PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARDS

INTRODUCTION

Version	Revision 2
Effective Date	June 2, 2021
Approved By	
	Director: Design, Engineering & Construction

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1.1 MASTER LIST OF STANDARDS

Master List of Design Standards – Common				
S. No	***Discipline***	***Standard***	***Standard Title***	***Revision***
1	Common	DS-01	Site Servicing	Not Issued
2	Energy	Energy	Energy and Environmental Design for New Construction and Major Renovations – adapted from LEED® 2009	Version 3.00
Master List of Design Standards – Architectural				
S. No	***Discipline***	***Standard***	***Standard Title***	***Revision***
1	Architectural	DSA-01	Architectural Space Planning & Finishes	Final Rev 1
2	Paint	RD-01	Painting	Final Rev 0
3	Elevator	RD-02	Elevator	Final Rev 0
4	Door Hardware	RD-03	Hardware	Final Rev 1
5	Signage	RD-04	Signage	Final Rev 1
6	Roofing	RD-05	Roofing	Final Rev 0
8			Landscaping	Not Issued
9			Classroom	Not Issued
10	Labs	RD-08	Laboratory	Final Rev 0
11	Vivarium	RD-09	Vivarium	Final Rev 0
12			Physical Security	Not Issued
13			Inventory Control	Not Issued
Master List of Design Standards – Mechanical				
S. No	***Discipline***	***Standard***	***Standard Title***	***Revision***
1	Mechanical	DSM-01	HVAC Systems	Final Rev 1
2		DSM-02	Plumbing Systems	Final Rev 1

3		DSM-03	Building Automation Systems	Final Rev 1
4		DSM-04	Fire Protection Systems	Final Rev 0
		Master List of Design Standards – Electrical		
S. No	***Discipline***	***Standard***	***Standard Title***	***Revision***
1	Electrical	DSE-01	Electrical Power Systems	Final Rev 0
2		DSE-02	Lighting Systems	Final Rev 0
3		DSE-03	Fire Alarm Systems	Final Rev 0
4		DSE-04	IT & Communications Systems	Final Rev 0
5		DSE-05	Access Control Systems	Final Rev 1

1.2 GENERAL

The University of Guelph, Physical Resources, has prepared the Design Standards with the intention to provide assistance during the planning, design and construction of all University facilities. These standards serve to consolidate the range of institutional knowledge retained by the Physical Resources Department Staff.

These Standards have been developed to establish the University's minimum expectations and requirements for Renovations and new Construction on campus. The Standards are based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design.

These standards are to be applied in the design of all projects, by both the University's internal design group and external consultants. The design team is required to read, understand and comply with the full Design Standards as they apply to the project.

The Design Standard includes the minimum building requirements which the University has recognized as necessary on all projects. These standards assure uniformity, system or component quality, compatibility, ease of maintenance and operational efficiency.

1.3 COMPLIANCE CRITERIA

Full compliance is mandatory on projects involving new construction. Full compliance is mandatory for new installation within projects involving significant renovations. Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing building architectural elements. Any deviations from the minimum requirements outlined in this Standard must be approved by the Project Manager and Discipline Manager, DEC before the completion of Schematic Design.

1.4 PURPOSE AND SCOPE

The Standards do not diminish or reduce the standard of care owed by a Consultant to the University nor relieve in any manner whatsoever a Consultant from any professional responsibility, duty or due diligence required towards the work.

Following these standards does not negate the need to follow the University of Guelph stakeholder and committee review processes applicable to project scope.

Documents that do not adhere to the Standards will be rejected and returned to the Design Team for appropriate revisions.

1.5 MAINTAINING THE STANDARDS

The Design Standards are created and maintained by Physical Resources and any enquiries about the Standards should be directed to the same.

This document is not meant to be a finite, rigid document, but a dynamic, fluid document, evolving as it incorporates innovative developments, concepts, feedback and practical applications. These standards have been established based on an assessment of current and future needs and the knowledge available to the date of their preparation. The University recognizes that many of the criteria and design parameters contained in the standards may require review and re-evaluation over time based on new or improved knowledge.

The design community and other interested parties are encouraged to provide comment and suggestions as to form and content based on their experience as users of the Standards. Informal review of the Standards as applicable to specific projects will be done during each project. This information will be used to update and maintain, as appropriate, the Standards.

Certain issues relating to University requirements may not be addressed within these standards and further innovations in design may identify the need for additional or revised standards. While these situations may often be addressed on a case by case basis through the application of good engineering practice, establishment of additional or revised standards may be necessary to ensure that the issues are addressed consistently for future applications. In consideration of these needs, the University will alter or revise the standards from time to time.

1.6 STANDARDS EXEMPTIONS & DEVIATIONS

All design and construction at the University must comply with the Standards herein. However, there are instances when an exemption or deviation may be appropriate. If a Consultant or the University's internal design group would like an exemption or deviation from the Standards to be considered, a formal request must be submitted to the Project Manager for review using the compliance checklist; a request for a deviation or an exemption will only be considered when there is quality, cost, or time benefits that do not compromise the integrity of the work to be performed. The Design Team shall specify the reasons for the deviation in detail – by providing drawings, sketches, technical information, mathematical calculations, technical & functional background information, implications to the longevity of the building, and implications on capital and operating budgets – as appropriate to allow a thorough and complete review by the Project Manager and discipline Design Manager. All requests for deviation and/or exemption must be submitted prior to completion of schematic design (30%).

This information will be reviewed by the Project Manager and discipline Design Manager who will advise as to acceptability of the request for exemption or deviation.

The University reserves the right to the final decision regarding the interpretation of the intent of these standards and the acceptability of changes from the standards proposed by the Consultant.

1.7 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	01-06-2015		Original Issue
1	08-04-2019		Revised Master List
2	03-03-2021		Revised Master List

UNIVERSITY of GUELPH

DESIGN STANDARD COMPLIANCE CHECKLIST

Design Standard ***[Insert Standard number and Title]***

[Checklist must be completed, signed-off and submitted to the Project Manager before the completion of schematic design (30%)]

Project Name:	***[Insert Project Name]***
University Project No.:	***[Insert Project No.]***
Project Description:	***[Insert Project Description]***
Project Type	[New Construction] [Significant Renovation] [Minor Renovation] ***(Pick one and delete the rest)***

Compliance Statement ***(check one)***

☐ The proposed design solution is in full compliance with the Design Standard

☐ The proposed design solution seeks deviations / exemptions from the Design Standardare; these deviations / exemptions are listed below

Standards Reference Article	**Requirement of the Standard**	**Requested Deviation / Exemption [1]**	**Rationale for seeking a Deviation / Exemption** (Use additional cross-referenced sheets as necessary)	**Overarching Impact (Capital Cost, Maintenance Cost, Schedule, etc.) of Deviation / Exemption** (Use additional cross-referenced sheets as necessary)	**Deviation Accepted or Rehjected by Discipline Manager and Project Manager** (Discipline Manager sign-off, counter-signed by the Project Manager)	
					Yes / No	Signnature & Date

[1] All design and construction at the University must comply with the Standards and Guidelines. However, there are instances when a deviation may be appropriate. If a Consultant intends to deviate from the Standards and Guidelines, a formal request must be submitted to the Project Manager and the Discipline Design Manager for review in accordance with the guidelines outlined in the Introduction document.

Consultant Firm: ______________________________

Consultant Name: ______________________________

Consultant Signature: ______________________________

University Project Manager: ______________________________

Signature: ______________________________

Date: ______________________________

University Discipline Manager: ______________________________

Signature: ______________________________

Date: ______________________________

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
Sustainable Sites			
Construction Activity Pollution Prevention	X		To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation and airborne dust generation. Design and implement an erosion control and sediment system. Objectives: • To prevent loss of soil during construction by storm water runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse. • To prevent sedimentation of storm sewer or receiving streams. • To prevent pollution of the air with dust and particulate matter.
Site Selection	X		To avoid the development of inappropriate sites and reduce the environmental impact from the location of a building on a site. Protect ecologically sensitive areas and minimize potential flood damage. Do not develop buildings, hardscape, roads or parking areas on portions of sites that meet any of the following criteria: • Ecologically sensitive land. • Land within 30.5 metres (100 feet) of any wetlands or areas of special concern identified by federal, provincial, or local authorities, OR within setback distances from wetlands prescribed in federal, provincial, or local regulations and requirements, whichever are more stringent.
Development Density and Community Connectivity		X	To channel development to urban areas with existing infrastructure, protect greenfields and preserve habitat and natural resources. Construct or renovate a building on a previously developed or graded site, that conforms with a minimum development density of 13,800 square metres per hectare requirement (60,000 square feet per acre), AND select a site in an area with a minimum density of 13,800 square metres per hectare (60,000 square feet per acre net).
Alternative Transportation			
Public Transportation Access		X	To reduce pollution and land development impacts from automobile use. BUS STOP PROXIMITY - Locate the project within 400 metres (¼ mile) walking distance (measured from a main building entrance) of 1 or more stops for 2 or more public, campus, or private bus lines with frequent service usable by building occupants.
Bicycle Storage & Changing Rooms	X		To reduce pollution and land development impacts from automobile use. Improve employee health and minimize use of fossil-fuelled transportation. Provide secure and covered bicycle racks and/or storage within 183 metres (200 yards) of a building entrance for 5% or more of Full-Time Equivalent (FTE) occupants. Provide secure bicycle racks and/or storage within 183 metres (200 yards) of a building entrance for 5% or more of peak Transient Users. Provide shower and changing facilities in the building, or within 183 metres (200 yards) of a building entrance, for 0.5% of Full-Time Equivalent (FTE) occupants.

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
Parking Capacity		X	To reduce pollution and land development impacts from automobile use. Minimize costs for constructing parking and encourage carpooling. OPTION 1 - Size parking capacity to meet but not exceed minimum local zoning requirements. Do not exceed 3.5 spaces per 93 square metres (1000 square feet) of gross floor area. Provide preferred parking for carpools or vanpools for 5% of the total provided parking spaces. OR OPTION 2 - For projects that provide parking for less than 5% (for New Construction) of full-time equivalent (FTE) building occupants: Provide preferred parking for carpools or vanpools, marked as such, for 5% (for New Construction) of total parking spaces. Providing a discounted parking rate is an acceptable substitute for preferred parking for carpool or vanpool vehicles. To establish a meaningful incentive in all potential markets, the parking rate must be discounted at least 20%. The discounted rate must be available to all customers (i.e. not limited to the number of customers equal to 5% of the vehicle parking capacity), publicly posted at the entrance of the parking area, and available for a minimum of 2 years. OR OPTION 3 - Provide no new parking. Do not exceed 3.5 spaces per 93 square metres (1000 square feet) of gross floor area. For projects with existing parking, provide preferred parking for carpools or vanpools for 5% (for New Construction) of the total provided parking spaces.
Site Development			
Protect or Restore Habitat	X		To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity. Use native species that are indigenous and are not invasive. Restore ecologically damaged sites, create biodiversity and reduce costs associated with maintenance. CASE 1. GREENFIELD SITES Limit all site disturbance to the following parameters: • 12 metres (40 feet) beyond the building perimeter; • 3 metres (10 feet) beyond surface walkways, patios, surface parking and utilities less than 300 mm (12 inches) in diameter; • 4.5 metres (15 feet) beyond primary roadway curbs and main utility branch trenches; • 7.5 metres (25 feet) beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities and playing fields) that require additional staging areas to limit compaction in the constructed area. CASE 2. PREVIOUSLY DEVELOPED AREAS OR GRADED SITES Restore or protect a minimum 50% of the site area (excluding the building footprint) or 20% of the total site area (including building footprint), whichever is greater, with native or adapted vegetation. Projects earning 5 points under SS Credit 2: Development Density and Community Connectivity may include vegetated roof surface in this calculation if the plants are native or adapted, provide habitat, and promote biodiversity.
Maximize Open Space		X	To promote biodiversity by providing a high ratio of open space to development footprint. Reduce the development footprint and/or provide vegetated open space within the project boundary such that the amount of open space exceeds local zoning requirements by 25%. Wetlands or naturally designed ponds may count as open space. If the side slope gradients average 1:4 (vertical : horizontal) or less and are vegetated.

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
Storm Water Management			
Quantity Control	X		To limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from storm water runoff and eliminating contaminants. CASE 1. SITES WITH EXISTING IMPERVIOUSNESS 50% OR LESS Implement a storm water management plan that prevents the post-development peak discharge rate and quantity from exceeding the pre-development peak discharge rate and quantity for the 1 and 2 year 24-hour design storms. CASE 2. SITES WITH EXISTING IMPERVIOUSNESS GREATER THAN 50% Implement a storm water management plan that results in a 25% decrease in the rate and volume of storm water runoff from the 2 year 24-hour design storms.
Quality Control		X	To limit disruption and pollution of natural water flows by managing storm water runoff. Implement a storm water management plan that reduces impervious cover, promotes infiltration and captures and treats the storm water runoff from 90% of the average annual rainfall using acceptable best management practices (BMPs). BMPs used to treat runoff must be capable of removing 80% of the average annual post-development total suspended solids (TSS) load. BMPs are considered to meet these criteria if they are designed in accordance with standards and specifications from a provincial, territorial, or local program that has adopted these performance standards. Implement a management plan to minimize pollution and eutrophication of waterways from excess nutrient pollutants such as nitrogen and phosphorus, often found in cleaning agents and fertilizers.
Heat Island Effect			
Non-Roof	X		To reduce heat islands to minimize impact on microclimates and human and wildlife habitats. During summer, these measures help to cool the local micro climate Use any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots): • Provide shade from existing tree canopy or within 5 years of landscape installation; landscaping (trees) must be in place at the time of occupancy. • Provide shade from architectural devices or structures that have a solar reflectance index (SRI) of at least 29. • Use hardscape materials with an SRI of at least 29. • Use an open-grid pavement system (at least 50% pervious).
Roof	X		To reduce heat islands to minimize impact on microclimates and human and wildlife habitats. Minimize cooling costs by reducing roof temperatures. OPTION 1 **-** Use roofing materials with a solar reflectance index (SRI) equal to or greater than the values in the table in LEED 2009 Guide for a minimum of 75% of the roof surface. OR OPTION 2 - Install a vegetated roof for at least 50% of the roof area. OR OPTION 3 **-** Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			Projected area roof meeting minimum SRI / 0.75 + Area of vegetated roof / 0.5 ≥ Total projected roof area ROOF TYPE — SLOPE — SRI Low-Sloped Roof — ≤ 2:12 — 78 Steep-Sloped Roof — > 2:12 — 29
Light Pollution Reduction	X		To minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction and reduce development impact from lighting on nocturnal environments. Save exterior lighting energy costs. FOR INTERIOR LIGHTING OPTION 1 - Reduce the input power (by automatic device) of all non-emergency interior luminaires with a direct line of sight to any openings in the envelope (translucent or transparent) by at least 50% between the hours of 11 p.m. and 5 a.m. After-hours override may be provided by a manual or occupant-sensing device provided the override lasts no more than 30 minutes. OR OPTION 2 - All openings in the envelope (translucent or transparent) with a direct line of sight to any non-emergency luminaires must have shielding (controlled/closed by automatic device for a resultant transmittance of less than 10% between the hours of 11 p.m. and 5 a.m.) FOR EXTERIOR LIGHTING Partially or fully shield all exterior luminaires with 1000 initial lamp lumens or more to meet the Full Cutoff IESNA Classification so they do not emit light directly to the night sky. Light areas only as required for safety and comfort. Do not exceed 80% of the Lighting Power Densities for exterior areas and 50% for building facades and landscape features as defined in ANSI/ASHRAE/IESNA Standard 90.1-2007 for the classified zone. Classify the project under 1 of the following zones, as defined in IESNA RP-33, and follow all of the requirements for that zone: LZ2 — Low (primarily residential zoning, neighbourhood business districts, light industrial with limited nighttime use and residential mixed use areas) Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 1.1 horizontal and vertical lux (0.10 horizontal and vertical footcandles) at the site boundary and no greater than 0.11 horizontal lux (0.01 horizontal footcandles) 3 metres (10 feet) beyond the site boundary. Document that no more than 2% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down). LZ3 — Medium (all other areas not included in LZ2) Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 2.2 horizontal and vertical lux (0.20 horizontal and vertical footcandles) at

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			the site boundary and no greater than 0.11 horizontal lux (0.01 horizontal footcandles) 4.6 metres (15 feet) beyond the site. Document that no more than 5% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down). For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary. Illuminance generated from a single luminaire placed at the intersection of a private vehicular driveway and public roadway accessing the site, is allowed to use the centerline of the public roadway as the site boundary for a length of 2 times the driveway width centered at the centerline of the driveway.
Water Efficiency			
Water Use Reduction	**X**		To increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems. Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation).
			Calculate the baseline according to the commercial and/or residential baselines outlined in the LEED 2009 Guide. Calculations are based on estimated occupant usage and must include only the following fixtures and fixture fittings (as applicable to the project scope): water closets, urinals, lavatory faucets, showers, kitchen sink faucets, and pre-rinse spray valves. AND Have in place a permanently installed water meter(s) that measures all potable water use for the entire building and associated grounds. Calibrate meter(s) following the manufacturer's recommendations if the building owner, management organization or tenant owns the meter. Meters owned by third parties (e.g., utilities or governments) are exempt.
Water Efficient Landscaping	**X**		To limit or eliminate the use of potable water or other natural surface or subsurface water resources available on or near the project site for landscape irrigation. Design landscaping with drought resistant vegetation, drip irrigation, cistern water of irrigation and/or deign landscape to eliminate the need for a permanent irrigation system.
			OPTION 1. REDUCE BY 50% **-** Reduce potable water consumption for irrigation by 50% from a calculated midsummer baseline case. Landscaped area must constitute at least 5% of the project site area. Reductions must be attributed to any combination of the following items: • Plant species, density, and microclimate factor • Irrigation efficiency • Use of captured rainwater • Use of recycled wastewater • Use of water treated and conveyed by a public agency specifically for non-potable uses Groundwater seepage that is pumped away from the immediate vicinity of building slabs and foundations can

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			be used for landscape irrigation and meet the intent of this credit. However, the project team must demonstrate that doing so does not affect site stormwater management systems. OR OPTION 2. NO POTABLE WATER USE OR IRRIGATION - Meet the requirements for Option 1. AND PATH 1 - Use only captured rainwater, recycled wastewater, recycled greywater, or water treated and conveyed by a public agency specifically for non-potable uses for irrigation. OR PATH 2 - Install landscaping that does not require permanent irrigation systems. Temporary irrigation systems used for plant establishment are allowed only if removed within one year of installation.
Innovative Wastewater Technology		X	To reduce wastewater generation and potable water demand while increasing the local aquifer recharge. Reduce potable water use for building sewage conveyance by 50% through the use of water-conserving fixtures (e.g., water closets, urinals) or non-potable water (e.g., captured rainwater, recycled greywater, and on-site or municipally treated wastewater). Install a cistern and piping to allow rain water to flush toilets or install tertiary wastewater facility.
Water Use Reduction	X		To further increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems. Employ strategies that in aggregate use less water than the water use baseline calculated for the building (not including irrigation). Calculate the baseline according to the commercial and/or residential baselines outlined in the LEED 2009 Guide. Calculations are based on estimated occupant usage and must include only the following fixtures and fixture fittings (as applicable to the project scope): water closets, urinals, lavatory faucets, showers, kitchen sink faucets, and pre-rinse spray valves.
Energy and Atmosphere			
Fundamental Commissioning of Building Energy Systems	X		To verify that the project's energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design, and construction documents. Engage a CxA to review design intent documentation, incorporate commissioning requirements, develop a commissioning plan, verify equipment installation, test performance, verify training, review O&M manuals, write report. Benefits of commissioning include reduced energy use, lower operating costs, reduced contractor callbacks, better building documentation, improved occupant productivity, and verification that the systems perform in accordance with the owner's project requirements. The following commissioning process activities must be completed by the project team. 1. Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities. a. The CxA must have documented commissioning authority experience in at least 2 building projects. b. The individual serving as the CxA must be independent of the project's design and construction management, though they may be employees of the firms providing those services. The CxA may be a qualified employee or consultant of the owner. c. The CxA must report results, findings and recommendations directly to the owner.

