .4 Focus and iris adjustment shall allow optimum picture quality to be achieved and to be remotely adjusted. The adjustment of focus and iris shall provide a focal range from 150mm in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer.
 - .5 The camera is to be waterproof with a self-contained lighting system capable of being remotely adjusted. Lights shall provide an even distribution of light around the pipeline perimeter without the loss of contrast or flare out or picture shadowing.

2.2 Materials

- .1 Digital video files are to be stored on new, unused DVD-R media in MPEG 2 format.
- .2 Photographs are to be in colour, with a minimum image size of 90mm x 70mm and shall be reproduced on premium glossy photo quality paper.

3.0 EXECUTION

3.1 CCTV Inspection

- .1 The Contractor shall submit samples of inspection reports, video (in MPEG 2 DVD format) together with corresponding digital data files for the Owners review within one week of receipt of notice to proceed with contract. This submission shall demonstrate compliance with the contract specifications and the accepted submission will be used as a benchmark for subsequent inspection report submissions.
- .2 No inspection surveys are to be carried out under this contract until an acceptable sample inspection report has been approved by the Contract Administrator.
- .3 Flow in the pipeline is not to exceed approximately 1/3 of the pipe diameter. Notify of excessive flows, inspect using flow reduction method (See Clause 3.10).
- .4 Steaming and fogging encountered during the inspection survey shall be eliminated by introducing forced air flow by means of fan.
- .5 The camera lens is to remain free of grease or other deleterious matter to ensure optimal clarity.
- .6 Inspection video images are to be produced in MPEG2 format by the following method:
 - .1 Video capture card and software designed to create and store real-time MPEG2 digital file direct to computer hard drive.
 - .2 Create a separate digital file and a separate title for each individual manhole-to-manhole inspection report. Format for the video file numbering to be provided by the Contract Administrator.
- .7 Set zero chainage at face of every manhole, or on entrance into pipe or start of pipe culvert.

- .8 Report and record on the full length of pipeline from inside face to inside face between manholes or outlet end of pipes and from one end of the pipe culvert to the other.
- .9 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- .10 The data generator shall electronically generate, and clearly display on the viewing monitor and video recording, a record of the following minimum information prior to the start of each run:
 - .1 Manhole (from-to) / pipe length reference numbers.
 - .2 Pipeline dimensions
 - .3 Pipe material (i.e. vitrified clay, concrete, pvc etc.)
 - .4 Type or use of pipe (i.e. sanitary or storm sewer)
 - .5 Date of survey (yyyy.mm.dd)
 - .6 Road name/location
 - .7 Direction of travel of survey equipment (U or D, Upstream or Downstream)
 - .8 Inspection (report) number. Format to be provided by the Contract Administrator.
 - .9 Verbal description of all the above on screen information.
- .10 The data generator shall continuously electronically generate, and clearly display on the viewing monitor and video recording, a record of the following minimum information during each run:
 - .1 Automatic update of the camera's metre reading position from adjusted zero.
 - .2 Manhole/pipe length reference numbers.
 - .3 Type or use of pipe (i.e. sanitary or storm sewer)
 - .4 The unique inspection/report number of the run.
 - .5 Display digital information such that it will not interfere with the video image on the screen.
- .11 The camera must stop at each defect, change of condition of pipe and service connection to record defect in accordance with WRc codes.
- .12 Pan each service connection (junction) such that the camera looks down the centerline of the service, pause for a minimum of five (5) seconds and note condition of the joint and /or pipe/service interface.
- .13 Immediately notify Contract Administrator of any blockage or obstruction that will not allow passage of survey equipment.
- .14 Restart the inspection survey from the opposite end of pipeline or culvert when a blockage or obstruction is encountered unless directed by Contract Administrator.

3.2 Site Coding Sheets

- .1 Each pipeline length to be recorded according to the WRc, MSCC 3rd edition. Any variation from the manual is to be noted in the survey report.
- .2 Standard coding form shown on page 14 of MSCC to be modified as follows:
 - .1 Line 2, field 8 (date) to be eight (8) characters in the format of yyyy.mm.dd (year, month, day).
 - .2 Condition detail number (video count) to be six (6) characters in the format of hh.mm.ss (hours, minutes, seconds).
 - .3 Note observations as to condition of service connections beyond mainline in remarks column using standard codes as per MSCC.