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			2. The owner must document the owner's project requirements. The design team must develop the basis of design. The CxA must review these documents for clarity and completeness. The owner and design team must be responsible for updates to their respective documents. 3. Develop and incorporate commissioning requirements into the construction documents. 4. Develop and implement a commissioning plan. 5. Verify the installation and performance of the systems to be commissioned. 6. Complete a summary commissioning report. COMMISSIONED SYSTEMS Commissioning process activities must be completed for the following energy-related systems, at a minimum (if they are installed as part of the core and shell project): • Heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls. • Lighting and daylighting controls. • Domestic hot water systems.
Minimum Energy Performance	X		To establish the minimum level of energy efficiency for the proposed building and systems to reduce environmental and economic impacts associated with excessive energy use. WHOLE BUILDING ENERGY SIMULATION: EITHER PATH 1. Model National Energy Code For Buildings (MNECB) Demonstrate a 23% cost improvement in the proposed building performance rating for new buildings or a 19% cost improvement in the proposed building performance rating for major renovations to existing buildings, compared with the reference building performance rating. Calculate the reference building performance rating according to the Model National Energy Code for Buildings 1997 (MNECB) using a computer simulation model for the whole building project. To achieve this prerequisite, the proposed design must meet the following criteria: • Comply with the mandatory provisions of the MNECB 1997. • Inclusion of all the energy costs within and associated with the building project. • Compare against a baseline building that complies with the reference building requirements as defined in the MNECB 1997. OR PATH 2. ASHRAE 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings Demonstrate a 10% cost improvement in the proposed building performance rating for new buildings, or a 5% cost improvement in the proposed building performance rating for major renovations to existing buildings, compared with the baseline building performance rating. Calculate the baseline building performance rating according to the building performance rating method in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda[a]) using a computer simulation model for the whole building project.

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			Appendix G of Standard 90.1-2007 requires that the energy analysis done for the building performance rating method include all energy costs associated with the building project. To achieve this prerequisite, the proposed design must meet the following criteria: • Comply with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in Standard 90.1-2007 (with errata but without addenda); • Inclusion of all the energy costs within and associated with the building project. • Compare against a baseline building that complies with Appendix G of Standard 90.1-2007 (with errata but without addenda). Regardless of the path chosen (MNECB 1997 or ASHRAE 90.1-2007), the following requirements apply. • The whole building project simulation must follow the procedures defined in the referenced standard and the *LEED Canada Energy Modelling Rules*. • For the purposes of this analysis, process energy is considered to include, but is not limited to, office and general miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, lighting exempt from the lighting power allowance (e.g., lighting integral to medical equipment) and other (e.g., waterfall pumps). • Regulated (non-process) energy includes lighting (e.g., for the interior, parking garage, surface parking, façade, or building grounds, etc. except as noted above), heating, ventilation and air conditioning (HVAC) (e.g., for space heating, space cooling, fans, pumps, toilet exhaust, parking garage ventilation, kitchen hood exhaust, humidification, etc.), and service water heating for domestic or space heating purposes. • Process loads must be identical for both the baseline building performance rating and for the proposed building performance rating. However, project teams may follow the exceptional calculation method (ANSI/ASHRAE/IESNA 90.1-2007, G2.5) or the *LEED Canada Energy Modelling Rules* to document measures that reduce process loads. Documentation of process load energy savings must include a list of the assumptions made for both the base and proposed design, and theoretical or empirical information supporting these assumptions. Project teams wishing to use ASHRAE approved addenda for the purposes of this prerequisite may do so at their discretion. Addenda must be applied consistently. ALL OPTIONS must meet all the requirements below: Have an energy meter(s) that measures all energy use, for both building and site energy uses. Calibrate meter(s) following the manufacturer's recommendations if the building owner, management organization or tenant owns the meter. Meters owned by third parties (e.g., utilities or governments) are exempt.

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
Fundamental Refrigerant Management	X		To reduce stratospheric ozone depletion. Specify equipment without CFC-based refrigerants. Zero use of chlorofluorocarbon (CFC)-based refrigerants in new base building heating, ventilating, air conditioning and refrigeration (HVAC&R) systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion prior to project completion. Phase-out plans extending beyond the project completion date will be considered on their merits. For new buildings, specify new HVAC equipment. Projects using Existing District Chilled Water Plants: The CFC phase-out must be completed by 2015 and either comply with the requirements of the authority having jurisdiction or meet the following conditions, whichever is more stringent: • The replacement or upgrade to alternative refrigerants, as determined by a third party assessment, is not economically viable (e.g. simple payback of the replacement is greater than 10 years). • Operation complies with U.S. EPA Clean Air Act Title VI, Rule 608 governing refrigerant management and reporting. • A comprehensive preventative maintenance program is established to minimize CFC leaks to less than 1% annually and the leakage over the remainder of the unit life is maintained below 30%. • The CFC based chillers are used as the lag chillers and do not deliver more than 25% of the total cooling from the plant.
Optimize Energy Performance	X		To achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use. WHOLE BUILDING ENERGY SIMULATION EITHER PATH 1. - Model National Energy Code For Buildings (MNECB) Demonstrate a percentage cost improvement in the proposed building performance rating compared with the reference building performance rating. Calculate the reference building performance according to the Model National Energy Code for Buildings 1997 (MNECB) using a computer simulation model for the whole building project. The minimum energy cost savings of 25% for new and 21% for existing building is expected. The energy analysis done for the building performance rating method must include all the energy costs associated with the building project. To achieve points under this credit, the proposed design must meet the following criteria: • Compliance with the mandatory provisions of the MNECB 1997. • Inclusion of all the energy costs within and associated with the building project. • Comparison against a baseline building that complies with the reference building requirements as defined in the MNECB 1997.

Criteria	**Required**	**Desirable**	**Notes on Intent, Requirements and Strategies**
			OR PATH 2. - ASHRAE 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings Demonstrate a percentage cost improvement in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda[a]) using a computer simulation model for the whole building project. The minimum energy cost savings of 12% for new and 8% for existing building is expected. Appendix G of Standard 90.1-2007 requires that the energy analysis done for the building performance rating method include all the energy costs associated with the building project. To achieve points under this credit, the proposed design must meet the following criteria: • Compliance with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in Standard 90.1-2007 (with errata but without addenda); • Inclusion of all the energy costs within and associated with the building project. • Comparison against a baseline building that complies with Appendix G to Standard 90.1- 2007 (with errata but without addenda). Regardless of the path chosen (MNECB 1997 or ASHRAE 90.1-2007), the following requirements apply: • The whole building project simulation must follow the procedures defined in the referenced energy standard and the *LEED Canada Energy Modelling Rules.* • For the purpose of this analysis, process energy is considered to include, but is not limited to, office and general miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, lighting exempt from the lighting power allowance (e.g., lighting integral to medical equipment) and other (e.g., waterfall pumps). • Regulated (non-process) energy includes lighting (e.g., for the interior, parking garage, surface parking, façade, or building grounds, etc. except as noted above), heating, ventilating, and air conditioning (HVAC) (e.g., for space heating, space cooling, fans, pumps, toilet exhaust, parking garage ventilation, kitchen hood exhaust, humidification, etc.), and service water heating for domestic or space heating purposes. • For this requirement, process loads must be identical for both the baseline building performance rating and for the proposed building performance rating. However, project teams may follow the exceptional calculation method (ANSI/ASHRAE/IESNA 90.1-2007 G2.5) or the *LEED Canada Energy Modelling Rules* to document measures that reduce process loads. Documentation of process load energy savings must include a list of the assumptions made for both the base and proposed design, and theoretical or empirical information supporting these assumptions.
Enhanced Commissioning	**X**		To begin the commissioning process early during the design process and execute additional activities after systems performance verification is completed.

Criteria	**Required**	**Desirable**	**Notes on Intent, Requirements and Strategies**
			Implement, or have a contract in place to implement, the following additional commissioning process activities in addition to the requirements of Fundamental Commissioning of Building Energy System: 1. Prior to the start of the construction documents phase, designate an independent Commissioning Authority (CxA) to lead, review, and oversee the completion of all commissioning process activities. a. The CxA must have documented commissioning authority experience in at least 2 building projects. b. The individual serving as the CxA: i. Must be independent of the work of design and construction. ii. Must not be an employee of, or contracted through the design firm (engineering firm of record). iii. Must not be an employee of, or contracted through a contractor or construction manager holding construction contracts. iv. May be a qualified employee or consultant of the owner. c. The CxA must report results, findings and recommendations directly to the owner. 2. The CxA must conduct, at a minimum, 1 commissioning design review of the owner's project requirements basis of design, and design documents prior to mid-construction documents phase and back-check the review comments in the subsequent design submission. 3. The CxA must review contractor submittals applicable to systems being commissioned for compliance with the owner's project requirements and basis of design. This review must be concurrent with the review of the architect or engineer of record and submitted to the design team and the owner. 4. The CxA or other project team members must develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems. 5. The CxA or other project team members must verify that the requirements for training operating personnel and building occupants are completed. 6. The CxA must be involved in reviewing the operation of the building with operations and maintenance (O&M) staff and occupants within 10 months after substantial completion. A plan for resolving outstanding commissioning-related issues must be included.
Enhanced Refrigerant Management		**X**	To reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.
			OPTION 1 - Do not use refrigerants. OR OPTION 2 - Select refrigerants and heating, ventilating, air conditioning and refrigeration (HVAC&R) that minimize or eliminate the emission of compounds that contribute to ozone depletion and global climate change. The base building HVAC&R equipment must comply with the published LEED formula, which sets a maximum threshold for the combined contributions to ozone depletion and global warming potential. For multiple types of equipment, a weighted average of all base building level HVAC&R equipment must also be calculated using the published LEED formula. ALL OPTIONS - Small HVAC units (defined as containing less than 0.23 kg (0.5 lbs) of refrigerant), and other equipment such as standard refrigerators, small water coolers, and any other cooling equipment that contains less than 0.23 kg (0.5 lbs) of refrigerant, are not considered part of the "base building" system and are not subject to the requirements of this credit. Do not operate or install fire suppression systems that

Criteria	**Required**	**Desirable**	**Notes on Intent, Requirements and Strategies**
			contain ozone-depleting substances such as CFCs, hydrochlorofluorocarbons (HCFCs) or halons.
Measurement and Verification	**X**		To provide for the ongoing accountability of building energy consumption over time.
			OPTION 1 - Develop and implement a measurement & verification (M&V) Plan consistent with Option D: Calibrated Simulation (Savings Estimation Method 2) as specified in the International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003. The M&V period must cover at least 1 year of post-construction occupancy. Provide a process for corrective action to ensure energy savings are realized if the results of the M&V plan indicate that energy savings are not being achieved. OR OPTION 2 - Develop and implement a measurement and verification (M&V) plan consistent with Option B: Energy Conservation Measure Isolation, as specified by the International Performance Measurement & Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction, April 2003. The M&V period must cover at least 1 year of post-construction occupancy. Provide a process for corrective action if the results of the M&V plan indicate that energy savings are not being achieved.
Material and Resources			
Storage and Collection of Recyclables	**X**		To facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.
			Provide an easily-accessible dedicated area or areas for the collection and storage of materials for recycling for the entire building. Materials must include, at a minimum, paper, corrugated cardboard, glass, plastics, metals, and, if a municipal collection program is available, organic wastes (including landscaping waste).
Building Reuse			
Maintain Existing Walls, Floors and Roof		**X**	To extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.
			Maintain the existing building structure (including structural floor and roof decking) and envelope (the exterior skin and framing, excluding window assemblies and non-structural roofing material). Expectation is that 55% building structure is reused, as measured by surface area.
Maintain Interior Non-structural Elements		**X**	To extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.
			Use existing interior non-structural elements (e.g., interior walls, doors, floor coverings and ceiling systems) in at least 50% (by surface area) of the completed building, including additions.
Construction Waste Management	**X**		To divert construction and demolition debris from disposal in landfills and incineration facilities. Redirect recyclable recovered resources back to the manufacturing process and redirect reusable materials to appropriate sites.

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			Recycle and/or salvage non-hazardous construction and demolition debris. Excavated soil and land-clearing debris do not contribute to this credit. Calculations can be done by weight or volume, but must be consistent throughout. The minimum percentage debris to be recycled or salvaged is expected to be 50%.
Materials Reuse		X	To reuse building materials and products in order to reduce demand for virgin materials and reduce waste, thereby lessening impacts associated with the extraction and processing of virgin resources.
			Use salvaged, refurbished or reused materials, the sum of which constitutes at least 5% or 10%, based on cost, of the total value of materials on the project. Mechanical, electrical and plumbing components and specialty items such as elevators and equipment cannot be included in this calculation. Include only materials permanently installed in the project.
Recycled Content	X		To increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.
			Use materials with recycled content such that the sum of post-consumer recycled content plus 1/2 of the pre-consumer content constitutes at least 10% or 20%, based on cost, of the total value of the materials in the project. The recycled content value of a material assembly is determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value. Mechanical, electrical and plumbing components and specialty items such as elevators cannot be included in any calculation. Include only materials permanently installed in the project. Recycled content is defined in accordance with the International Organization of Standards document, ISO 14021—Environmental Labels and Declarations - Self-declared Environmental Claims (Type II environmental labeling).
Regional Material	X		To increase demand for building materials and products extracted, processed, and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation.
			Use building materials or products that have been extracted, harvested, recovered and processed within 800 km (500 miles) (2,400 km if shipped by rail or water) of the final manufacturing site. Demonstrate that the final manufacturing site is within 800 km (500 miles) (2,400 km if shipped by rail or water) of the project site for these products. If only a fraction of a product or material is extracted, harvested, recovered, processed and manufactured locally, then only that percentage (by weight) must contribute to the regional value. The 20% or 30% of regional materials is required. Mechanical, electrical and plumbing components and specialty items such as elevators and equipment must not be included in any calculation. Include only materials permanently installed in the project.
Rapidly Renewable Materials	X		To reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials.
			Use rapidly renewable building materials and products for 2.5% of the total value of all building materials and products used in the project, based on cost. Rapidly renewable building materials and products are made from plants that are typically harvested within a 10-year cycle or shorter.
Certified Wood	X		To encourage environmentally responsible forest management.

Criteria	**Required**	**Desirable**	**Notes on Intent, Requirements and Strategies**
			Use a minimum of 50% (based on cost) of wood-based materials and products that are certified in accordance with the Forest Stewardship Council's (FSC) Principles and Criteria, for wood building components. These components include at a minimum structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes. Include materials permanently installed in the project. Wood products purchased for temporary use on the project (e.g., formwork, bracing, scaffolding, sidewalk protection, and guard rails) may be included in the calculation at the project team's discretion. If any such materials are included, all such materials must be included in the calculation. If such materials are purchased for use on multiple projects, the applicant may include these materials for only one project, at its discretion.
Minimum Indoor Air Quality Performance	**X**		To establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.
			Meet the minimum requirements of Sections 4 through 7 of ASHRAE 62.1-2007, Ventilation for Acceptable Indoor Air Quality (with errata but without addenda[a]). AND CASE 1. MECHANICALLY VENTILATED SPACES Mechanical ventilation systems must be designed using the ventilation rate procedure or the applicable local code, whichever is more stringent. CASE 2. NATURALLY VENTILATED SPACES Naturally ventilated buildings must comply with ASHRAE 62.1-2007, paragraph 5.1 (with errata but without addenda).
Environmental Tobacco Smoke (ETS) Control	**X**		To prevent or minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke (ETS).
			Prohibit smoking in the building. Prohibit on-property smoking within 7.5 metres (25 feet) of entries, outdoor air intakes and operable windows. Provide signage to allow smoking in designated areas, prohibit smoking in designated areas or prohibit smoking on the entire property.
Outdoor Air Delivery Monitoring	**X**		To provide capacity for ventilation system monitoring to help promote occupant comfort and well-being.
			Install permanent monitoring systems to ensure that ventilation systems maintain design minimum requirements. Configure all monitoring equipment to generate an alarm when the airflow values or carbon dioxide (CO_2) levels vary by 10% or more from the design values via either a building automation system alarm to the building operator or a visual or audible alert to the building occupants. All outdoor airflow and/or CO_2 sensors must be calibrated as part of Fundamental Commissioning of Building Energy Systems and recalibration requirements must be included in the project O&M Manual. AND CASE 1. MECHANICALLY VENTILATED SPACES Monitor CO_2 concentrations within all densely occupied spaces (those with a design occupant density of 25 people or more per 93 square metres (1000 square feet)). CO_2 monitors must be between 0.9 and 1.8 metres (3 feet and 6 feet) above the floor.

Criteria	**Required**	**Desirable**	**Notes on Intent, Requirements and Strategies**
			Provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor air intake flow with an accuracy of plus or minus 15% of the design minimum outdoor air rate, as defined by ASHRAE 62.1-2007 (with errata but without addenda[a]) for mechanical ventilation systems where 20% or more of the design supply airflow serves non-densely occupied spaces. CASE 2. NATURALLY VENTILATED SPACES Monitor CO_2 concentrations within all naturally ventilated spaces. CO_2 monitors must be between 0.9 and 1.8 metres (3 feet and 6 feet) above the floor. One CO_2 sensor may be used to monitor multiple spaces if the natural ventilation design uses passive stack(s) or other means to induce airflow through those spaces equally and simultaneously without intervention by building occupants. CO_2 monitoring is required in densely occupied spaces.
Increased Ventilation	**X**		To provide additional outdoor air ventilation to improve indoor air quality (IAQ) and promote occupant comfort, well-being and productivity.
			CASE 1. - MECHANICALLY VENTILATED SPACES Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2007- Ventilation for Acceptable Indoor Air Quality (with errata but without addenda[a]) as determined by IEQ Prerequisite 1: Minimum Indoor Air Quality Performance. CASE 2. - NATURALLY VENTILATED SPACES Determine that natural ventilation is an effective strategy for the project by following the flow diagram process shown in Figure 2.8 of the Chartered Institution of Building Services Engineers (CIBSE) Applications Manual 10: 2005, Natural Ventilation in Non-domestic Buildings. AND OPTION 1 - Show that the natural ventilation systems design meets the recommendations set forth in the CIBSE manuals appropriate to the project space. PATH 1. CIBSE Applications Manual 10: 2005, Natural ventilation in Non-domestic Buildings. PATH 2. CIBSE AM 13:2000, Mixed Mode Ventilation. OR OPTION 2 - Use a macroscopic, multi-zone, analytic model to predict that room-by-room airflows will effectively naturally ventilate, defined as providing the minimum ventilation rates required by ASHRAE 62.1-2007 Chapter 6 (with errata but without addenda), for at least 90% of occupied spaces
Construction IAQ Management Plan			
During Construction	**X**		To reduce indoor air quality (IAQ) problems resulting from construction or renovation and promote the comfort and well-being of construction workers and building occupants.
			Develop and implement an IAQ Management Plan for the construction and pre-occupancy phases of the building as follows: • During construction, meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines For Occupied Buildings Under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3). • Protect stored on-site and installed absorptive materials from moisture damage.

Criteria	**Required**	**Desirable**	**Notes on Intent, Requirements and Strategies**
			• If permanently installed air handlers are used during construction, filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE 52.2-1999 (with errata but without addenda[a]). Replace all filtration media immediately prior to occupancy.
Before Occupancy	**X**		To reduce indoor air quality (IAQ) problems resulting from the construction or renovation to promote the comfort and well-being of construction workers and building occupants.
			Develop an IAQ management plan and implement it after all finishes have been installed and the building has been completely cleaned before occupancy: OPTION 1. - FLUSH-OUT PATH 1 - After construction ends, prior to occupancy and with all interior finishes installed, install new filtration media and perform a building flush-out by supplying a total air volume of 4,300 cubic metres of outdoor air per square metre (14,000 cubic feet of outdoor air per square foot) of floor area while maintaining an internal temperature of at least 16ºC (60ºF) and relative humidity no higher than 60%. OR PATH 2 - If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 1,075 cubic metres of outdoor area per square metre (3,500 cubic feet of outdoor air per square foot) of floor area. Once a space is occupied, it must be ventilated at a minimum rate of 1.54 L/s/m² (0.30 cfm/ft²) of outdoor air or the design minimum outdoor air rate determined in IEQ Prerequisite 1: Minimum Indoor Air Quality Performance, whichever is greater. During each day of the flush-out period, ventilation must begin a minimum of 3 hours prior to occupancy and continue during occupancy. These conditions must be maintained until a total of 4,300 cubic metres per square metre (14,000 cubic feet per square foot) of outdoor air has been delivered to the space. All finishes must be installed prior to flush out. OR OPTION 2. - AIR TESTING Conduct baseline IAQ testing, after construction ends and prior to occupancy, using testing protocols consistent with the United States Environmental Protection Agency Compendium of Methods for the Determination of Air Pollutants in Indoor Air and as additionally detailed in the *LEED Canada Reference Guide for Green Building Design and Construction*. For each sampling point where the maximum concentration limits are exceeded, conduct an additional flush-out with outdoor air and retest the noncompliant concentrations. Repeat until all requirements are met. When retesting noncompliant building areas, take samples from the same locations as in the first test, although it is not required. Conduct the air sample testing as follows: a. All measurements must be conducted prior to occupancy, but during normal occupied hours with the building ventilation system started at the normal daily start time and operated at the minimum outdoor air flow rate for the occupied mode throughout the test. b. All interior finishes must be installed, including but not limited to millwork, doors, paint, carpet and acoustic tiles. Movable furnishings such as workstations and partitions should be in place for the testing, although it is not required. c. The number of sampling locations will depend on the size of the building and number of ventilation

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			systems. For each portion of the building served by a separate ventilation system, the number of sampling points must not be less than 1 per 2,300 square metres (25,000 square feet) or for each contiguous floor area, whichever is larger. Include areas with the least ventilation and greatest presumed source strength. d. Air samples shall be collected between 0.9 and 1.8 metres (3 and 6 feet) from the floor to represent the breathing zone of occupants, and over a minimum 4-hour period.
Low Emitting Materials			
Adhesive and Sealants	**X**		To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.
			All adhesives and sealants used on the interior of the building (i.e., inboard side of the weatherproofing system and applied on-site) must comply with the requirements of LEED 2009 Guide as applicable to the project scope. • Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management District (SCAQMD) Rule #1168. Volatile organic compounds (VOC) limits are listed in the LEED 2009 Guide and correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005. • Aerosol Adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.
Paints and Coatings	**X**		To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.
			Paints and coatings used on the interior of the building (i.e., inboard side of the weatherproofing system and applied on-site) must comply with the following criteria as applicable to the project scope: • Architectural paints and coatings applied to interior walls and ceilings must not exceed the volatile organic compound (VOC) content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993. • Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997. • Clear wood finishes, floor coatings, stains, primers, and shellacs applied to interior elements must not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.
Flooring Systems	**X**		To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.
			OPTION 1 All flooring must comply with the following as applicable to the project scope (a small amount of non-compliant flooring may be used for specialty areas provided it does not exceed 5% of floor area): • All carpet installed in the building interior shall meet the testing and product requirements of the Carpet and Rug Institute's Green Label Plus program. • All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program. • All carpet adhesive must meet the requirements of Adhesives and Sealants includes a volatile organic

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			compound (VOC) limit of 50 g/L. • All hard surface flooring covered by the FloorScore standard must be certified as compliant with the standard (current as of the date of this rating system, or more stringent version) by an independent third-party. Flooring products covered by FloorScore include vinyl, linoleum, laminate flooring, engineered wood flooring, ceramic flooring, rubber flooring and wall base. • All components of hard surface flooring systems (regardless of FloorScore requirement), including but not limited to, adhesives, sealants, and backing, must meet the requirements of Adhesives and Sealants. • Concrete, wood, bamboo, and cork floor finishes such as sealers, stains, and finishes, must meet the requirements of South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004. VOC limits are listed below. • Clear wood finishes: varnish 350 g/L; lacquer 550 g/L • Floor coatings: 100 g/L • Sealers: waterproofing sealers 250 g/L; sanding sealers 350 g/L; all other sealers 200 g/L • Shellacs: Clear 730 g/L; pigmented 550 g/L • Stains: 250 g/L • Tile setting adhesives and grout must meet South Coast Air Quality Management District (SCAQMD) Rule 1168. VOC limits are listed below and correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005. • Ceramic tile adhesive: 65 g/L • Grout and mortar: 250 g/L OR OPTION 2 All flooring products installed in the building interior must meet the testing and product requirements of the California Department of Public Health Standard Practice for The Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda. A small amount of non-compliant flooring may be used for specialty areas provided it does not exceed 5% of floor area.
Composite Wood and Agrifiber Products	**X**		To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.
			Composite wood and agrifibre products used on the interior of the building (i.e., inboard side of the weatherproofing system and applied on-site) shall contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifibre assemblies must not contain added urea-formaldehyde resins. Composite wood and agrifibre products are defined as particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates and door cores. Materials considered fixtures, furniture, and equipment (FF&E) are not considered base building elements and are not included.
Indoor Chemical and Pollutant Source Control	**X**		To minimize building occupant exposure to potentially hazardous particulates and chemical pollutants.
			Design to minimize and control the entry of pollutants into buildings and later cross-contamination of regularly occupied areas through the following strategies:

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			• Employ permanent entryway systems at least 3 metres (10 feet) long in the primary direction of travel to capture dirt and particulates entering the building at regularly used entrances that are directly connected to the outdoors or other contaminant generating spaces. Permanently installed grates, grilles, or slotted systems that allow for cleaning underneath must comprise at least 1 metre (3 feet) of the 3 metre (10 feet) requirement. Walk-off/Roll-out mats are acceptable for the remainder of the length only when maintained on a weekly basis by a contracted service. Entrances from adjacent areas where outdoor dirt is reduced, such as from covered parking structures, need not have permanently installed grates, grilles, or slotted systems if they are equipped with portable walk-off mats that total at least 3 metres (10 feet) long, with a weekly cleaning and maintenance program in place. Core and Shell projects that do not have entryway systems cannot achieve this credit. • Sufficiently exhaust each space where hazardous gases or chemicals may be present or used (e.g., garages, housekeeping and laundry areas, science laboratories, prep rooms, art rooms, shops of any kind, and copying and printing rooms) to create negative pressure with respect to adjacent spaces when the doors to the room are closed. For each of these spaces, provide self-closing doors and deck-to-deck partitions or a hard-lid ceiling. The exhaust rate must be at least 2.5 L/s/m² (0.50 cfm/ft²), with no air recirculation. The pressure differential with the surrounding spaces must be at least 5 Pascals (Pa) (0.02 inches of water gauge) on average and 1 Pa (0.004 inches of water) at a minimum when the doors to the rooms are closed. • Provide containment (i.e., a closed container for storage for off-site disposal in a regulatory compliant storage area, preferably outside the building) for appropriate disposal of hazardous liquid wastes in places where water and chemical concentrate mixing occurs (e.g., housekeeping, janitorial and science laboratories). • In mechanically ventilated buildings, install new air filtration media in regularly occupied areas prior to occupancy for all air handling equipment with a maximum flow rate of more than 283 L/s (600 cfm); these filters must provide a minimum efficiency reporting value (MERV) 13 or higher. Air handlers with a maximum supply volume of 283 L/s (600 cfm) or less are exempt from the filtration requirements provided they are equipped with the highest supply air filtration level commercially available for the specific equipment. Filtration should be applied to process both return and outside air that is to be delivered as supply air.
Controllability of Systems			
Lighting		**X**	To provide a high level of lighting system control by individual occupants or groups in multi-occupant spaces (e.g., classrooms and conference areas) and promote their productivity, comfort and well-being. Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences. Provide lighting system controls for all shared multi-occupant spaces that complies with ASHRAE/ IESNA Standard 90.1-2007 section 9.4.1.2 (Lighting) (with errata but without addenda[a]), to enable adjustments that meet group needs and preferences.
Thermal Comfort		**X**	To provide a high level of thermal comfort system control by individual occupants or groups in multi-occupant spaces (e.g., classrooms or conference areas) to promote their productivity, comfort and well-being.

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			Provide individual comfort controls for 50% (minimum) of the building occupants to enable adjustments to meet individual needs and preferences. Operable windows may be used in lieu of controls for occupants located 6 metres (20 feet) inside and 3 metres (10 feet) to either side of the operable part of the window. The areas of operable window must meet the requirements of ASHRAE Standard 62.1-2007-Ventilation for Acceptable Indoor Air Quality, paragraph 5.1 Natural Ventilation (with errata but without addenda[a]). Provide comfort system controls for all shared multi-occupant spaces to enable adjustments that meet group needs and preferences. Conditions for thermal comfort are described in ASHRAE Standard 55-2004-Thermal Environmental Conditions for Human Occupancy (with errata but without addenda) to include the primary factors of air temperature, radiant temperature, air speed and humidity.
Thermal Comfort			
Design	**X**		To provide a comfortable thermal environment that promotes occupant productivity and well-being.
			Design heating, ventilation and air conditioning (HVAC) systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy (with errata but without addenda[a]).
Verification	**X**		To provide for the assessment of building occupants' thermal comfort over time.
			Thermal Comfort – Design. Agree to conduct a thermal comfort survey of building occupants within 6 to 18 months after occupancy. This survey should collect anonymous responses about thermal comfort in the building, including an assessment of overall satisfaction with thermal performance and identification of thermal comfort problems. Agree to develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building. This plan should include measurement of relevant environmental variables in problem areas in accordance with ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy, (with errata but without addenda[a]). Provide a permanent monitoring system to verify that building performance meets the desired comfort criteria as determined.
Daylight and Views			
Daylight		**X**	To provide for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.
			Achieve daylighting in at least 75% of the regularly occupied spaces. OPTION 1. - SIMULATION Demonstrate through computer simulations that 75% or more of all regularly occupied spaces achieve daylight illuminance levels of a minimum of 250 Lux (25 footcandles) and a maximum of 5,000 Lux (500 footcandles) in a clear sky condition on March 21 or September 21 at 9.00 am and 3.00 pm; areas with illuminance levels below or above the range do not comply. However, designs that incorporate view-preserving automated shades for glare control may demonstrate compliance for only the minimum 250 Lux (25 footcandles) illuminance level. OR

Criteria	**Required**	**Desirable**	**Notes on Intent, Requirements and Strategies**
			OPTION 2. - PRESCRIPTIVE For the Side-lighting daylight zone : • Achieve a value, calculated as the product of the visible light transmittance (VLT) and window-to-floor area ratio (WFR) of daylight zone between 0.150 and 0.180. The window area included in the calculation must be at least 0.76 metres (30 inches) above the floor. • The ceiling must not obstruct a line in section that joins the window-head to a line on the floor that is parallel to the plane of the window; is twice the height of the window-head above the floor in, distance from the plane of the glass as measured perpendicular to the plane of the glass. • Provide sunlight redirection and/or glare control devices to ensure daylight effectiveness. For Top-lighting Daylight Zone : • The daylit zone under a skylight is the outline of the opening beneath the skylight, plus in each direction the lesser of: a. 70% of the ceiling height, OR b. 1/2 of the distance to the edge of the nearest skylight, OR c. The distance to any permanent opaque partition (if transparent show VLT) that is farther than 70% of the distance between the top of the partition and the ceiling. • Achieve a skylight roof coverage that is between 3% and 6% of the roof area with a minimum 0.5 visible light transmittance (VLT). • The distance between the skylights must not be more than 1.4 times the ceiling height. • Skylight diffuser, if used, must have a measured haze value of greater than 90% when tested according to ASTM D1003. Avoid direct line of sight to the skylight diffuser. Exceptions for areas where tasks would be hindered by the use of daylight will be considered on their merits. OR OPTION 3. - MEASUREMENT Demonstrate, through records of indoor light measurements, that a minimum daylight illumination level of 250 Lux (25 footcandles) has been achieved in at least 75% of all regularly occupied areas. Measurements must be taken on a 3 metre (10-foot) grid for all occupied spaces and must be recorded on building floor plans. Only the floor area associated with the portions of rooms or spaces meeting the minimum illumination requirements may be counted in the calculations. For all projects pursuing this option, provide daylight redirection and/or glare control devices to avoid high-contrast situations that could impede visual tasks. Exceptions for areas where tasks would be hindered by daylight will be considered on their merits. OR OPTION 4. - COMBINATION Any of the above calculation methods may be combined to document the minimum daylight illumination in at least 75% of all regularly occupied spaces. The different methods used in each space must be clearly recorded

Criteria	**Required**	**Desirable**	**Notes on Intent, Requirements and Strategies**
			on all building plans. In all cases, only the floor area associated with the portions of rooms or spaces meeting the requirements can be applied toward the total area calculation required to qualify for this credit. In all cases, provide glare control devices to avoid high-contrast situations that could impede visual tasks. Exceptions for areas where tasks would be hindered by the use of daylight will be considered on their merits.
Views		**X**	To provide building occupants a connection to the outdoors through the introduction of daylight and views into the regularly occupied areas of the building. Achieve direct line of sight to the outdoor environment via vision glazing between 0.76 metres and 2.3 metres (30 inches and 90 inches) above the finished floor for building occupants in 90% of all regularly occupied areas. Determine the area with direct line of sight by totalling the regularly occupied floor area that meets the following criteria: • In plan view, the area is within sight lines drawn from perimeter vision glazing. • In section view, a direct sight line can be drawn from the area to perimeter vision glazing. Line of sight may be drawn through interior glazing. For private offices, the entire floor area of the office can be counted if 75% or more of the area has direct line of sight to perimeter vision glazing. For classrooms and other multi-occupant spaces, the actual floor area with direct line of sight to perimeter vision glazing is counted.
Innovative Design			
LEED Accredited Professional	**X**		To support and encourage the design integration expected by these requirements. At least 1 principal participant of the project team must be a LEED Accredited Professional (AP).
Regional			
Durable Building		**X**	To minimize materials use and construction waste over a building's life resulting from inappropriate material selection or premature failure of the building and its constituent components and assemblies. Develop and implement a Building Durability Plan, in accordance with the principles in CSA S478- 95 (R2007) – Guideline on Durability in Buildings, for the components within the scope of the Guideline, for the construction and preoccupancy phases of the building as follows: • Design and construct the building with the intent that the predicted service life equals or exceeds the design service life (DSL) established in Table 2 in CSA S478-95 (R2007) – Guideline on Durability in Buildings. • Provide the owner's expectation of design service life. • Where component and assembly design service lives are shorter than the design service life of the building, design and construct those components and assemblies so that they can be readily replaced, and use a design service life in accordance with Table 3 in CSA S478-95 (R2007) – Guideline on Durability in Buildings, as follows: • For components and assemblies whose Categories of Failure are 6, 7 or 8 in Table 3, use a design service life equal to the design service life of the building. • For components and assemblies whose Categories of Failure are 4 or 5 in Table 3, use a design service life equal to at least half of the design service life of the building. • Demonstrate the predicted service life of chosen components or assemblies by documenting demonstrated

Criteria	Required	Desirable	Notes on Intent, Requirements and Strategies
			effectiveness, modeling of the deterioration process or by testing in accordance with Clauses 7.3, 7.4 or 7.5. • Complete Tables A1, A2 and A3 from CSA S478-95 (R2007) – Guideline on Durability in Buildings. • Develop and document the quality management program in accordance with CSA S478-95 (R2007) – Guideline on Durability in Buildings. • Document the elements of quality assurance activities (including design and field reviews) carried out in the format contained in Table 1, Quality Assurance and the Building Process, of CSA S478-95 (R2007) – Guideline on Durability in Buildings. • Utilize a qualified building science professional to develop and deliver the Building Durability Plan who: • Is employed by a firm with an Engineering Certificate of Authorization or an Architectural Certificate of Practice. • Has experience in performing building science reviews focused on the envelope durability for at least two prior buildings. • Can demonstrate one of the following: • Has successfully completed at least 35 hours of instruction in building science courses that address envelope durability within the last 10 years. OR • Has a certificate demonstrating building envelope expertise from a building warranty program (e.g., TARION). OR • Is independent of the architectural firm of record.

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSA-01

ARCHITECTURAL, SPACE PLANNING AND FINISHES

Version	Revision 1
Effective Date	06-02-2021

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1 INTRODUCTION

1.1 General

.1 This Architectural Space Planning and Finishes Design Standard has been developed to establish the University's minimum expectations and requirements for Renovations and new Construction on campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of Site Layout & Landscaping, Building External Elevations, Space Planning, Materials and Finishes, Building Performance, Accessibility and Sustainability.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new installation within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing building architectural elements.

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Architectural Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The Designer remains responsible for ensuring any proposed design solutions are in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Architectural Design, DEC, together with proposed measures for addressing the conflict before completing the Schematic Design.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovation shall be tabled for consideration by the Manager, Architectural Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

.1 Ontario Building Code
.2 Accessibility for Ontarians with Disabilities Act (AODA)
.3 University's Campus Master Plan
.4 University's Landscaping Standard
.5 University's Hardware Standard
.6 University's Signage Standard
.7 University's Classroom Standard
.8 University's Laboratory Standard
.9 University's Vivarium Standard
.10 HVAC Systems Design Standard DSM-01
.11 Plumbing Systems Design Standard DSM-02
.12 Electrical Lighting Standard DSE-02
.13 University's Painting Standard
.14 University's Physical Security Standard
.15 University's Elevator Standard

.16 University's Roofing Standard
.17 University's Office Space Allocation Guidelines
.18 Handbook of the Canadian Roofing Contractors Association
.19 Accessible design for the built environment B651-04

2 DESIGN STANDARDS

2.1 General

2.1.1 The requirements outlined in the following clauses is applicable to all new Construction; Application Specific requirements are outlined under clauses 2.2 – 2.8.

2.1.2 Overarching Design Principles
- .1 Building Design shall support the intended Functional Program
- .2 Building Design shall present an individual identity to the structure while fulfilling the following objectives:
  - .1 Draw inspiration from the original buildings on campus.
  - .2 Make evident the activities occurring within the building while supporting the wider structural patterns of the campus.
  - .3 Embody principles of Crime Prevention through Environmental Design (CPTED)
  - .4 All new construction shall be constructed to be Accessible by following the AODA, OBC Part 3, Section 3.8, CSA Standard B651-04 – Accessible Design for the Built Environment and Facility Accessibility Design Manual – Wellington County Accessibility Partnership at minimum to the extent mandated and where possible to the ideal extent where practical and/or feasible.
  - .5 Where scope of work involves a building with heritage character, attention to how project scope restores and/or aligns with the original character of building is required. All buildings on Couling list, built prior to 1927, designated buildings and those within 30m of a designated building or the Heritage Conservation District (HCD)will require review with Heritage Guelph for all major exterior interventions. Scope of work, need for Heritage Consultant and Heritage impact assessment must be reviewed with Manager Architectural. Any scope of work that needs to go to Heritage Guelph must be brought there through Manager Architectural.
  - .6 Designated Buildings on Campus currently are; Presidents Residence, Alumni House and Massey Hall, HCD is currently properties on either side of Gordon from Speed river to University.

2.1.3 Materials selected shall be North American manufactured and readily available to the extent possible. Use of any materials not readily available in North America shall be identified and presented for the approval of the Manager, Architectural Design, DEC before completion of the Schematic Design.

2.1.4 Furniture must be part of the planning process during schematic design.

2.1.5 The University will not accept any asbestos materials or products that contain asbestos.

2.1.6 Group the placement of the following building accessories in and around one principal building entrance:
- .1 Fire alarm system panel
- .2 Fire department connection, ie. standpipe or sprinkler connection point
- .3 Placement of exterior hydrants

2.2 Building Siting and Footprint

2.2.1 New Buildings shall be sited in general accordance with the University's Campus Master Plan.

2.2.2 Overall footprint and Gross Floor Area shall be in general accordance with the University's Campus Master Plan, validated through Functional Planning and Programming at the onset of a project.

2.2.3 Site Plan Approval shall be obtained if the project site borders one or more main city streets (Gordon Street, College Ave., Stone Road are prime examples).

2.2.1 Radon

.1 University Standard Specification section 02 56 20 Radon Mitigation shall be used for all new building and building additions - as required by Code

.2 LEX Scientific is the University's preferred radon consultant for all projects. For any new project that includes an addition or a new build, the Design Team will be expected to include LEX Scientific as a part of the Design Team.

2.3 Landscaping and Site Appurtenances

2.3.1 Landscaping and Planting shall be in general accordance with the University's Landscaping Standard.

- .1 Proposed approaches to Landscaping shall be submitted to the Landscape Advisory Committee (LAC) for review at the Schematic Design Stage.
- .2 Conceptual Landscaping Plans shall be submitted to the LAC for review as a part of the Design Development process.

2.3.2 General Landscape Design Criteria are as follows:

- .1 Retain as many trees on site as feasible and incorporate University's tree protection guidelines when trees are in construction zone.
- .2 Any trees removed will be replaced with a 2:1 ratio.
- .3 Grade topsoil to drain surface water away from buildings and walkways.
- .4 Design with consideration to maintenance requirements.
- .5 Provide enough distance between trees and other features to accommodate cost effective mowing equipment.
- .6 Avoid sharp angles, tight spaces and slopes greater than 3:1 that would make lawn maintenance difficult and unsafe.
- .7 Use indigenous plant species to the extent feasible and practical.
- .8 Use of permanently installed sprinkler systems are not permitted within Planting Beds.

2.4 Site Furniture and Appurtenances

2.4.1 Railings

- .1 Constructed from Hot Dipped Galvanized Steel, except as noted below:
  - .1 Plain Galvanized Steel Railings are permitted in "back of house" areas such as Service Alleys, Loading Docks, etc.
  - .2 Stainless Steel, Aluminum Alloy or Powder Coated Galvanized Railings are permitted at and in the vicinity of the Main Entrance or where required to compliment the Landscaping Plan.
    - Galvanized railings to be powder coated must be etched (sandblasted or acid) and primed with a Sherwin Williams 'Pro-Grill' primer or approved equivalent. Weathered galvanizing may consider use of a phosphoric acid to etch.
- .2 All Fasteners shall be stainless steel.
- .3 Mounted to the substrate utilizing a 4-hole Plate mount with 2 diagonally placed fasteners

2.4.2 Bollards

- .1 Bollards, where provided shall be of the "Fixed Type" except as noted below:

.1 Removable bollards shall be provided at Public Entrances where there is a perceived need that the entrance may have to serve a dual function of means of access for materials and equipment.
.2 Removable bollards may be provided in Loading Areas with restricted access.
.3 Removable bollards should be installed to allow removal without the need to unbolt the mounting plate anchored to the foundation.
.4 Bollards are to have appropriate base, asphalted in bollards are not permitted.