3.3 Camera Position

- .1 Position the camera lens centrally in the pipeline to a tolerance of $\pm 10\%$ off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned 2/3 the height of the pipe measured from the invert.

- .2 Position the camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.

3.4 Camera Travel Speed

- .1 Travelling speeds of the camera in the pipeline shall be as follows:
 - .1 0.1m/s for pipeline of diameter less than 200mm.
 - .2 0.15 m/s for diameters 200mm and larger but not exceeding 310 mm: and
 - .3 0.20 m/s for diameters exceeding 310 mm

3.5 Camera Position Chainage Device

- .1 Use a chainage device which enables the cable length to be accurately measured to indicate the location of the camera.
 - .1 Chainage information to be transmitted electronically to control area and displayed on the monitor.
- .2 Chainage device shall be accurate to within 0.3 m up to the first 50 m of pipe length and within $\pm 1\%$ for lengths exceeding 50 m.
- .3 Chainage tolerance shall be checked at the start of contract and a minimum of once every two weeks there after or every 5000 m of pipeline inspected, whichever is greater.
- .4 Provide an audit form showing dates and distances checked to meet both tolerance requirements. Chainage linear measurement to be checked by use of a cable calibration device or tape or electronic measurement between fixed points.

3.6 Photographs and/or Digital Images

- .1 Photograph all major defects as defined by condition codes: B, CM, CXI, D, FC, FL, FM, H, IR, IG, JDL, JX, OB, OJL, RM, and X.
- .2 The following data, in alpha-numeric form, shall be overlaid on photographs such that it will not interfere with the defect condition reported:
 - .1 Report/job number
 - .2 Metre reading position (chainage)
 - .3 Manhole/pipe length reference numbers (from - to)
 - .4 Photograph number
 - .5 WRc. condition defect code
 - .6 Date of survey (yyyy.mm.dd)
- .3 Capture photographs and alpha-numeric data as a digital image in JPEG format if required, as specified in contract documents.
- .4 Co-ordinate photographs with the hard-copy report by reference number and inserting into the report following the relevant section of pipeline inspected.

3.7 Inspection Reporting Hard copies & Digital Format

- .1 Submit reports to the Contract Administrator within 10 working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.
- .2 Present machine printed (hard copy) and computer generated database reports according to the MSCC format as follows:

- .1 Each binder to commence with an index of all survey inspection reports contained within.
 - .2 Hard copy reports to be presented in tabular form in accordance with WRc MSCC
 - .3 Reports to be presented in sections or drainage areas and/or by pipeline type or as specified in the contract documents.
 - .4 Computer database file to contain identical survey report information as the printed report exclusive of photographs.
 - .5 Digital information to be presented in tabular configuration in accordance with the UBC standard file format in Microsoft ACCESS (.MDB) (See Clause 3.12). A single master database file to be presented at the end of the project containing all the project CCTV reports.
 - .6 Provide a CD ROM of digital photographs. Each disk to be labelled with photo and contract numbers.
 - .7 Include Owner supplied, scale drawings showing highlight inspected pipeline. Drawing to be attached to inspection condition report for each section of sewer pipeline surveyed.
- .3 Present reports in 215 mm x 280 mm three ring (D type) binders.
 - .4 Attach computer disks (DVD and CD) in three hole plastic diskette sheet holder in back of binder.
 - .5 Attach identical identification labels on the three ring binder, DVD's (video files) and CD's (database and still digital images).
 - .6 Provide additional copies of printed reports, if required, or as specified in contract documents.
 - .7 All dimensions and chainages in the reports shall be in metric units.

3.8 Flushing and Cleaning

- .1 Clean or flush sewers immediately prior to CCTV inspection survey, unless otherwise specified in the contract documents or directed by the Contract Administrator.