.2 Bollards should be spaced to allow easy passage for the Utility Carts used by Campus Operation and Maintenance Staff
.3 Constructed from Hot Dipped Galvanized Steel, except as noted below:
.1 Epoxy Coated Galvanized Steel Bollards are permitted in “back of house” areas such as Service Alleys, Loading Docks, etc.
.2 Stainless Steel, Aluminum Alloy or Powder Coated Galvanized Bollards are permitted at and in the vicinity of the Main Entrance or where required to compliment the Landscaping Plan.
- Galvanized bollards to be powder coated must be etched (sandblasted or acid) and primed with a Sherwin Williams ‘Pro-Grill’ primer or approved equivalent. Weathered galvanizing may consider use of a phosphoric acid to etch.

.4 All fasteners shall be stainless steel.
.5 All bollards in loading areas or areas subject to regular vehicular traffic shall be clearly marked or otherwise identified as a visual aid. Marking shall be coordinated with the landscape design.
.6 Standard of Acceptance: ‘Sureguard’ (Bollard Guard Products Corporation) or Equivalent.

2.4.3 Site Furniture

.1 Site Furniture shall be in general accordance with the University’s Landscaping Standard.
.2 Standard Benches across campus will be custom designed Accoya wood and steel bench procured through DEC, Architectural or in approved locations
.1 Eva bench (wood and steel) - http://www.victorstanley.com/product/eva/

2.4.4 Signage

.1 Signage shall be in general accordance with the University’s Signage Standard.
.2 All Fasteners shall be stainless steel

2.4.5 Site Lighting

.1 Site Lighting shall be designed to complement the Landscaping Plan.
.1 Arrange Light Fixtures to minimize Light Pollution
.2 Light Fixtures shall be in general accordance with the Electrical Lighting Standard DSE-02

2.5 Building Exterior & Massing

2.5.1 Building shall be typically four storeys in height to maintain the low to mid-rise character of the campus.

2.5.2 The following minimum architectural design features and elements shall be incorporated into every building, at least on one elevation:

.1 Obvious Defined Entries
.1 With clear connection to campus circulation patterns
.2 Scaled proportional to the human scale

.2 Masonry Elements
.1 Stone, Brick and Terra Cotta, singly or in combination

2.6 Building Envelope – Exterior Assemblies

2.6.1 General

.1 To be specified with low maintenance and longevity as priorities with a guaranteed minimum lifespan of 30 years.

.2 Minimum averaged R-Value of R15 over the entire wall assembly including joints and glazing. Documentation demonstrating compliance shall be submitted for review by the Manager, Architectural Design, before completion of the Schematic Design Phase

.2 Composed of Concrete, Stone, Brick, Curtain Wall Assemblies and Glazing Assemblies, singly or in combination.

.3 Use of Exterior Insulation Finishing Systems (EIFS) and uncoated concrete masonry systems is not permitted.

.4 Use of Stucco should be limited; areas proposed for stucco are subject to the approval of the Manager, Architectural Design and shall be identified before completion of the Schematic Design Phase.

.5 Use extra durable and vandal resistant finishes at grade.

.6 Use Concrete or Stone for all envelope elements to a minimum height of 1.5m above the water tables or 1.5m above grade whichever is greater.

2.6.2 Rain Screen Systems

.1 Incorporate to the extent feasible and practical, a Rain-Screen System as outlined in the whitepaper co-authored by the Ontario Association of Architects and CMHC.

- .1 Air Barrier should be incorporated in to building envelope to meet the characteristics of an air barrier system as discussed in Construction Specifications Canada's TEK-AID AIR BARRIERS - DIGEST. Locate the plane of the sealing element (usually a membrane) exterior to the major structural elements. The air barrier typically consists of a number of materials acting together as a system. Minimize the number of materials used to form this system plastic film or spun-woven fibre film; are not to be used as an air sealing element. Minimize changes of plane in the air barrier system. Where practicable, avoid changes of plane at air barrier membrane connection to window frames.
- .2 Air barrier detail continuity and constructability must be given particular attention at:
  - window and door frames
  - mechanical and electrical penetrations
  - wall/roof connections
  - changes in plane
  - joints between like and dissimilar materials
- .3 Provide large scale details to show how air barrier continuity will be achieved and how differential movements and construction sequences will be accommodated. Insulation must be secured mechanically and in direct contact with the air barrier system.

.2 Except as noted otherwise, insulate walls to a minimum value of R12, roofs and soffits to R14 and foundation perimeters to R10.

.3 Minimize thermal bridging, and design to prevent condensation on interior surfaces due to thermal bridging. Use structural neoprene thermal breaks for minor projecting steel elements and use insulated double Z-bars or thermal clips to support cladding and metal roofing.

2.6.3 Brick and Stone

.1 All Brick & Stone color to match adjacent building / context.

.2 Brick, stone and mortar selections and color to be reviewed and approved by Manager, Architectural Design, before finalizing the Schematic Design.

.3 Use of site mixed mortar colours is not permitted.

.4 Brick and Stone shall have sample panels constructed as a part of the construction process for approval of workmanship and materials.

2.7 Building Envelope – Windows, Curtainwall and Glazing

2.7.1 General Requirements

.1 Shall be limited to a maximum of 25% of a building facade.
.2 Minimum averaged R-Value of R3 and a Shading Coefficient SCx 0.50 or lower.
.3 Horizontal skylights are not permitted; however, clearstories are acceptable.
.4 Safety glazing materials shall be used in locations prone to accidental damage such as entrance & exit doors and adjacent to unprotected fixed glass panels.
.5 Glazing to be minimized at grade level.
.6 Tinted colours of glazing should be avoided. If to be considered then provide specifications for inventory and approval from the Manager, Architectural Design.
.7 All replacement windows and glazing elements to match existing. Select windows or glazing assemblies with a High 'I Factor' in the case of older building where high resistance to condensation is required (typically due to in adequate air circulation).
.8 All new windows and glazing systems to be from a standard manufacturing range.
.9 Designed with factory finished aluminum frames with Thermal Break Construction. Documented Test Results demonstrating R-Values of the assembly shall be submitted for review by the Manager, Architectural Design as a part of the Schematic Design Phase.
.10 Double glazed, triple glazed or thermo-pane with a minimum R-Value of R-3 for the assembly. Submit test data for review by the Manager, Architectural Design as a part of the Schematic Design Phase.
.11 Energy conservation must be incorporated into fenestration design; examples include short canopies on South and West exposures and low emissivity.
.12 Safety glazing systems shall be provided where demanded by the application.
.13 All operable hardware, hinges, handles, pulls, etc. shall be heavy duty.
.14 Sealants shall be permanently elastic, non-shrinking, and non-migrating.
.15 Multi-lite windows are not permitted except with prior approval by the Manager, Architectural Design as a part of the Schematic Design Phase.
.16 Use of operable windows is not recommended except in the case of student residences. Where desired, the use of operable windows shall be identified at the Schematic Design Phase and presented for the approval of the Manager, Architectural Design.
.17 Frames mechanically fastened into structure.
.18 Fritting and/or Graphics to be incorporated on large expanses of glass to ensure a bird safe design. Submit design intent for review to the Manager, Architectural Design as a part of the Schematic Design Phase.

2.7.2 Special Requirements – Student Residences

.1 Use stainless steel vandal resistant fasteners
.2 Security screens shall be used for exterior windows reachable from exterior grade level. Screens should be stainless steel or aluminum finish.

2.8 Building Envelope – Roof Assemblies

2.8.1 General Requirements

.1 Roof Assemblies shall be in general accordance with the University's Roofing Standard.
.2 Roof Assemblies shall be of the "Three Ply Cold Applied Built-up Roofing System" type; Hot Kettle or Torch Applied systems are not permitted.
    .1 Standard of Acceptance: Tremco
.3 Warranty and Maintenance Regimes
    .1 Installer's Extended Warranty: for a period of 2 years following the date of Substantial Completion

.2 Manufacturer's Extended Warranty: a full replacement for all elements of the roofing system down to the roof deck for a period of 20 years following the date of Substantial Completion.
.3 Inspection & Maintenance Services: manufacturer's inspection and maintenance services in years 2, 5, 10 & 15 of the Manufacturer's Extended Warranty period.

.4 Use of Green Roofs is subject to the approval of the Manager, Architectural Design and Director, DEC. Intent to use Green Roofs shall be identified and presented for consideration at the Schematic Design Phase. Where Green Roofs are proposed and accepted, the following elements shall be incorporated into the design:
.1 Measures for Leak Detection
.2 Measures for Irrigation

.5 Renovations
.1 Match existing base building standards
.2 Where significant roof penetrations are anticipated, explore the opportunity to upgrade the roofing system to comply with the requirements of the Roofing Standard.

2.9 Building Interior – General Requirements

2.9.1 General

.1 All new buildings should be designed to encompass the overarching objectives listed below:
.1 Functionality: Support the efficient execution of tasks assigned to each functional unit.
.2 Collaboration: Facilitate an efficient and effective collaboration amongst units through the spatial relationships of facilities, provision of common areas to encourage both formal and informal interaction, and having a high degree of internal visibility to enhance awareness of activities within the building. Avoid adjacencies that are problematic, eg. mechanical rooms or washrooms directly over server rooms.
.3 Safety and Security: The security and safety of building occupants, the continuity of essential operations, and the protection of assets.
.4 Durability: Designed to withstand 24 hour uses; materials and components must be selected with a mind to durability, ease of maintenance, reliability and longevity.
.5 Flexibility: The building must be capable of accommodating on-going changes within the overarching framework of the original functional program.
.6 Acoustics: consider noise sensitive spaces locations within overall plan and avoid high noise program adjacencies.

.2 Internal Circulation:
.1 Interior pedestrian routes should be linked and intuitive, with occasional views to allow orientation.

.3 Interior Finishes:
.1 In renovations finishes should use and/or be in keeping with established building standards. Where none exist then design of major renovations should look to establish appropriate standards.

.4 On any new construction / renovation, include occupancy signs for areas intended for more than 60 people.

2.9.2 Floor Systems

.1 Preferred construction is poured in place concrete. Where fire rating versus depth of slab, vibration and/or sound transmission considerations, or timelines and/or budget prohibits this type of construction then hollow core pre-stressed slab or composite steel deck systems may be considered but are to be approved as part of schematic design by Manager, Architectural Design.
.1 Hollow core pre-stressed slab will only be considered if 'wet' areas are minimal and can be mitigated by waterproofing and drainage measures. No services shall be run within

the slab. Integral cove bases are to be incorporated as well as waterproofing in all rooms where program includes plumbing.

2.10 Building Interior – Space Planning Criteria

2.10.1 Allocation Guidelines

.1 Allocation Guidelines shall be in general accordance with the University's Office Space Allocation Guidelines.

.2 The tabulation below outlines the minimum sizing criteria for different uses and occupancies. All other spaces shall be sized to support functional requirements.

.1 Circulation Corridors:

- 1.8m (width) minimum area / key dimension

.2 Accessible Single Washroom

- In accordance with OBC

.3 On-Floor Electrical, I.T. / CCS, and Service Closets:

- Minimum $5m^2$ each, size to be validated by the electrical designer.

.3 Office or Workstation Requirements for Faculty, Staff and Graduate Students; The allocation of office space will be based upon functional need and the following guidelines:

Office Space Category	Administrative Function	Academic Function	Functional Allocation	Standard Allocation	
				SM	SFT
A	President	President	1 Dedicated Private Office	**40.00**	**431.00**
B	Vice-Presidents	Dean	1 Dedicated Private Office	**26.00**	**280.00**
C	Associate / Assistant Vice Presidents	Associate Dean	1 Dedicated Private Office	**19.00**	**205.00**
D	Directors	Department Chair/Director	1 Dedicated Private Office	**15.00**	**161.00**
E	Unit Managers	Full-Time Faculty/Contractual Faculty/Program Counselors	1 Dedicated Office / Workstation	**12.00**	**129.00**
F	Coordinators / Supervisors	N/A	1 Dedicated Office / Workstation	**10.00**	**108.00**
G	Administrative Assistants	Administrative Assistants / Secretaries	1 Workstation in Shared Space	**8.00**	**86.00**
H	Administrative / Technical Staff	Technicians/Technologists	1 Workstation in Shared Space	**7.00**	**75.00**

J	Clerical / Operational Staff	Clerical Staff	1 Workstation in Shared Space	**6.00**	**65.00**
K	N/A	Emeriti/Retired Research Faculty/Postdoctoral Fellow	Shared Office (2:1) within E size office	**6.00**	**65.00**
L	N/A	Sessional Lecturers / Retired Teaching Faculty/Research Associates/Scholars & Teaching Assistants	Shared Office (3:1) within E size office	**4.00**	**43.00**
M	N/A	Graduate Students	Shared Space(4:1) within E size office	**3.00**	**32.00**

2.10.2 Mechanical Rooms

.1 A designated and dedicated Mechanical Room shall be provided in every new building to accommodate the incoming water service.

.2 Designated and dedicated Mechanical Room(s) shall be provided to accommodate HVAC Plant Equipment and Process Equipment.

- .1 Provide at least one double door for entry into each Mechanical Room.
- .2 Provide Elevator Access for each Mechanical Room located above or below the Ground Floor Level.
- .3 Incorporate measures to facilitate movement of materials into and out of Mechanical Room(s).

2.10.3 Electrical Rooms

.1 A designated and dedicated Electrical Room shall be provided in every new building to accommodate the incoming electrical service.

.2 Designated and dedicated Electrical Room(s) shall be provided to accommodate Electrical Switchgear and Switchboards.

- .1 Provide at least one double door for entry into each Electrical Room.
- .2 Provide Elevator Access for each Electrical Room located above or below the Ground Floor Level.
- .3 Incorporate measures to facilitate movement of materials into and out of Electrical Room(s)

2.10.4 Building Storage Room

.1 Provide a designated room in new buildings, substantial additions or renovations where none currently exist, of approximately 8’x8’ for storage of critical replacement materials for building.

2.10.5 Offices

.1 Offices shall be sized in accordance with the requirements of the Office Space Allocation Guidelines.

.2 Office Furniture Layouts shall be submitted for the approval of the Manager, Architectural Design, before completion of the Design Development phase.

.1 Furniture layout shall be thought out as a part of the final overall layout of a space. Also refer to the requirements of Clause 2.19.

.2 Blocking in walls and placement of electrical/data/communication outlets and placement of wall switches and thermostats shall be coordinated with the furniture layouts.
.3 Use of Service Poles is not permitted without the prior approval Manager, Architectural Design; requests for approval shall be tabled before completion of the Design Development phase.
.4 At a minimum two (2) data outlets and three (3) duplex electrical outlets shall be provided in each office and at each workstation.
.5 In the case of private offices, maintain at least 6" clear between the door frame and nearest wall to allow space for coat hooks behind door. Provide Door Wall Stops.
.6 In the event that an Office space is designed with glazing on the Corridor / Public side, the section of glazing below the desk height shall be frosted or treated as a spandrel to mask desk clutter, if any.

2.10.6 Laboratories

.1 Laboratories shall be designed in accordance with the University's Laboratory Standard.
.2 Laboratories for animals shall be designed in accordance with the University's Vivarium Standard.
.3 Architectural layouts shall be established with full consideration to the desired Containment Level and Pressurization/Air-flow regimes.
.4 Laboratories Handling Chemicals to follow NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals.
.5 Laboratories housing or requiring the use the Lasers, X-rays or other radioactive materials/equipment shall be laid-out in consultation with the University's Radiation Safety Officer.
.6 Locate laboratories other than teaching laboratories:
    .1 In areas away from general traffic flow, and
    .2 Away from spaces readily accessible by the general public.
.7 Laboratory layouts shall be developed around the use of modularized benches and mechanical & electrical servicing to maximize, within reason, flexibility and adaptability for future changes in use.
.8 Functional Planning and Programming shall endeavor to capture all equipment, chemicals and reagents that are likely to be used within the lab.
.9 Designated spaces shall be incorporated within the lab for the storage of:
    .1 Waste Containers – Recyclables and Garbage
    .2 Laboratory Waste Containers
    .3 Gas Cylinders
    .4 Mobile equipment used within the Lab
    .5 Lab carts, flat-bed carts, etc. use to move equipment and materials within the lab or between the lab and the rest of the building.
    .5 A closet for Street Clothes, Aprons, etc.
    .6 Flammable Storage Cabinet
    .7 A Designated Locked Storage for Toxic Substances and Controlled Drugs

2.10.7 Universal Washrooms

.1 At least one (1) Universal Washroom shall be provided in all new construction and major renovations.

2.10.8 Housekeeping Rooms and Closets

.1 Custodial Services are inherent to the operations of buildings and proper service areas must be considered with all other areas during the schematic design stage of each building with input from the Custodial Services management team. Specific housekeeping room and closet needs depend on the size, use and materials used in each building, however, the following can be used as a guideline.

.2 At least one (1) Housekeeping Room shall be provided in every building
- Locate the room close to the Service Entrance and a direct path of travel to the Service Elevator
- Minimum size: 200 ft^2
- Double Doors for entry and exit, minimum door opening - 72”
- Wall Hooks shall be provided to hang 10’-0” and 12’-0” ladders
- Provide a designated Charging Station to charge battery powered equipment; provide two (2) 20A Duplex GFI receptacles on dedicated circuits in this area.

.3 At least one (1) Housekeeping Closet shall be provided on every floor or for every 15,000 ft^2-18,000 ft^2 of floor area.
- Minimum size: 60 ft^2
- Minimum door opening: 36”
- Provide one(1) 20A Duplex GFI receptacle on a dedicated circuit in each closet for charging battery powered equipment

.4 Requirements common to Housekeeping Room and Closet(s); provide the following:
- A 24”x24” Slop Sink c/w an 8” curb or lip and washable and durable wall panel surround.
- Permanent Signage over the Slop Sink in a visible location stating: *“WARNING: It is dangerous and unlawful to dispose of flammable, toxic, corrosive, oily, or other hazardous waste down drains. FOR DISPOSAL CONTACT ENVIRONMENTAL HEALTH AND SAFETY, PHONE 53282”*
- Floor Drain, in addition to slop sink drain, with a positive slope to drain
- A minimum of four(4) Mop Holders over the Slop Sink
- A minimum of four(4) 6” hooks for storage of rotary brushes and pads
- Lockset keyed to HKP in existing buildings and EA in new construction.
- To be painted with a minimum high gloss latex paint, epoxy paint preferred in high use rooms and closets.
- Light fixtures shall have shatterproof cover or shield.
- Shelving: To be wood, minimum of 3 with a depth of 15” – 18” and 40”, to bottom of first shelf, above floor level. Shelving to be adjustable, with a minimum 14" between shelves.

.5 Any combination or all of the following could be used in housekeeping rooms and or closets. Housekeeping will determine on a project by project basis what equipment will be required, which will help in determining size of housekeeping rooms.
- Ladder(s) - 6' to 12' in length
- Auto scrubber, Large Ride-On, H 50" L 60" W 331.4"
- Auto scrubber, Small walk behind, H 43" L 48" W 30"
- Sweeper
  - Large, H 47" L 60" W 32"
  - Small, H 22" L36.5 W 25.5"
- Small Scrubber, H 44" L 35" W 17"
- Stripper
  - Large , H 40" L45"
  - Small Edge, H 44" L 19" W 18"
- Swing Scrubber, H 48" L
- Garbage carts
  - Large, H 42" L 62" W 32"
  - Small, H 37" L 43" W 31"

- Upright Vacuum, H 49" W 12, 5"
- Backpack Vacuum, H 22" L 18" W 12"
- J-cart, H 38" L 46" W 22"
- Wet Pick Up, H 38" L 29" W 15.5"
- Carpet Cleaner
    - Large, H 26" L 33" W25"
    - Small spotter, H 36" L 21" W 21"
- Mop Bucket, 1 – 4, H 29" L 17" W 15"
- Re-lamping Cart, H 42" L 32" W 27"
- Floor Fan, H 19" L19 " W 17"
- Dehumidifier, H 34" L 17" W 19"
- Dust mops, Wet Mops, Brooms - Standard 54" length
- Extension poles, 6 - 8 '

2.11 Building Interior – Walls and Wall Finishes

2.11.1 General Requirements

.1 Interior partitions and walls may be constructed of Concrete Block or Gypsum Board on Steel Studs. Exceptions include:

  .1 Concrete Block shall be used for walls of Main Mechanical & Electrical Rooms.

  .2 Concrete Block shall be used for walls in areas with a potential for physical abuse.

  .3 Concrete Block shall be coated with durable epoxy paint in areas subject to moisture.

.2 Washroom and Showers:

  .1 Walls may be constructed of Epoxy Coated Concrete Block or multifunctional tile substrate and building panel such as KERDI-BOARD by Schluter System L.P. or equivalent.

  .2 Washroom and Shower Walls shall be finished with “Glaze” or Ceramic Tile.

  .3 Grout shall be non-sanded epoxy based and of a color that does not show dirt and salt and affords a high level of cleanability.

.3 Provide Acoustic Batt Insulation over the entire height of walls identified as acoustic separations. The acoustical properties of insulation shall be adequate to provide the identified STC rating for the assembly.

.4 Gypsum Board installed on Concrete Block to be glued and mechanically fastened.

.5 Wall Protection and Corner Guards:

  .1 To be provided on all circulation areas as well as anticipated high traffic areas that could likely be exposed to abuse.

  .2 Use of FRP Wall Protection Panels is permitted in Mechanical & Electrical Rooms, Service Rooms, Closets and other “Back of House” areas.

  .3 Wall protection in Student Residences shall be in the form of ½” plywood behind impact resistant gypsum wall board.

  .4 The need to incorporate wall protection measures in Classrooms and other areas where walls could be subject to physical damage should be reviewed with the Manager, Architectural Design, before completing the Schematic Design.

  .5 Corner Guards shall be provided at all exposed outside corners within circulation areas as well as all other areas where there is a high likelihood of impacts to corners.

  .6 Corner Guards shall be provided at all exposed outside corners within corridors leading to Mechanical and Electrical Room(s)

.6 Special Requirements – Student Housing:

  .1 Main Halls - Concrete block preferred, impact resistant drywall backed with ½” plywood may be considered.

  .2 Vestibules / Exit Stairs / Kitchenettes - Concrete block

.3 Corridors - Concrete block preferred, impact resistant drywall backed with ½" plywood may be considered.
.4 Dorm Rooms / Lounges - Concrete block preferred, impact resistant drywall may be considered.

.6 Demountable Walls

.1 Consideration for demountable walls such as Trendwall or approved alternate as a solution where frequent change or quick construction is necessary. Sometimes difficult to achieve appropriate STC ratings with this wall type. Acoustic issue must be carefully considered, designed, and communicated to end user.

2.12 Building Interior – Floors and Floor Finishes

2.12.1 General Requirements

.1 Overarching Design Criteria:
.1 Number of distinct products and finishes shall be kept to a minimum to minimize long-term maintenance costs.
.2 Joints or seams in flooring shall be kept to a minimum and located as much as possible off high traffic zones.
.3 Proposed approach to selection and use of finishes shall be presented to the Manager, Architectural Design for approval as a part of the Design Development process.
.4 Carpet recommended manufacturers are Tandus, Milliken and Interface.

.2 High Traffic Entries and Circulation Areas:
.1 Ceramic Tiles with Stainless Steel Sunken Floor Grates and Pan (less drains) for full extent of the entry where possible.
.2 Ceramic Tiles are to have a DCOR over 0.42 with due consideration given to manufacturer's recommended maintenance practices, durability, cleanability and resistance to salt and dirt.
.3 Size of Tiles shall be as large as possible; preferred minimum size is 300mm x 600 mm (12"x24")
.4 Use of Vinyl Composite Tile is not permitted.
.5 Walk-Off Carpet Tile (similar or equivalent to Abrasive Action by Tandus) for a minimum of 5m past the Sunken Floor Grate outlined above; the final extent shall be identified in consultation with the Manager, Architectural Design, DEC before completing the Schematic Design.
.6 Resilient Flooring low VOC, non-wax, antibacterial recycled content minimum of 10%, heat welded seams and integral cove base may be considered with prior approval (at the Schematic Design Stage) from the Manager, Architectural Design.
.7 Draining floor grid shall be used in all entries to as large an area as feasible to cover path of travel. Preferred product is pedimat with aluminum level base frame and aluminum pan not drained. Matting shall be segmented such that no section is heavier than 60lbs.

2.12.2 Stairs and Stairwells

.1 Photo-luminescent nosing shall be used in Exit Stairwells and Stairs in Classrooms with auditorium style seating.
.2 Exit Stairwells - Use of ceramic tile with Photo-luminescent Steel Pan Nosing Construction is acceptable.
.3 Special Requirements – Student Housing
.1 Rubber treads and risers in stairwells
- One piece construction

- Circle dimple design for treads
- No grooves; only smooth

2.12.3 Research Classrooms, Laboratories, Storage and General Offices

.1 Resilient Flooring low VOC, non-wax, antibacterial recycled content minimum of 10%, heat welded seams and integral cove base where required, or

.2 Carpet Tile / Rolled Goods with 'powerbond' backing and 90% solution dyed / soil resistant material where appropriate for the application.

  .1 Products requiring the use of an under pad are not permitted.

2.12.4 Lecture Theatres, Seminar Rooms and Academic Offices

.1 Carpet Tile (preferred) or Rolled Goods with powerbond backing and 90% solution dyed / soil resistant material where appropriate for the application.

  .1 Products requiring the use of an underpad are not permitted.

.2 Chemically Bonded Carpet with prior approval (at the Schematic Design Stage) from the Manager, Architectural Design, DEC.

  .1 Cut Pile Carpet, Printing Dyed Fiber and Olefin and Polyster Fibers are not acceptable.

2.12.5 Animal Facilities

.1 Monolithic Epoxy Finish

.2 100 mm Cove Base

2.12.6 Mechanical and Electrical Rooms, and Housekeeping Rooms & Closets

.1 Monolithic Epoxy Finish or sealed concrete

.2 100 mm Cove Base

.3 Positively sloped towards a Floor Drain

2.12.7 Thresholds and Bases

.1 Base should be highly durable. Use Johnsonite Tightlock or bound carpet base when using carpet or sheet floor or ceramic tile when ceramic tile is the flooring of choice.

.2 Use of wooden baseboards is not permitted.

.3 Thresholds should be aluminum or other metal to match surroundings.

.4 Use of Rubber/Plastic/Composite thresholds is not permitted.

2.12.8 Special Requirements - Student Residences

.1 Carpet - Corridors (Secondary), Dorm Rooms, & Lounges:

  .1 Carpet (rolled goods only) complete with powerbond, or equivalent backing, closed loop nylon, 90% solution dyed, 3.0 - 5.0 mm maximum pile height, and soil resistant.

  .2 Colour/pattern must not show dirt and salt easily.

  .3 100% of the carpeted area must be glued directly to the substrate, no underlayment allowed.

  .4 Welded seams centered under doors.

  .5 Layout carpet to minimize the amount of seams not in traffic routes. Traffic routes to use seams required to maximize strength and durability of carpet.

.2 Flooring - Entrances / Lobby / Info Desk Areas / Service Entrances / Exit Stairs:

  .1 Porcelain / Ceramic tiles (colour pattern that does not show dirt and salt easily and has a high level of cleanability).

  .2 Grout (non-sanded epoxy based) color: colour that does not show dirt and salt easily and has a high level of cleanability.

.3 Walk off matting (Tandus Abrasive Action, or equivalent) in traffic area on top of tiles to be installed for all year long use from main entrances to secondary corridors and elevators.

.3 Corridors (Main):

.1 Porcelain / Ceramic tiles (colour pattern that does not show dirt and salt easily and has a high level of cleanability).

.2 Grout (non-sanded epoxy based) color: colour that does not show dirt and salt easily and has a high level of cleanability.

.4 Kitchenettes:

.1 Porcelain / Ceramic tiles (colour pattern that does not show dirt and salt easily and has a high level of cleanability).

.2 Grout (non-sanded epoxy based) color: colour that does not show dirt and salt easily and has a high level of cleanability.

Or

.3 Maintenance free non-wax sheet flooring (Gerflor, Noraplan or equivalent)

.4 Anti-bacterial, Antistatic and fungicidal.

.5 100% of the area must be glued directly to the substrate, no underlayment allowed.

2.13 Building Interior – Washrooms Accessories

2.13.1 General Requirements

.1 Consult with Custodial Services regarding “standard” accessories (paper towel dispenser, toilet paper dispenser, sanitary disposal, garbage containers, and soap & hand sanitizer units) as these standards change on a project by project basis dependent on building requirements. Minimum requirements are as follows:

.1 Hose bib in every washroom, under sink, always keyed type for security and vandalism purposes.

.2 Shower Curtain Rods – height of installation based on size of shower curtain used by housekeeping. University to provide sample to determine exact measurements. Curtain to be installed 1” above finished shower base elevation. ASI 1224 Shower Curtain Rod, 1” diameter, Stainless Steel rod c/w concealed fasteners or approved alternate.

.3 Mirrors should be accessible (reachable) for cleaning.

.4 Toilet partitions: Solid phenolic core partition, through bolted, stainless steel fasteners, floor to ceiling mounted, and laminated with high pressure laminated plastic sheets. No solid colours for laminate, must be flecked. Only specify standard colour selections.

.5 All washrooms to be complete with central floor drain.

.6 Garbage - No recessed garbage containers allowed, only wall mounted stainless steel or loose containers acceptable, to be determined on a project by project basis.

.7 Sharps container (Disposal Box for Needles, Syringes & Sharp Objects) shall be installed in all new washrooms. Mounting height shall be 42" (top of unit), from the finished floor surface.

.2 Any combination or all of the following could be used in public washrooms only. Housekeeping will determine on a project by project basis what equipment will be required.

.1 High efficiency hand dryers

- Large washrooms – 2
- Small washrooms – 1
- Wall area below hand dryers to be protected with a durable, cleanable material

.2 Toilet paper dispensers, one per stall, to be supplied by University and installed by contractor.

- .3 Soap Dispenser, one dispenser per sink, to be supplied by University and installed by contractor.
  - Do not install soap dispensers above electrical receptacles
- .4 Sanitary Disposal, to be supplied by University and installed by contractor.
  - Sanitary boxes in low traffic to moderate use buildings, plastic or stainless steel
  - Sani-pod units to be used in high traffic buildings
- .5 Hand sanitizer dispensers to be provided outside all public washrooms entrances, to be supplied by University and installed by contractor.

.3 Any combination or all of the following could be used in student residence washrooms only. Housekeeping will determine on a project by project basis what equipment will be required.

- .1 Hand sanitizer dispensers to be provided inside washrooms on walls immediately inside the door, to be supplied by University and installed by contractor.
- .2 Toilet paper dispensers, one per stall, to be supplied by University and installed by contractor.
- .3 No soap dispensers, hand dryers, soap dispensers or sanitary disposal units to be provided in residences.

.4 Toilet Partitions

- .1 Toilet partitions to be affixed at three points of contact; floor bolting, divider panel connection & overhead bracing.

2.13.2 Washroom Accessories – Special Requirements – Student Residences

.1 Fixed mirrors: silvered 6mm with “pencil edge” polished edge finish and mechanically mounted with concealed fastenings.

- .1 In addition to concealed mechanical wall fasteners adhere mirror to prepared wall substrate with silicone-based adhesive as approved by mirror manufacturer to be fully compatible with silvering coating as manufactured to prevent de-lamination;

.2 Coat hooks, 3 per shower area: Satin finish stainless steel, 25 x 160 mm with 75 mm projection. Acceptable material: Bobrick # B-233, or equivalent.

2.14 Building Interior – Washroom and Shower Floors, Walls & Ceilings

2.14.1 Floors

.1 Ceramic tiles, colour pattern that does not show dirt and soap scum easily and has a high level of cleanability, speckled tile preferred.

.2 Non-Sanded Epoxy Based Grout, colour that does not show dirt and soap scum easily, neutral colours preferred.

.3 Substrate complete with ‘Hydro-Ban’ or ‘Kerdi’, or equivalent, waterproofing system. System to be installed on entire floor area.

.4 Must slope to drain with a minimum 1% slope.

.5 Make joints between tile uniform and approximately **3** mm wide (or dimensioned to match tile joints as manufactured) plumb, straight, true, even and flush with adjacent tile.

.6 Do not caulk at intersection of tiled walls, floors, and ceilings. Provide grout-filled seams.

.7 Tile floors preferred but non-wax / maintenance free sheet flooring acceptable in some cases with prior approval (at the Schematic Design Stage) from the Manager, Architectural Design, DEC.

.8 Proud or sharp edges on tile unacceptable.

2.14.2 Special Requirements – Floors - Student Residences

.1 Door thresholds to be marble or travertine and be ½” above finished floor.

.2 Tile mandatory in all residences.

2.14.3 Walls

.1 Ceramic tiles, solid colour, accents acceptable.
.2 Light coloured Non-Sanded Epoxy Based Grout.
.3 Substrate must be level, plumb, true and square. Use Kerdi-Board, or equivalent, system to accomplish this in locations where existing substrate is not level, plum, true and square.
.4 Kerdi Board, or equivalent, is to be the finished substrate surface. All patching and leveling to be done behind Kerdi Board. Fill any large voids with layers of Kerdi and parging, behind the final sheet of Kerdi.
.5 All corners complete with aluminum 'Schluter', or equivalent, trim, sized appropriately to the tile thickness. Using tile for corners may be acceptable with prior approval (at the Schematic Design Stage) from the Manager, Architectural Design, DEC. If approved, include a significant quantity of extra stock of these tiles.
.6 Full tile to be used at all locations if possible. If cut tiles are required they are only to be used on inside corners at the most conspicuous locations.
.7 Make joints between tile uniform and approximately 3 mm wide (or dimensioned to match tile joints as manufactured) plumb, straight, true, even and flush with adjacent tile.
.8 Tile walls preferred but epoxy painted moisture resistant drywall acceptable in some cases with prior approval (at the Schematic Design Stage) from the Manager, Architectural Design, DEC.
.9 Proud or sharp edges on tile unacceptable.

2.14.4 Ceilings

.1 Ceramic tiles, solid colour.
.2 Light coloured Non-Sanded Epoxy Based Grout.
.3 Tiled ceilings preferred but drywall, painted with epoxy paint, acceptable in some cases with prior approval (at the Schematic Design Stage) from the Manager, Architectural Design, DEC.
.4 Make joints between tile uniform and approximately 3 mm wide (or dimensioned to match tile joints as manufactured) plumb, straight, true, even and flush with adjacent tile.

2.14.5 Washroom Vanities

.1 Solid Surface Countertops: DuPont "Corian", Formica or Wilsonart, (or equivalent) non-porous filled polymer through body colour, Solid grade, 13 mm minimum thickness. No solid colours, must use flecked.
.2 38mm high applied front edge nosing; 6mm radius top and bottom edge profile.
.3 152mm high applied matching backsplash and end splash at adjacent walls c/w 6mm radius top edge profile.
.4 19 mm waterproof Fir ply substrate fully adhered to solid surface countertops.
.5 All solid surface countertops to be fabricated as one piece, without surface seams.
.6 When floating, mount on steel support system. If in wet area, steel must be stainless steel.

2.15 Building Interior – Ceiling Systems

2.15.1 General Requirements

.1 Gypsum Wall Board or Lay-in Acoustic Tile:
  .1 Acoustic Tile installed within a 600 mm x 1200 mm grid. Use of 600 mm x 600 mm tile shall be limited to "feature spaces" and shall be identified and presented for approval by the Manager, Architectural Design before completion of the Design Development Phase.
    - Use of Acoustic Tile is not permitted in Washrooms.
  .2 Grid suspension systems supported off the building structure

- Edge molding, 28 gauge, cold-rolled steel angles, galvanized and prefinished on exposed surfaces in baked-enamel, white.
- Framing: 28 gauge, cold-rolled steel tees, galvanized and prefinished on exposed surfaces in baked-enamel, white.

.2 Ceiling Systems shall be arranged to provide ready access to services above.
.3 Use of Clipped Ceiling Tiles (as a means of fire separation) is not permitted.
.4 Suspended Ceiling to be plumb and square with adjoining work, main tees as long as practical to minimize joints.
.5 Oversize tiles are not permitted.

2.15.2 Special Requirements – Ceiling Systems - Student Residences

.1 Main Halls / Vestibules / Exit Stairs / Corridors / Lounges / Kitchenettes - Painted concrete, impact resistant drywall or Lay-In washable/cleanable tile within a 600mm x 1200MM grid. Grid size may be changed based on space and design requirements if approved by the Manager, Architectural Design, at the Schematic Design Stage.
.2 Dorm Rooms - Impact resistant drywall

2.16 Building Interior – Partitions

2.16.1 General

.1 Block walls shall be the partition type for areas requiring durability and/or sound transfer.
.2 Gypsum Board Assemblies typically 16mm thick for partition applications / 13mm acceptable for fascia's, soffits and suspended ceilings.
.3 Design assemblies to provide sound control ratings as appropriate: offices requiring acoustical privacy extend wall to underside of slab minimum STC52, Washrooms extend wall to underside of slab and STC 47 to 52 depending on adjacencies. Classrooms extend to underside of slab minimum STC 52.
.4 In the case of renovations, the following shall be considered.
  .1 The extent of firestopping is to cover entire project area, i.e. any penetrations in rated walls in project areas are to be firestopped not just new penetrations required by the scope of the project.

2.16.2 Special Requirements – Partitions - Student Residences

.1 Main Halls - Concrete block preferred, impact resistant drywall backed with ½" plywood may be considered.
.2 Vestibules / Exit Stairs / Kitchenettes - Concrete block.
.3 Corridors - Concrete block preferred, impact resistant drywall backed with ½" plywood may be considered.
.4 Dorm Rooms / Lounges - Concrete block preferred, impact resistant drywall may be considered.

2.17 Building Interior – Painting

2.17.1 General

.1 As outlined in the University's Painting Standard.

2.18 Building Interior – Doors, Frames and Hardware

2.18.1 General

.1 In the case of renovations, all doors, frames and hardware shall match the existing building standards.

.2 All Doors are to be industry standard door width sizes: 914.4 mm (3'-0"), 1066.8 mm (3'-6"), and 1219.2 mm (4'-0"). Height is 7’-0” standard. Where wider doors are required due to equipment using a second leaf is preferable over an oversize door. Doors taller in height must be approved by the Manager, Architectural Design, DEC before completion of the Schematic Design, and must have an anchor in frame every 2’-0”.

.3 Avoid use of glass in bottom ½ of door for buildings where vandalism could be more prevalent.

.4 Use of Georgian Wire Glass is not permitted.

2.18.2 Exterior Doors and Frames

.1 Main and Secondary entrance doors shall be heavy duty (at least 16 Gauge) commercial doors with reinforcements for all hardware: closers, locks, exit devices, butt hinges and power operators.

.2 Exterior aluminum frames shall be reinforced for hardware: butt hinges, continuous hinges and strikes.

.3 Bronze is standard and Bright or Deep Colors are not permitted without prior approval from the Manager, Architectural Design, DEC.

.4 Wood Doors (painted or stained) are not permitted except in instances where required to preserve historical character.

.5 Double door sized openings shall use a keyed removable center mullion.

2.18.3 Interior Doors and Frames

.1 All doors shall be Solid Core type. Use of Hollow Core or Alternate Types shall be submitted for the approval of the Manager, Architectural Design, DEC before completion of the Schematic Design.

  .1 Where permitted, Hollow Core Doors shall be Commercial Grade, with core and hardwood stile specifications to be suitable for application.

  .2 Quality of doors and frames to be sufficient to provide security to rooms, with consideration given to fire rating, acoustical or special requirements.

  .3 Do not design doors which void guarantee because of oversized cut outs or insufficiently sized stiles and rails.

.2 Finishes should be Flush wood with catalyzed lacquer, Plastic Laminate, factory finish paint.

.3 Welded and ground frames 16 gauge minimum, knockdown frames to be avoided, no wood frames or trim materials to be used. Provide minimum three anchors for standard door height frame.

.4 Transom and side panels provide similar quality and appearance to doors.

.5 The use of Acoustical folding doors is to be considered only with the prior approval of the Manager, Architectural Design; a performance specification shall be submitted for review during the design development phase.

.6 In cases where doors are subject to high abuse, extra attention is to be paid to door construction and profile.

.7 All steel doors to be stiffened at edges

2.18.4 Hardware

.1 All Hardware shall be as per the University’s Hardware Standard.

.2 Supply, installation, and keying by contractor

2.18.5 Fire Shutters

.1 All fire shutters will terminate at a low wall or counter, any fire shutter that must terminate at the floor must be brought to the attention of manager architectural.

2.18.6 Special Requirements – Doors - Student Residences

.1 Solid core laminated, all edges to be sealed, piano hinges recommended.

2.19 Signage

2.19.1 General

.1 All interior and exterior signage must conform to the University of Guelph Signage Standards. If in existing building interior signage must match existing standard in that building or replace a logical area to avoid piecemeal signage systems.