3.9 Root Cutting and Removal

- .1 Remove roots for condition codes RM where required, to allow for CCTV equipment to pass.

3.10 Flow Reduction

- .1 Reduce flow in pipeline to approximately 1/4 pipe diameter to allow CCTV inspection by combination of the following:
 - .2 Schedule work for off peak flow times.
 - .3 Plug or block flow at upstream manhole.
 - .1 Plug designed to either plug all flow or impede flow to the approximate 1/4 pipe diameter.
 - .2 Obtain Contract administrator's approval prior to plugging or impeding any flow.
 - .3 Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipeline.
- .4 Temporary bypass pump flow around inspection section when required, as specified in contract documents. Plug to be flow through with hoses and pump of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free. Flow to be pumped to downstream manhole on same system or run as inspection is to take place. Obtain Contract Administrator's approval prior to setting up temporary bypass pump system.

3.11 Coding Accuracy

- .1 Coding accuracy shall be a function of the number of defects or construction features not recorded (omissions) and the correctness of the coding and classification recorded. Coding accuracy to satisfy the following requirements:
 - .1 header accuracy 95%
 - .2 detail accuracy 85%
- .2 The Contractor shall implement a formal coding accuracy verification system at the onset of the work. Coding accuracy to be verified by the Contractor on a random basis on a minimum of 10% of the inspection reports. Contract Administrator will be entitled to review the accuracy verification system and results and be present when the assessments are being conducted.
- .3 A minimum of two accuracy verifications shall be performed for each operator for each working week. Coding not satisfying the accuracy requirements shall be re-coded and the accuracy of the inspection report immediately preceding and following the non-compliant inspection shall be verified. The process shall be repeated until the proceeding and subsequent inspections meet accuracy requirements.

3.12 Standard CCTV Digital File Format – Header Table

- .1 Below are two tables listing fields and data types to be used in the Digital file (MDB) submission.

HEADER TABLE

NAAPI FIELD NAME	DATA TYPE	FIELD PROPERTIES		CITY OF FIELD NAME
ID	AutoNumber			
SURVEYEDBY	Text	12		
CONTRACTNUMBER	Text	8		
JOBNUMBER	Text	10		
CATCHMENT	Text	10		
DIVISION	Number	Byte		
DISTRICT	Text	3		
PIPELENGTHREF	Text	11		
DATE	Date/Time			
TIME	Date/Time			
LOCATION	Text	50		
STARTMANHOLE	Text	10		
SDEPTH	Text	4		
SCOVER	Number	Single		
SINVERT	Number	Single		
FINISHMANHOLE	Text	10		
FDEPTH	Text	4		
FCOVER	Number	Single		
FINVERT	Number	Single		
USESEWER	Text	1		
DIRECTION	Text	1		
SIZE1	Number	Integer		
SIZE2	Number	Integer		
SHAPE	Text	1		
MATERIAL	Text	3		
LINING	Text	3		
PIPELENGTH	Number	Single		
TOTALLENGTH	Number	Single		
YEARLAID	Text	4		
VIDEONUMBER	Text	5		
COMMENTS	Text	50		
PURPOSE	Text	1		
SEWERCATEGORY	Text	1		
PRECLEANING	Text	1		
WEATHER	Text	1		
LOCATIONCODE	Text	1		
FURTHERDETAILS	Text	48		

CONDITION DETAILS TABLE

FIELD NAME	DATA TYPE	FIELD PROPERTIES		CITY OF..... FIELD NAME
ID	AutoNumber	Long integer		
VIDEONUMBER	Date/Time	hh:nn:ss		
PHOTOGRAPHNUMBER	Number	Integer		
DISTANCE	Number	Single		
CONTINUOUSDEFECT	Text	2		
CODE	Text	4		
DIAMETER_DIMENSION	Number	Integer		
CLOCKFROM	Number	Integer, "00"		
CLOCKTO	Number	Integer, "00"		
PERCENTAGE	Number	Byte		
INTRUSION	Number	Integer		
JOBNUMBER	Text	10		
REMARKS	Text	34		

END OF SECTION