.2 Any film or graphics on exterior windows must be approved by manager architectural.

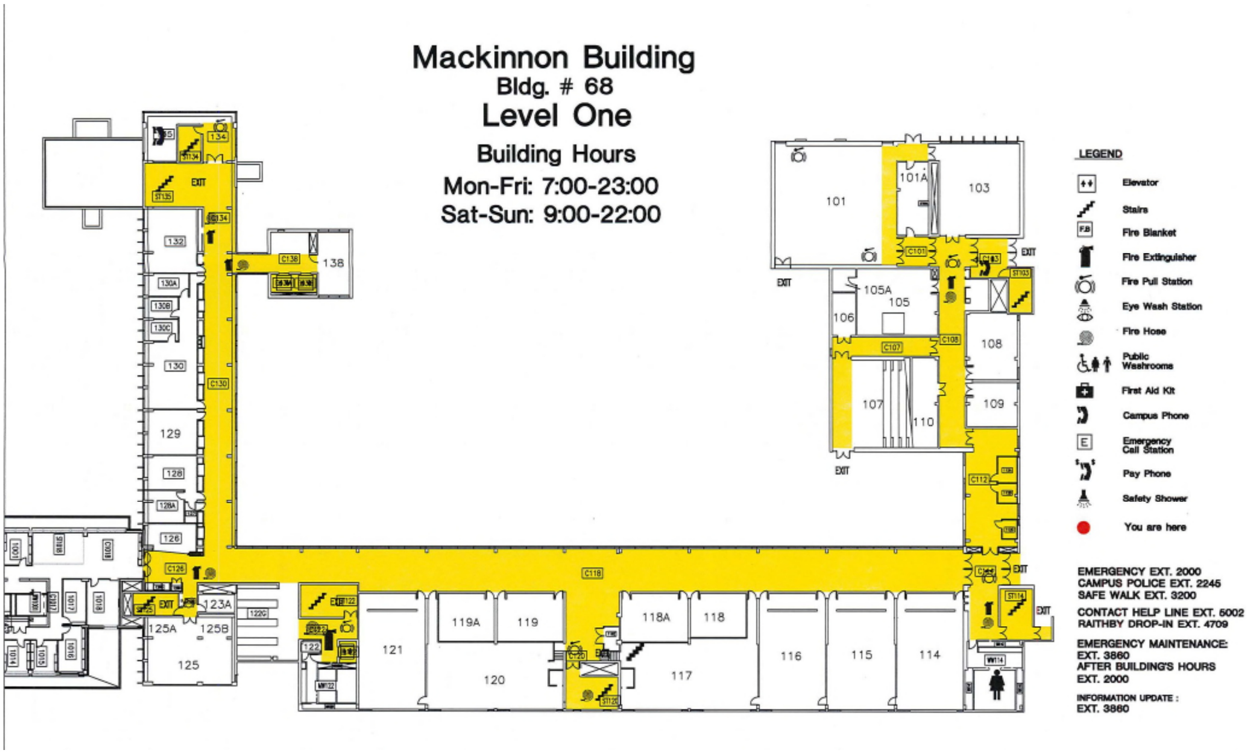
2.19.2 Life Safety Plans

.1 Life Safety Plans are an item the University of Guelph has introduced as part of the signage plan to meet the regulations under the Ontario Fire Code and authorities having jurisdiction. Our policy at University of Guelph is to post a plan as described below at all major entry points to building and at all levels where vertical circulation enter a floor. There may be exceptions to posting locations but all are to follow the general rule of being a quick and easily found guide to building features.

.2 Simplified Plans:

- .1 Remove Elevators and Stairs details, add icons
- .2 Corridors and circulation are shaded yellow
- .3 Icons are added and inventoried to ensure accuracy
- .4 Locations/Quantities for plans need to be determined then correct orientations generated. Signage service provider can put ‘you are here’ dot on plans and typically prefer .jpg or .pdf type files. This inventory complete with orientations should be updated on Life Safety Plan tracking spreadsheet.
- .5 Holders for these signs should follow building standards and generally would be Vista for lobby signs then Vista or a simple acrylic sleeve for subsequent locations and floors as best suited to project. In aggressive environments (Student Residences) or high quantity situation printed vinyl decals on metal panel is viable option.
- .6 Size - Typically these plans will be 11” x 17” or 18” x 24” as the project requires.
- .7 Layout – Emergency contacts should be lower right hand corner with a box around, building information at bottom of drawing, legends at right or bottom depending on what works with plan size and building layout.
- .8 Contacts may be added but should be vetted with client contact to ensure accuracy. Should include at minimum: Emergency ext., campus police ext., safe walk ext., Possible Others: Emergency Maintenance, Building Contacts.

.3 Example Life Safety Plan:



2.20 Millwork

2.20.1 General

.1 All architectural millwork will be designed and fabricated to AWMAC Millwork Standards premium grade. Built-in millwork should be avoided where a furniture solution would provide more long term flexibility.

.2 Use 110º hinges where door opens adjacent to wall; 170 º hinges where there is no adjacent wall.

.3 Provide edge banding to all edges exposed, matching colour in 3mm PVC.

.4 Drawer Slide: heavy duty ball bearing telescopic slides.

.5 Adjustable standards and clips to be metal.

.6 Acceptable substrates are plywood, MDF and OSB to be specified dependent on application. All exposed surfaces should be finished in plastic laminate interiors of millwork are permitted to be melamine.

.7 In high humidity or wet areas marine grade plywood substrate preferred.

2.20.2 Laboratories

.1 Laboratories shall be designed in accordance with the University's Laboratory Standard.

.2 Laboratories for animals shall be designed in accordance with the University's Vivarium Standard.

.3 Bench-tops – Dry Labs & Biology Labs: Chemical resistant P-Lam with plywood substrate.

.4 Bench-tops – Wet Labs & Chemistry Labs: Solid phenolic or epoxy top. Use of Chemical resistant P-Lam with plywood substrate is permitted only with the prior approval of the Manager, Architectural Design.

.5 Bench-tops shall be designed with marine edges and drip stops to aid containment of spills.

.6 Bench depth standardized at 30” unless otherwise required for the application. All non-standard sizes shall be brought to the attention of the Manager, Architectural Design before completion of the Design Development phase.

.7 Base Cabinets

  .1 Configured with a 50/50 split between Doors and Drawer Units.

  .2 Door hardware to permit 180^{o} opening and not be self-closing.

  .3 Drawers shall be one piece construction, full extension, ball bearing slides and stops to keep the drawer from being pulled out of its carcass.

2.20.3 Adjustable Wall-mounted Shelving

.1 Shelving shall be sized and constructed of a gauge or thickness selected to suit the intended application.

  .1 Support all shelving on 24” centers.

  .2 Supports shall incorporate a double pilaster arrangement.

.2 Shelving over bench-top equipment shall be designed to support the weight of equipment that it could be expected to support.

2.21 Furniture & Specialties

2.21.1 General

.1 Furniture and furnishings must be functionally efficient, compatible and economical to replace/ add to with good life cycle value. Public spaces, especially those outside of classrooms, are to have furnishings that allow use but are difficult to vandalize or move from their location.

.2 In the case of renovations, new furniture shall blend in with and meet the standards benchmarked by the existing furniture.

.3 Demountable walls should be considered as an alternative in spaces where flexibility is a primary concern.

.4 On all new construction projects and renovations larger than 5000 sq. ft., a furniture consultant shall be engaged to facilitate the furniture selection, design & layouts. Conceptual furniture layouts shall be presented for review to the Manager, Architectural Design no later than at the 50% Design Review stage.

.5 Furniture layouts shall be coordinated with the Mechanical & Electrical installations.

.6 Glazed demountable wall systems can be used but maintenance issues need to be evaluated and client made aware of maintenance costs.

2.21.2 Window Coverings

.1 A Roller-shade is the preferred product for window coverings, Hunter Douglas or equivalent quality. Heavy Duty Clutch Operated Control System, engineered heavy duty chain drive pully operating system with adjustment-free continuous T304 stainless steel ball chain with 110 lbs breaking strength, standard loop length as long as shade. Chain tensioner to be compliant with WCMA safety standard, components will be maintenance free from adjustments or lubrication, heavily reinforced aluminum roller tube and extruded aluminum weight in a sealed pocket hem bar for tracking adjustments and uniform look. Typically 3% or 5% openness with blackout capability where required by the functional use in neutral colours. Consideration to uniformity of appearance from exterior of building should be given.

.2 Special Requirements – Student Housing

  .1 Curtains will be considered and sometimes mandatory, review on a project by project basis. If curtains selected, must be easily removable, washable and pre-shrunk lined cotton

2.21.3 Whiteboards & Bulletin Boards

.1 Whiteboards must be P3 ceramic steel porcelain enamel, or 28-gauge steel boded to a minimum of ½" thick. MDF core with an aluminum back – bonding material shall be waterproof.

.2 Bulletin boards shall be Forbo or approved alternate (fire rating) and that bulletin board may not exceed 25% of wall area that is resides on.

3 INSTALLATION & WORKMANSHIP STANDARDS

3.1 General

.1 The requirements outlined in the following clauses are applicable to all Architectural elements.

.2 All joints between tile to be uniform and approximately 3 mm wide (or dimensioned to match tile joints as manufactured) plumb, straight, true, even and flush with adjacent tile.

.3 ACT to be affixed to wall at edges of space

.4 Window shades are to be installed with proper anchor and appropriate length of anchor. Anchors are never to be snipped off.

.5 Brick and Stone & Ceramic Tile shall have sample panels constructed as a part of the construction process for approval of workmanship and materials.

3.2 Carpet Seaming / Laydown Practices

.1 Seaming diagrams shall be provided prior to commencing installation.

.2 Minimize seams in high traffic areas.

.3 Where possible, position seams under doors.

3.3 Roller Shade Installation

.1 Anchor to support minimum every 2' of shade but at least 3 points in accordance with manufacturers standards and specifications with heavy duty bracket, 1/8" thk hardened steel. Adequate clearance shall be provided to permit unencumbered operation of shade and hardware.

3.4 Wall Mounted Systems

.1 Blocking shall be provided in walls to support wall-mounted furniture & systems.

3.5 Extra Inventory

.1 After review with applicable stakeholders and user groups, present an inventory list for extra stock (product and quantity) to the Project Manager and Construction Manager for consideration prior to release of tender documents. For each item presented, provide strong reasoning on the need for said item to be stocked. This list shall be prepared giving consideration to the following:
.1 Likely hood that the inventory material will be required in the short term (1 - 9 years) and long term (10 - 20 years).
.2 Amount and application and any applicable warranties of the product
.3 Availability and procurement lead
.4 Cost

.2 No paint, adhesives, caulking, grouts, or similar type products are to be stocked. It is preferred that floor finishes are not stocked. Mechanical and Electrical items shall be itemized to evaluate whether the University already stocks said components.

.3 For all items that are accepted as Stock Inventory, the user groups must provide an area within the project building to store the items. Physical Resources is not responsible for extra inventory.

3.6 Stairs and Stairwells

.1 Nosing's shall be installed on top of carpet and fastened with mechanical fasteners. Adhesives may be used in conjunction but not as sole means of attachment.

4 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision

0	10-22-2014		
1	06-02-2021		Article 3.5 – Extra Inventory Miscellaneous Revisions highlighted in red.

UNIVERSITY of GUELPH

Office Space Allocation Guidelines

Functional Space Requirements

Office or Workstation Requirements for Faculty, Staff or Graduate Students

The allocation of office space will be based upon functional need and the following guidelines:

- Allocated office space is not permanent
- Normally Faculty and Staff are allocated only one office
- Faculty who request a second office will require approval from VP Academic, VP Research and must meet one of the following criteria:
  - Assigned a college or departmental administrative function, however, during the term of their administrative appointment their current faculty office should be used for other purposes.
  - Maintain an active research program requiring additional space and located in a separate building from their current office.
- Graduate students would include:
  - Full-time PhD students and full-time Masters Students enrolled in on campus programs.
- Office space categories based on functional requirements would be allocated as below:

Office Space Category	Administrative Function	Academic Function	Functional Allocation	Standard Allocation		Allocation Buffer Allowance to Meet Guidelines	Buffered Standard Allocation	
				SM	SFT		SM	SFT
A	President	President	1 Dedicated Private Office	**40.00**	**431.00**	10% for Older Buildings (Prior to 1964 University of Guelph Act)	44.00	474.00
B	Vice-Presidents	Dean	1 Dedicated Private Office	**26.00**	**280.00**		28.60	308.00
C	Associate/Assistant Vice Presidents	Associate Dean	1 Dedicated Private Office	**19.00**	**205.00**		20.90	226.00
D	Directors	Department Chair/Director	1 Dedicated Private Office	**15.00**	**161.00**		16.50	177.00
E	Unit Managers	Full-Time Faculty/Contractual Faculty/Program Counselors	1 Dedicated Office/Workstation	**12.00**	**129.00**		13.20	142.00
F	Coordinators/Supervisors	N/A	1 Dedicated Office/Workstation	**10.00**	**108.00**		11.00	119.00
G	Administrative Assistants	Administrative Assistants/Secretaries	1 Workstation in Shared Space	**8.00**	**86.00**		8.80	95.00
H	Administrative/Technical Staff	Technicians/Technologists	1 Workstation in Shared Space	**7.00**	**75.00**		7.70	83.00
J	Clerical/Operational Staff	Clerical Staff	1 Workstation in Shared Space	**6.00**	**65.00**		6.60	72.00
K	N/A	Emeriti/Retired Research Faculty/Postdoctoral Fellow	Shared Office (2:1) within E size office	**6.00**	**65.00**		6.60	72.00
L	N/A	Sessional Lecturers/Retired Teaching Faculty/Research Associates/Scholars & Teaching Assistants	Shared Office (3:1) within E size office	**4.00**	**43.00**		4.40	47.00
M	N/A	Graduate Students	Shared Space(4:1) within E size office	**3.00**	**32.00**		3.30	35.00

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD RD-01

PAINTING

Version	Revision 0
Effective Date	October 03, 2014
Approved By	Jill Vi Oct. 23rd '14
	Manager, Architectural Design, DEC
Reviewed By	Dec 1 - 14
	Director, MES

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1.1 GENERAL

1.1.1 The Painting Contractor will produce a 'Properly painted surface.' A properly painted surface is defined as uniform in appearance, color, texture, hiding and sheen. It is also free of foreign material, lumps, skins, runs, sags, holidays, misses, or insufficient coverage. It is also a surface free of loose, chipped, broken or bubbled paint, as well as drips, pin holes, spatters, spills or overspray whether or not caused by the Painting Contractor's workforce.

1.1.2 Specify the appropriate Surface Preparation requirement for project. Level 4, Supreme, is recommended.

1. <u>Level 1 - Basic:</u>
   This surface preparation level requires basic cleanliness of surfaces to ensure the adhesion of new finishes to the surfaces to which they are applied with less concern for the adhesion of existing paint coats and quality of appearance of the finished surfaces. Preparation shall include the removal of surface dust, dirt, obvious loose paint and other surface contaminants by washing, light power washing or pressure washing, hand cleaning, including the use of a duster brush or broom, and mildew treatment. This level of preparation should ensure that subsequently applied coats of paint will adhere to existing paint coats.
2. <u>Level 2 - Standard:</u>
   This surface preparation level requires basic cleanliness of surface to ensure the adhesion of new finishes to the surfaces to which they are applied as well as the examination of existing coatings to assess their adhesion. With this level of surface preparation, good adhesion and longevity of finish is of primary concern and appearance is of secondary concern. This level of surface preparation includes that described in Level 1 plus other procedures necessary to create a sound surface for repainting including solvent cleaning, basic patching/filling, caulking, light sanding/abrading, and "feather edge" sanding.
3. <u>Level 3 - Superior:</u>
   The level 3, superior, surface preparation level incorporates the requirements of Levels 1 and 2 with added emphasis on the quality of appearance of finish painted surfaces. This level of surface preparation includes filling, patching, taping cracks in drywall, and properly dealing with "nail pops," approximate matches to existing textures, and thorough sanding to minimize existing runs, sags, brush/roller marks, and the surface profile of cracked and peeling areas, and other existing surface defects. Under this level of preparation the general surface profile is retained but defects causing abrupt surface profile differences exceeding 1/16 inch or 62.5 mils will be corrected.
4. <u>Level 4: Supreme:</u>
   The Level 4, supreme, surface preparation level incorporates the requirements of Levels 1, 2 and 3 with even more emphasis on the quality of appearance of finish painted surfaces. Under this level of surface preparation, all necessary preparation techniques will be employed to improve the quality of appearance except Restoration/Resurfacing. Thorough filling and sanding will be accomplished to

eliminate defects causing abrupt surface profile differences exceeding 1/32 inch or 31 mils.

5. Level 5 - Restoration/Resurfacing:
   This degree of surface preparation is required when existing conditions indicate that the surfaces are severely deteriorated or there is substrate damage. Existing coatings may be completely or nearly completely removed. Abrasion, chemical removers or applied heat may be employed in order to remove a failed coating and/or to expose a failing substrate. Substrates may have to be completely replaced, repaired or resurfaced.

1.2 SUBMITTALS

1.2.1 General

1. Consultants, in coordination with the contractor(s), are required to submit records of the final products used. This information to be submitted to the Manager, Architectural Services, separate from the close out documentation. List products in relation to finish system which at a minimum will include the following:
   a. Product name, type and use
   b. Manufacturer's product number
   c. Colour number and name
   d. Sheen
   e. Point of Purchase
   f. Floor Plan(s) showing placement of all colours.

1.3 QUALITY ASSURANCE

1.3.1 General

1. If sprayed, all walls and ceilings must be back-rolled on final coat.
2. Apply paint using brushes and rollers of high quality grade and as appropriate for the task.
3. Existing glossy painted surfaces shall be properly prepared by cleaning and de-glossing.
4. Patch Painting will not be acceptable, total affected area shall be painted. Terminate painting only at corners or joints.
5. The paint contractor is responsible for protection of all adjacent surfaces. The contractor shall at all times protect those surfaces with approved materials.
6. Enamel and varnish undercoats are to be sanded smooth prior to the re-coating. Tops and bottoms of wood and metal doors are to be finished in the same manner as door facing.
7. New plaster and other masonry surfaces shall not be primed until it has been determined these substrates have dried sufficiently to safely accept paint. Unacceptable moisture content should be reported by appropriate authority.

8. No exterior painting shall be undertaken if air or surface temperature is below 10^{o} C or immediately following rain or until frost, dew or condensation has evaporated.
9. Paints, stains, and coatings shall be specifically manufactured for the intended use.
10. The final coats to exhibit uniformity of colour and uniformity of sheen across the full surface area.
11. Ensure compatible paint products are being used on all surfaces.
12. All walls and ceilings, new or existing shall receive at least two finish coats of the specified paint.
13. Cleaning - Specifications will convey the obvious, especially when it comes to cleaning before painting.
14. The paint contractor is responsible for a complete and thorough clean-up of the areas and items painted. Over paint, splatter and spills will be completely removed prior to inspection of the work.
15. Caulking:
    a. The application of painter's caulk shall be assumed within the scope of work:
        i. Joints between wood or wood composite materials, trim, baseboard, molding, and casements. These joints include and are limited to wood to wood or wood composite substrates, and wood to gypsum drywall, plaster or similar wall surfaces. These joints shall only be between field painted surfaces.
    b. The application of painter's caulk shall be assumed not within the scope of work:
        i. Surface defects, cracks, joints, voids or holes greater than 1/8 inch (3.18mm) wide, deep or across in wood, masonry, gypsum drywall, plaster or any other substrate.

1.3.2 Mock Ups

1. Approved Benchmark Sample(s) are established utilizing full scale, on-site surface areas. These shall be prepared using the complete specified or approved paint, coating and/or decorative system. The sample is to include surface preparation, and the application of the primer, intermediate, finish coat and touch-up materials.
2. The Painting Contractor shall prepare and apply the complete coating system as specified in the contract documents to produce the Benchmark Sample(s).
3. The recommended Benchmark Sample area(s) will be clearly defined in the bid documents. Small areas, such as doors, handrails and trim, may have a more practical square footage arrangement, as agreed by the parties involved. The specific number, placement and size of samples will be clearly defined in the bid documents.
4. The Benchmark Sample(s) shall leave exposed a sampling of the approved substrate, before and after any specified surface preparation for the system. In addition, there should be left a separate and individual sampling of each designated and subsequently applied coating and any intercoat surface preparation.
5. In order to determine whether a surface has been "properly painted" it shall be examined without magnification at a distance of thirty-nine (39) inches or one (1) meter, under finished lighting conditions and from a normal viewing position.

1.4 SURFACE PREPARATION

1.4.1 General

1. Clean substrate surfaces free from dust, grease, soiling, or extraneous matter, which are detrimental to finish.
2. Patch, repair, and smoothen minor substrate defects and deficiencies, e.g. machine, tool and sand paper marks, shallow gouges, pin holes, marks, and nibs.
3. Clean, sweep, and vacuum floors and surfaces to be painted, debris and dust free prior to painting.
4. Remove all rust, scale, loose paint and other deleterious matters from existing surfaces which require re-painting. Thoroughly clean and prepare such surfaces to accept positive and permanent bond of new paint finish. If such preparation exposes bare surface, provide touch up primer.
5. Where finish hardware has been installed, remove, store, and re-install finish hardware to accommodate painting. Do not clean hardware with solvent that will remove permanent lacquer finishes.
6. Clean existing cementitious surfaces by pressure washing, indicate on drawings, with a TSP solution and pressure range of 1500 - 4000 PSI at 6 - 12". Rinse areas with clean water and allow to thoroughly dry. Provide for collection and disposal of water.

1.5 PRODUCTS

1.5.1 General

1. For some areas, Architectural Services has a list of standard colours by building. Ensure these lists are consulted prior to producing finish schedule. The colours on the list do not exclude the use of other colors as may be appropriate for a specific project, with prior approval of the Manager, Architectural Services.
2. Paint materials for paint systems shall be products of a single manufacturer.
3. The following manufacturers shall be used unless otherwise approved by the Manager, Architectural Services:
   a. Sherwin Williams
   b. ICI
   c. Benjamin Moore
   d. General Paint
   e. Any proposed substitution must be available in the Guelph and surrounding area and approved by the Manager, Architectural Services.
4. No extra paint to be kept on site or turned over to owner upon project completion.

1.5.2 Finish

1. Surfaces previously painted in Alkyd based product shall be painted over with similar based product or appropriate primer.
2. Sheen - The following is a list of recommended sheens, any changes must be approved by the Manager, Architectural Services.

a. Eggshell – walls
b. Semi-gloss – all trims, doors and high traffic surfaces.
c. Student Residences – All areas to be painted in semi-gloss.
d. Ceilings - Low sheen or flat

3. Interior Paint
   a. 100% Acrylic painting to be generally used.
   b. Epoxy and alkyd painting to be approved by Manager, Architectural Services under special circumstances.
   c. Minimum one (1) coat water base primer/sealer, two (2) finish coats on all surfaces.
4. Doors, metal frames, railings:
   a. Preparation - To wash with TPS (Trisodium Phosphate) all the surfaces and sand. Surfaces preparation to be done adequately to obtain best performance.
   b. Primer - 1 coat, Sherwin Williams, Acrylic, Preprite, Bonding Primer, Interior/exterior, Adhesion Promoting Primer, B51W50 or ICI Paints, Acrylic, ICI X-Pert 250 Gripper, or equivalent system.
   c. Finish - 2 coats minimum, 100% acrylic, semi-gloss finish.
5. Other paint materials such as linseed oil, shellac, turpentine, etc. shall be the highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and shall be compatible with other coating materials as required.

1.6 DEFINITIONS

1. **CRACKS:** For the purpose of this standard: A break in the substrate and/ or surface which can result in a subsequent break in the paint film.
2. **HOLIDAYS:** Application defects whereby small areas are left uncoated.
3. **NORMAL VIEWING POSITION:** For the purpose of inspection a normal viewing position shall be at eye level at a minimum of thirty-nine (39) inches or one (1) meter from the wall. Inspection lighting can be used as defined in this standard.
4. **OVERSPRAY:** The paint that did not hit the intended surface during a spray application. This can appear as small raised specks around the area sprayed and can give a halo effect on smooth surfaces. [MPI] Spray particles that are not wet enough to fuse when they reach the surface being sprayed. As a result, overspray may contaminate property beyond the surface being sprayed.
5. **PIN HOLE:** A minute hole in a paint film that resembles a pore or pin prick, often due to improper solvent release during drying or the trapping of air or gas in the film during setting.
6. **RUNS:** Narrow downward movement of a paint film resulting in an irregular surface.
7. **SAGS:** A coating irregularity similar to runs but often broader in scope.
8. **DEVIATION:** Completed work that is not in accordance with the specification requirements.
9. **AGGRESSIVE ENVIRONMENT (CONDITION):** Examples include but are not limited to: frequent chemical exposures (splash, spillage, fumes), immersion service, secondary containment service, high heat service, marine service and geographic regions with wide temperature ranges, prolonged exposure to ultraviolet rays and high humidity.
10. **AS REQUIRED:** A term requiring no action on the part of the Painting and Decorating Contractor unless directed through references in the plans and specifications.

11. **DEFECTIVE:** Subnormal with respect to written specifications.
12. **DEVIATION:** Completed work that is not in accordance with the specification requirements.
13. **HIDING (Hiding Power)**: The degree or ability of an opaque coating, applied in a uniform film, to cover, mask or obscure the substrate to which it is applied, or the colors underneath. Hiding power is provided by the paint's pigment.
14. **NONCOMPLIANT:** Deficiency in characteristic, documentation or procedure that renders quality of an item unacceptable or indeterminate.
15. **PROPERLY PAINTED SURFACE:** A surface uniform in appearance, color, texture, hiding and sheen. It is also free of foreign material, lumps, skins, runs, sags, holidays, misses, or insufficient coverage. It is also a surface free of drips, spatters, spills or overspray caused by the Painting and Decorating Contractor's workforce.

1.7 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	2013-10-03		

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD RD-02

ELEVATOR

Version	Revision 0
Effective Date	10-08-14
Approved By	Jill Vi... OCT. 23rd. 14
	Manager, Architectural Design, DEC
Reviewed By	Steve ... Dec 1-14
	Director, MES

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1.1 GENERAL

1.1.1 Proprietary Equipment

1. Provision of proprietary equipment, limited or restricted access software and diagnostic tools, or equipment designed with automatic “time out” or “shut down” features will not be accepted.
2. Provide University of Guelph with all diagnostic tools, equipment, software and manuals to allow others to undertake equipment maintenance other than original installer.
3. Under no circumstances shall prototype components or equipment be provided.
4. Arrange that the equipment can be maintained and adjusted by any competent elevator company without the use of proprietary tools, information or equipment or, if such tools, information or equipment are required, provide them (these shall become the property of the owner).
5. Do not incorporate any running time, cycle counters or trip counters that would cause the equipment to shut down or alter its operation in any ways.

1.1.2 Cab Interior

1. Buttons with LED illumination for automatic operation to replace all existing buttons including, door open button, door close button and phone button. Buttons shall be Dupar, US91 Optic C3 with BB button having the following features:
    1. Surround finish shall be mirror chrome.
    2. BB button shall be mirrored steel outer with stainless steel middle.
    3. Bi-illumination features in white/red. Partially light button and Braille in white, and turn halo around button in red when pressed while Braille turns to full white intensity.
    4. Buttons shall be as a minimum 19 mm in size.
    5. All buttons shall be both visual and emit an audible tone when activated.
    6. Number the floor push buttons to correspond with the floors served.
    7. Include corresponding Braille tactile to the left of each button in black anodized aluminum. Tactile to be recessed and studded on the car station. Braille shall be a minimum of 16 mm high and raised a minimum of .75 mm.
2. Ensure the alarm button sounds the alarm bell on the car top.
3. Provide new key switches to include a stop switch, an independent service switch, light switch, inspection switch, emergency light test switch, and a fan switch all contained in a locking service cabinet.
    1. Locking service cabinet shall also include for a 115 volt GFI outlet.
4. Provide a digital dot matrix car position indicator with characters at least 50mm high in size; colour of indicator display to be red.
5. Include for fully volume adjustable passing chimes in the car.
6. Provide a rechargeable battery powered emergency light that is activated immediately upon power failure.
7. Provide for each car, an automatic voice annunciator. The audible signal shall be 10 dBA minimum above ambient, but shall not exceed 80 dBA maximum, measured at the annunciator. Ensure the signal is an automatic verbal announcement that announces the floor at which the car has stopped and direction of travel. Ensure the audible signal also has a frequency of 1500 Hz maximum and sounds as the car passes or stops at a floor served by the elevator. Voice annunciator speaker grille shall be located on the car station or in the

front return. Provide adjustable volume and on/off switch in locking service cabinet for future Owner's use.

8. New car cab interiors shall include, new wall panels, new base frieze and reveals, new flooring, new front returns, new ceiling, re-skinned canopy, new handrail, new bumper rail, and re-skinned transom.
    1. Each side and rear wall is to consist of new Plastic Laminate wall finish.
    2. Front return, car door, door jambs, transom to be skinned in Rimex Stainless Steel 12LG finish.
    3. Side and rear wall panels below the handrail are to be finishes in Rimex Stainless Steel 12LG finish, while the panels above the handrail to be plastic laminate.
    4. Car canopy to be re-skinned in #4 brushed stainless steel.
    5. The reveals surrounding the wall panels and kick-plates are to be stainless steel finish
9. Supply and install on all non-access walls, 38 mm diameter stainless steel handrails with ends returned to wall and securely fastened and spaced 40 mm between the handrail and the wall. Install handrail at a height of 812 mm as measured from top of handrail to floor as per Accessibility for Ontarians Disability Act (AODA) requirements.
10. Supply and install on back wall only, stainless steel bumper rail, ¼" x 3" flat bar, at a height of 229 mm as measured from the top of the rail to the finished floor.
11. Any finish is to be of Architectural Grade with all fastening systems invisible from view from within the elevator cab.
12. Provide four (4) canopy recessed pot lights with stainless steel trims and LED lights. Equally space and locate lights towards the corners of the cab canopies.
13. Re-skin car canopy in #4 brushed stainless steel finish.
14. Flooring: Non-Wax / Maintenance Free Sheet Flooring, no seams, Centura Gerflor or equivalent.
15. Protective Pads & Hooks: Provide one set of custom fitted protective pads for all elevators including pads to fit over the front return and transom areas with a cut out for the car station and locking service cabinet. Cut out should allow for the car position indicator to be visible. Pads shall meet with all B44 Code requirements. Ensure that the protective pad material is well stuffed, has a diamond pattern stitching and is treated with a fire retardant. Supply and install aluminum hooks inside all elevator cabs from which to fasten the pads to the walls.
16. Car Stations: For all elevators, main panel shall be located on the right hand side when standing in the car facing the doors. The stainless steel operating panel is to be a brushed #4 finish.

1.1.3 Hall Stations / Hall Indication / Hall Doors

1. Supply and install new surface mounted stations at all landings in #4 brushed finished stainless steel with extended faceplates such that the centre line of the hall call button or buttons is between 895 mm and 945 mm as measured to the finished floor. If necessary and convenient to the building, install new stations in overtime at no additional cost to the University. Hall buttons shall be from same series and colour as those selected for the car. Retain and reuse where currently provided, stainless steel covers plates behind all existing hall stations. If new covers are required as a result of this work, provide same.
2. Provide new surface mounted hall lanterns and stainless steel faceplates above all entrances of all elevators. All hall lanterns shall be LED illuminated with Green for UP and Red for

DOWN. Engrave at one end of this stainless steel plate, University of Guelph's elevator designation, 50 mm high character, and black in-filled.

3. Supply and install new metal hall door Braille tactile plates on both sides of each door frame with the centre line at 1525 mm to the Braille tactile. Do not reuse existing plates and ensure all glue residual from these existing plates are removed from the frame. Plates shall have stainless steel background with black characters. Ensure Ground floor or main egress is provided with a star symbol. Plates shall meet all Ontarians Disability Act (ODA) Guidelines and as a minimum have characters 50 mm high and at least .75 mm thick.
4. Provide for each car at the ground floor above the entrance, new surface mounted lobby 2 character dot matrix position indicators with characters 50 mm high. Faceplate shall be #4 stainless steel. When car is on independent service, display “IS” on the indicator. Engrave on left hand side of faceplate and 75 mm high, elevator number (E#) and filled in black.
5. Hall doors and entrance frames to be re-skinned at all typical levels in Rimex Stainless Steel 12LG finish.
6. Supply and install for all cars, new aluminum cab sills.

1.1.4 Painting – Machine Room

1. Paint machine room floor in 2 coats of grey enamel using low odor paint. If requested by University due to possible paint odor concerns, carry out this work in overtime at no cost to the University.

1.1.5 Elevator Maintenance

1. Elevator maintenance of elevators shall commence upon Substantial Completion and shall be carried out in accordance with University of Guelph's Maintenance Agreement document, which is to be provided with the Bid and Contract Documents, for a period of twelve (12) months. Include all labour, materials, equipment, and services that are necessary to fulfill the requirements of preventive elevator maintenance in accordance with the requirements of ASME A17.1-2010/CSA B44-10 Safety Code for Elevators inclusive of Article 8.6.1.2, CSA B44.2-10, and the University of Guelph's maintenance requirements as provided in Section 14100, Maintenance Agreement.
2. Make good any defect not resulting from vandalism or misuse, for a period of one year from the Date of Substantial Performance, or at any time during the maintenance contract. Warranty shall cover for both the labour and material associated with the replacement of such part(s).

1.1.6 Controllers

1. CSA microprocessor based non-proprietary controls meeting all of the latest ASME A17.1-2010/CSA B44-10 Safety Code for Elevators and all University of Guelph and Specification requirements.
2. Identify on the Bid Form the make and model of the elevator controller.
3. The elevators shall also offer Independent Service Operation, Automatic, Phase I and Phase II Firefighter Emergency Operation, and future security card provisions including floor tracking.

1.1.7 Drive System – SCR DC Regenerative

1. Supply and install new Regenerative solid-state digital motor drive systems to control speed of the elevator by applying variable power to the motor. Drives shall be either:
   1. DSD 412 as manufactured by Magnetek
   2. System 12 as manufactured by Motion Control Engineering

1.1.8 Door Operator

1. Supply and install on all elevators, new GAL MOVFR closed-loop door operators capable of providing smooth and consistent door operation on each of the car doors.

1.1.9 Door Protection Device

1. Provide new electronic infrared detectors on all cars.
2. Ensure the protection device initiates door reversal at any point of travel, when any object is in the path of the closing door without engaging the object.
3. Ensure the operation of the protection device includes limited door reversal operation or "nudging" and is set-up to operate as per the requirements of the ASME A17.1-2010/CSA B44-10 Code.

1.1.10 Security

1. A minimum of two co-axial RG6/U 75 ohm co-axial cables and 8 pairs of shielded wires per elevator are to be supplied within the travel cables or as a separate travelling cable for future CCTV camera provisions or security card requirements.

1.1.11 Heating, Ventilating, and Air Conditioning

1. Ventilation and temperature control of elevator equipment room to maintain ambient temperatures between 10 to 30 degrees Celsius. Thermostatic control device on the machine room wall should be electronic.
2. Preference for cooling the mechanical rooms is to use chilled water fan-coils with a fan coil located in either the machine room itself, or located in an adjacent space with supply and return ductwork to the elevator room.
3. Remove and dispose of all existing car fans and provide new 2 speed fan for all cars and wired to 3 position switch in car locking service cabinet. Isolate fan from car canopy to ensure noise level of fan shall meet 58 dBA.
4. Provide new stainless steel fan grille in the car canopy.

1.1.12 Machine Room Guarding

1. Supply and install for all elevating devices, machine room guarding in accordance with MOL standards and requirements and to all applicable published guidelines or standards on this topic.

1.2 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	2013-10-08		

University of Guelph - Campus Elevator List
Physical Resources
Design, Engineering Construction

											No. of Floors		
Elevator No.	Building No.	Building Name	Location	Installation No.	Original Make	Mod Contractor	Serial No.	Capasity (kg)	Type	Machinery	Total	Front	Rear
0	71	McLaughlin Library	North west corner, north elevator	17775	Otis			1814	Passenger	MG traction, overhead geared - Duplex	6	6	
1	31	Alexander Hall	West Entrance	64511006	Otis			1588	Passenger	Machine room-less VVVF traction	4	4	
1	71	McLaughlin Library	north west corner, south elevator	17776	Otis			1814	Passenger	MG traction, overhead geared - Duplex	6	6	
1	159	Thornbrough	North Commons	64500568	Otis			2041	Passenger	Machine room-less VVVF traction	4	2	2
2	26	Reynolds		21884	Horn	Delta		1134	Passenger	Hydraulic, with PVC	4	4	
3	71	McLaughlin Library	North East Bank, west	17768	Otis			1814	Passenger	MG traction, overhead geared - Triplex	7	7	
4	71	McLaughlin Library	North East bank, middle	17769	Otis			1814	Passenger	MG traction, overhead geared - Triplex	7	7	
5	71	McLaughlin Library	North East bank, East	17770	Otis			1814	Passenger	MG traction, overhead geared - Triplex	7	7	
6	71	McLaughlin Library	South East	17771	Otis			1814	Passenger	MG traction, overhead geared	7	7	
7	69	Crop Science	Small (east)	17515	Dover			907	Passenger	Hydruaulic, with PVC - Duplex	4	4	
8	69	Crop Science	Large (west)	17514	Dover			1814	Service	Hydruaulic, with PVC - Duplex	5	4	2
9	68	Mackinnon	South West- C Block (south)	17200	Otis			1362	Passenger	MG traction, overhead geared - Duplex	10	10	
10	68	Mackinnon	South West- C Block (north)	17199	Otis			1362	Passenger	MG traction, overhead geared - Duplex	10	10	
11	68	Mackinnon	East wing	17201	Otis			1134	Passenger	MG traction, basement geared	4	4	
12	70	Animal Science & Nutrition	North loading dock	18155	Dover			1588	Service	Hydraulic, with PVC	5	4	2 (rear doors @ B are bolted shut)
13	70	Animal Science & Nutrition	Centre of building	18160	Dover	Schindler with MCE controls		1134	Passenger	Hydraulic, with PVC	4	4	
14	70	Animal Science & Nutrition	South East	18311	Dover			1814	Freight	Hydraulic, original cylinder	5	5	
15	73	McNaughton	North bank, north (large)	18647	Otis			2722	Passenger	MG traction, overhead geared - Duplex	6	6	
16	73	McNaughton	North bank, south (small)	19486	Otis			1134	Passenger	MG traction, overhead geared - Duplex	6	6	
17	28	Hutt		16317	Globe	Delta		1134	Passenger	Hydraulic, with PVC	4	4	
18	59	Trent		15315	Globe	Delta		907	Passenger	Hydraulic, with PVC	3	3	-
19	11	Johnston Hall	West Wing	24201	Armor			907	Passenger	2 speed traction, basement geared	4	4	-
20	11	Johnston Hall	North East side - loading dock	16136	Globe	Delta		680	Freight	Hydraulic, with PVC	2	1	1
21	67	Lambton Hall	South	16159	Delta			1134	Passenger	Hydraulic - PVC integrity unconfirmed	5	5	
22	67	Lambton Hall	North	16158	Dover			1134	Passenger	Hydraulic - PVC integrity unconfirmed	4	4	
23	2	MacDonald Hall		182	Anglo Electromatic	Delta Controller		907	Passenger	2 speed traction, basement geared	4	4	
24	39	Main		36	Cober	Montgomery		907	Passenger	1 speed traction, overhead geared	3	3	-
26	32	Graham Hall		16318	Globe	Delta Controller		1134	Passenger	Hydraulic, with PVC	3	3	
27	31	Alexander Hall	South Wing	9558	Turnbull	Delta		794	Passenger	VVVF traction	4	3	2
28	27	Demolished											
29	27	Demolished											
30	72	South Residence	Mountain Building (72A)	18192	Otis			1134	Freight	Hydraulic, no PVC	3	3	
31	72	South Residence	Prairie Building (72B)	18191	Otis			1134	Freight	Hydraulic, no PVC	3	3	
32	72	South Residence	Maritime Building (72C)	18190	Otis			1134	Freight	Hydraulic, with PVC	3	3	
33	7	Creelman Hall		149	Otis			680	Freight	1 speed traction, basement winding drum	2	2	-
34	18	Richards		215	Anglo Electromatic	Delta		1361	Passenger	VVVF traction	4	4	2
35	73	McNaughton	Book Store freight	18646	Otis			680	Freight	1 speed traction, basement winding drum	3	3	
36	8	Mills Hall		16219	Globe	Delta		1134	Passenger	Hydraulic - PVC integrity unconfirmed	4	4	-
37	31	Alexander Hall	North Wing	9557	Turnbull	ThyssenKrupp		1588	Passenger	VVVF traction	4	3	2
38	172	Lennox Addington	Addington tower	20319	Horn	Delta		680	Passenger	VVVF traction, overhead geared - Duplex	10	10	
39	172	Lennox Addington	Addington tower	20318	Horn	Delta		910	Passenger	VVVF traction, overhead geared - Duplex	10	10	
40	172	Lennox Addington	Lennox hall between A and C	20320	Horn	Delta		680	Passenger	VVVF traction, overhead geared	9	4	5
41	25	MacLachlan		30091	Dover/Turnbull			907	Passenger	Hydraulic, no PVC	4	4	
42	180	East Residence	North	22308	Armor	ThyssenKrupp		907	Passenger	VVVF traction, overhead geared - Duplex	13	13	
43	180	East Residence	South	22309	Armor	ThyssenKrupp		907	Passenger	VVVF traction, overhead geared - Duplex	13	13	
44	159	Thornbrough	Centre of building	22698	Dover			907	Passenger	Hydraulic, buried - PVC unconfirmed	3	3	
45	158	University Centre	North-West corner (west)	27435	Otis			907	Passenger	2 speed traction, overhead geared	6	6	
46	158	University Centre	North-West corner (east)	27432	Otis			1814	Service	2 speed traction, overhead geared	6	6	
47	158	University Centre	South-East corner (north)	27324	Otis			1134	Passenger	MG traction, overhead geared - Duplex	6	6	
48	158	University Centre	South-East corner (south)	27325	Otis			1134	Passenger	MG traction, overhead geared - Duplex	6	6	
49	158	University Centre	North East corner (west)	27323	Otis			1588	Passenger	MG traction, overhead geared - Duplex	5	5	

50	158	University Centre	North East corner (east)	27322	Otis			1588	Passenger	MG traction, overhead geared - Duplex	5	5	
51	12	Central Animal Facility		23646	Dover			1814	Freight	Hydraulic, no PVC, original cylinder	2	2	1
52	49	Pathobiology		28384	Dover/Turnbull	Delta Controller		1814	Passenger	Hydraulic, no PVC	2	2	
53	21	Zavitz Hall		15205	Horn	Delta		907	Passenger	2 speed traction, overhead geared	4	4	
54	45	Large Animal Clinic		39087	Dover/Turnbull	Delta Controller		907	Passenger	Hydraulic, no PVC, partially submergerd	2	2	
55	75	Gryphon Centre		64392	Federal			545	Handicap Lift	Hydraulic, above ground	2	2	
56	72	South Residence	John Eccles Centre	64392	Otis			907	Passenger	Hydraulic, twin post, above ground	2	2	
57	81	Bovey Lab	East end	65031	Dover			1134	Passenger	Hydraulic, buried, no PVC	4	4	
58	81	Bovey Lab	West end	65032	Dover			1134	Passenger	Hydraulic, buried, no PVC	4	4	
61	50	W.F. Mitchell Athletic Centre	Pool to mechanical level below	69059	Delta			1814	Platform Lift	Hydraulic - telescopic	2	2	
62	112	MacDonald Stewart Hall Ext.		71027	Northern/Niagara			1160	Passenger	Hydraulic - PVC integrity unconfirmed	3	3	
63	88	Food Technology Centre	South-West corner	71877	Dover			2270	Service	Hydraulic, buried - PVC unconfirmed	3	3	
64	38	Food Science		71878	Dover			2045	Passenger	Hydraulic - PVC integrity unconfirmed	7	4	3
65	88	Food Technology Centre	North-East handicap lift	72402	Concord			341	Handicap Lift	Roped Hydrualic	2	1	1
66	160	John T. Powell		73543	Concord			454	Handicap Lift	Roped aboved ground hydraulic	2	2	
67	159	Thornbrough	East side	75807	Otis			2041	Passenger	Hydraulic, twin post, above ground	3	2	1
68	43	CRIFS		69257	Unitec			1130	Passenger	Hydraulic, PVC unconfirmed	3	2	1
69	186	East Village Town Hall	Town Hall	77634	Otis			1134	Passenger	Hydraulic, with PVC	3	3	
70	140	Science Complex	North Wing, East end	81060	Delta			1160	Passenger	Hydraulic, with PVC	4	4	
71	140	Science Complex	North Wing, Centre, Freight	81077	Delta			2722	Freight	VVVF traction, overhead geared	6	6	
72	140	Science Complex	North Wing, Centre, Passenger	81061	Delta			1160	Passenger	Hydraulic, with PVC	4	4	
73	175	Central Animal Facility Ext.		84046	Delta			1356	Passenger	Hydraulic, with PVC	2	1	1
74	140	Science Complex	West Wing, North end	83958	Delta			1160	Passenger	Hydraulic, with PVC	6	5	1
75	140	Science Complex	West Wing, South end	83957	Delta			1160	Passenger	Hydraulic, with PVC	4	4	
76	154	MacKinnon Ext.		83451	Otis			1361	Passenger	Machine room-less VVVF traction	6	6	
77	138	Biodiversity		84260	Otis			1134	Passenger	Hydraulic, twin post, above ground	2	2	
78	89	OVC Pathobiology	South-West service elevator	64496748	Delta			2268	Service	VVVF traction, basement geared	6	6	
79	89	OVC Pathobiology	East side passenger, by stairs	64492118	Delta			1160	Passenger	Hydraulic, with PVC	4	4	
80	89	OVC Pathobiology	Lab dumbwaiter	64498892	Bramalea			226	Dumbwaiter	Geared chain driven	2	1	1
DW	174	Clinical Research		19619	Otis			100	Dumbwaiter	1 speed traction, basement winding drum	2	1	1
	135	Biodiversity Genomics			Schindler				Service	Hydraulic, twin post, above ground			

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD RD-03

HARDWARE

Version	Revision 2
Effective Date	March 2021

TABLE OF CONTENTS

1 GENERAL

1.1 COMPLIANCE CRITERIA

.1 These standards generally describe the common hardware and its minimum standard to be used at the University of Guelph. These standards do not describe all situations.

.2 The designer shall meet with a representative of the University lock shop during the design development stage to review the needs for locks and hardware, and ensure the proper functions are applied correctly.

.3 A determination must be made regarding the need for additional security to the project; any enhanced security proposal will be designed to University of Guelph standards.

.4 Functionality is priority over aesthetics.

1.2 MINIMUM DESIGN STANDARDS

.1 In addition to the materials described below, the following procedures apply:

- .1 Where a project has more than $20,000 in architectural (door) hardware, the prime consultant shall specify all hardware as part of the work. The prime consultant shall use an accredited Architectural Hardware Consultant to prepare the specification.
- .2 Where a project has less than $20,000 in architectural (door) hardware, the hardware may be covered with in a cash allowance in the construction contract. The construction contract shall include requirements for preparation of a hardware schedule by an accredited Architectural Hardware Consultant, who may be an employee of the hardware supplier.
- .3 For projects with hardware needs for 10 doors or less, door hardware may be procured from the University Lock Shop via a requisition issued by the University Construction Coordinator/Project Manager/Designate with a minimum of 12 weeks' notice. The Lock Shop will provide and cut all door lock cylinders for installation by the contractor, via a requisition issued by the University construction coordinator/project manager / designate.
  - .1 The above should be reviewed with the University Lock Shop on a project by project basis as the complexity of some smaller projects may revise the expected requirements.
- .4 In existing buildings, the University Construction Coordinator/Project Manager/or Designate shall consult with the Lock Shop to determine if use of Medeco cylinders is appropriate, or if it is appropriate to use lock cylinders that match the existing building conditions.
  - .1 Corbin / Russwin remains the standard cylinder selection.
  - .2 For Student Housing Services, only Corbin to be used.
- .5 When specifying Medeco, the Lock Shop will coordinate the keying Layout and the numbers of keys required. On larger orders, the contractor will receive the cylinders 'pre-pinned' (with construction key). Upon turn over, the construction keys are disabled while the user keys are activated.
  - .1 It is the responsibility of the contractor to ensure the cylinders are turned over in a timely matter to ensure the University Lock Shop has time to change the cylinders before building turnover.

.6 There are no requirements that hardware be purchased from any particular supplier, only that the products specified in the hardware standard are supplied and meet the criteria noted in article 1.5.
.7 All requests for single or multiple electronic door access systems and/or information systems must be directed to the Manager, Electronic Access, who will then forward the request to the University Project Manager for system design approval and implementation. "Stand Alone Units" shall be a 'Genetec System' and of the card or fob design.
.8 Key pad units may be used with prior approval of the University Lock Shop. Key pads are not to be connected to the Genetec System.
    .1 Standard: Kaba E-Plex

1.3 REFERENCES

.1 ANSI A 156.4, Door Controls-Closers
.2 ANSI A 156.15, Life Safety Closer Holder Release Devices
.3 ANSI A 156.18, Materials and Finishes
.4 ASTM B 117, Method of Finish Corrosion Testing
.5 NFPA No. 80, National Fire Protection Association

1.4 SUBMITTALS

.1 Submit manufacturers' product data indicating compliance with reference standards, transportation, storage, handling and installation requirements.
.2 Submit shop drawings and complete hardware lists to the University Lock Shop for review indicating:
    .1 Door locations, sizes, hardware manufacturer's catalogue numbers, finish symbols, abbreviations and quantities required
    .2 Locations and mounting heights of each type of hardware
.3 Supply templates and required information to door and frame manufacturer to enable accurate sizes, locations of cutouts, and reinforcement for hardware.
.4 Keying Schedule: Submit to University Lock Shop the finishing hardware schedule for keying for review. Locks and cylinders are not to be ordered until finalized keying schedule has been approved and the keying schedule returned to the hardware supplier.
.5 Closeout submittals:
    .1 Submit the following for each Product for incorporation into Operation and Maintenance Manuals:
        .1 Hard copy of installation instructions and same information in a searchable PDF format on CD
        .2 Templates
        .3 Finishing hardware schedule
        .4 Maintenance data
        .5 Operating instructions and safety precautions
        .6 Parts list with name and address of supplier
        .7 Lubrication schedule and type of lubricant recommended
        .8 Keys, tools and special devices
        .9 Inspection procedures related to preventive maintenance

1.5 QUALITY ASSURANCE

.1 Manufacturers: Companies specializing in manufacturing door hardware and registered with BHMA.

.2 Hardware suppliers:

- .1 Companies specializing in supplying commercial door hardware for no less than two years, staffed to complete their related work and be acceptable to manufacturer.
- .2 Companies must be available for site visits when requested by University.
- .3 Employ a Hardware Consultant to be available for consultation about hardware at reasonable times during course of work.
- .4 Hardware suppliers require access control service technician on staff with same day service capabilities.

.3 Certifications:

- .1 Employ an Architectural Hardware Consultant that is a member in good standing with the Door and Hardware Institute, whose name shall be stated in tender proposal, to inspect completed installation and certify that hardware has been supplied and installed in accordance with manufacturer’s printed instructions and as specified.
- .2 The hardware supplier shall be a certified install and commissioning company for Kaba-ilco stand-alone locking systems.

.4 Special Conditions:

- .1 Automatic Operators and Activators shall be supplied and installed by authorized personnel who are familiar with the product. Installation shall include all wiring connections including connections for any additional electrified material by others and associated with the operation of the operators.
- .2 All wire, junction boxes, conduit and the like shall be furbished and installed by the Division 16 Contractor. The hardware supplier shall furnish complete riser and wiring diagrams to the Division 16 Contractor, which shall include all necessary supplies required for conductors. Installation of and connections to access control systems specified elsewhere are not included in this section.
- .3 Hardware suppliers will supply, install, commission, and train the owner for all of the material and locks related to the Kaba-ilco stand-alone locks.
- .4 Projects involving even one door replacement/repair/revision must include the University Lock Shop for the approval in the selection of all door hardware. Responsibility for installation to be determined at the time of review.

1.6 WARRANTY

.1 Contractors to submit a warranty in accordance with General Conditions against failure to meet design criteria and requirements, except that warranty period is extended as follows:

- .1 All manual door closers shall carry a manufactures ten (10) year warranty.
- .2 Closers with electrical components shall have a two (2) year manufacturer’s warranty.
- .3 Coverage: Complete replacement including affected adjacent Work.

2 PRODUCTS

2.1 ALTERNATIVES

.1 Materials and equipment specifically described are to be named in the specification for establishing a standard of materials and workmanship to which this supplier shall adhere. The pre-selected suppliers wishing to submit specified alternatives for material or equipment must include the following:
   - .1 Manufacturer and supplier name.
   - .2 Statement assuming full responsibility that any equipment must not exceed the space requirements allocated on the drawings. This supplier is responsible for any additional installation costs resulting from the acceptance of a substitute piece of equipment or product.
   - .3 Subject to the approval of the University Lock Shop.

2.2 GENERAL

.1 Ensure that hardware selected will function correctly and meets contract requirements and Ontario Building Code and authorities having jurisdiction.

.2 Hardware for fire rated and labeled door and frame assemblies shall be ULC listed or as accepted by authorities having jurisdiction.

.3 Fire-rated assemblies:
   - .1 Hardware: Selected and installed in accordance with applicable codes and regulations. NFPA - 80 and to approval of Ontario Fire Marshall.
   - .2 Fire rated doors: ULC labeled hardware. Submit written certification of conformance to ULC requirements for each type of hardware prior to delivery.
   - .3 Locksets and latch sets on fire rated doors: 19mm throw minimum.

.4 Fire-rated doors and frames are to be fitted with the testing agency's listing label. Fire labels for hollow metal doors should be placed on the hinge edge of the door rail, and fire labels for hollow metal frames should be placed on the hinge jamb. Fire labels for solid core wood doors should be placed on either the hinge edge of the door or on the door's top edge.

2.3 MANUFACTURERS

.1 This standard does not describe all situations; the designer must use judgment to supplement the standard as required, for review and approval by the University Lock Shop.
   - .1 Continuous Hinges
     - .1 Continuous hinges are to be used on all doors over 36" wide, on high frequency doors, and doors requiring protection from movable equipment or carts:
       - Standard - Pemko FM Full Mortise series
     - .2 Retrofit of new doors in existing frames or situations which may require plumb or vertical adjustments:
       - Standard - Pemko FM Full Mortise series
     - .3 All new door and frame installations:
       - Standard - Pemko FM Full Mortise series
     - .4 10 year Warranty on all Continuous Hinges
     - .5 When using any continuous hinge featuring the plumb or vertical 'adjusta-screw' it is necessary to order the hollow metal door with hinge side reinforcement. This must be added in at the time of manufacture with a minimum thickness of 10GA.

.6 Approved alternate: Select SL/HD/LL

.2 Hinges (non-continuous)

.1 Standard: Stanley

- FBB191 NRP 630
- FBB168 626
- FBB179- 26D, 114 X 102 - All doors opening into an occupied space, i.e., Offices, classrooms, storage, maintenance rooms, washrooms.
- FBB179 NRP 26D, 114 X 102 - All doors opening from an occupied space into a common area or door adjoining two occupied spaces.

.2 Approved alternate: Hager models

.3 Locksets

.1 Use only barrier-free compliant lever handle mortise locks.

.2 Use of cylindrical or orbit handle locks to match existing locks is not acceptable.

.3 Standard: Corbin/Russwin

- ML2000 Series - NSA 630 - Typical installation
- CL3300 Series - NZD 626 - May be used in a retrofit where the existing doors are prepared for this application or in a suite of offices or rooms, i.e., Residence bedrooms where the main door to the suite is fitted with an ML2000 series

.4 Approved alternate: None

.4 Cylinders

.1 Standard: Corbin/Russwin

- Various keyways to match existing keying system.
- To be Grand Master keyed to University standards, i.e., HO5 and N9
- Medeco High security patent protected institutional keyway Grand Master keyed to University standards. See note 1.2.4. & 1.2.5.

.2 Approved alternate: Medeco – See note 1.2.4. & 1.2.5.

.5 Exit devices

.1 Standard: Sargent 8500 Series, Narrow Style

- ETL trim mandatory on exterior door applications. To be reviewed with the University Lock Shop to determine when interior applications do not require the ETL trim.
- Vertical rod devices only to be used on the interior and not at all exposed to the weather.
- Removable mullions to be key removable type.
  - o Use Sargent 980L for steel doors.
- 8800 series - 630 Finish; typical NFR installation with dogging feature and ETL outside trim design
- For exit only, delete dogging feature and outside trim
- 8600 series - 630 Finish; to be used in areas with cart traffic, i.e., hallways in food areas, loading docks, etc.
- 8900 series to be used in conjunction with RCI-F4114 electric strike for Fire Rated installations
- When functional exterior trim is required use ETL design.
- Use prefix12 on all series for fire rated applications.

.2 Approved alternate: Von Duprin in retrofit situations only.

.6 Door closers

.1 Standard: LCN

- 4041, finish and arm type as required by site conditions
- 1461FC closers will be used in low traffic interior areas

.2 Approved alternate: N/A

.7 Bolts

.1 Surface bolts are to be used when possible

.2 Specified product: Glynn Johnson

- 1631- US2G, Lower bolt
- 1632- US2G, Upper bolt
- 1631- L-US2G, Locking bolt

.3 All surface mounted applications to be fastened with thru-bolts

.4 Approved alternate: Ives

.8 Flush Bolts

.1 Standard: Glynn Johnson

- UL-FB6-26-D

.2 Approved alternate: Ives

.9 Electric Strikes

.1 Standard: Rutherford

- 0161 08 24V DC Fail locked, to be used with rim exit device NFR
- 2124 08D 24V DC RH/LH Fail locked to be used with Corbin/Russwin mortise lockset NFR
- 2114 08D 24V DC to be used with cylindrical locksets NFR
- F 4114 to be used in conjunction with Sargent 12-8900 series exit device for Fire Rated installation
- Paired fire door where a typical installation may jeopardize the integrity of the mullion must use an exit device with an electric retractable latch feature.

.2 The power supplies for these products are:

- Rutherford- PS 24V 1.5A
- Rutherford- PS 24 V 3A
- Selection dictated by the number of strikes and the total run.

.3 Approved alternate: HES 9000 series

.10 Door Stops

.1 Floor stops and overhead stops as required by site conditions

.2 Standard: Canadian Builders Hardware

- CBH120 Wall stop, typical installation
- CBH100-CBH120, as site conditions dictate

.3 Wall stops are to be used whenever possible

.4 Approved alternate: Hagar

.11 Door Sweeps

.1 Standard: K N Krowder

- W-24 S-Nylon brush - All exterior and interior doors with an aluminum threshold
- CT50 Automatic - All level threshold doors requiring a door sweep.

.2 Approved alternate: Hagar

.12 Weather-stripping
 .1 Standard: K N Krowder
  - Type: as situation dictates
 .2 Approved alternate: Hagar
.13 Thresholds
 .1 Standard: K N Krowder
  - CT series, Handicap with frost barrier at all exterior doors, Aluminum Finish
  - CT series, Handicap, fire rated for all other doors requiring a threshold, Aluminum Finish.
 .2 Approved alternate: Hagar
.14 Power Door Operators
 .1 Besam SW200 electro-hydraulic opener for exterior and heavy use applications.
 .2 Ditec HA8 operators preferred choice for low use and interior applications.
.15 Removable Mullions
 .1 Standard: Sargent
  - EL980 to be used on paired openings in conjunction with electric strikes on exterior and non-fire rated doors only.
  - 12-L980 on all fire rated paired openings not exceeding 8'-0" x 8'-0"
  - Locking mullions to be keyed alike
 .2 Approved alternate: None
.16 Pull Handles / Push Plates / Kickplates
 .1 Standard: Canadian Builders Hardware - CBH design as site conditions dictate.
  - Avoid the use offset pulls whenever possible.
 .2 Approved alternate: Hagar
.16 Concealed Rods
 .1 Standard: Sargent
 .2 Acceptable for use if ordered with doors and when panics and mullions are required.
 .3 If used mullions and electrified panics must be used.

2.4 MANUFACTURED UNITS

.1 Door Pulls
 .1 Where door pulls are scheduled on one side of a door with a push plate on the other side, pull is to be installed with flat head thru bolts and the push plate mounted in such a manner to cover the heads of the bolts. Push plates drilled and exposed bolt heads will not be accepted.
.2 Kick Plates
 .1 Mop Plates and Push Plates shall be finished in material as specified, 1.27 mm and shall be free of rough or sharp corners or edges.
.3 Thresholds
 .1 Supply complete with countersunk holes, screws, and anchors as required. Length of thresholds equal to door width. Confirm threshold sizes before ordering.
.4 Door Closers

.1 Provide with back checking feature and of proper size to operate door efficiently. Where non-size closers are provided, installer to adjust closer for size as per manufacturers chart.

2.5 KEYING

.1 Where keying into an existing system, match existing, keying to University standards

.2 All Medeco system lock sets and cylinders are subject to the following:

.1 Master keyed under one existing recorded Medeco Biaxial master keyed (MK) system.

.2 Keyed alike (KA) or keyed different (KD) as noted on the schedule.

.3 Cylinders will be construction keyed or the hardware supplier will provide temporary cylinders keyed alike and at the Hardware Suppliers expense; exchange the temporary cylinders with the proper Corbin or Medeco cylinders, depending on project.

.4 Keyed alike groups: as determined by the Consultant and/or University.

.5 Supply to Consultant and University four master keys.

3 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	2013-10-16	All	Creation of standard
1	2020-02-24	All	Overall update of standard
2	2021-03-03	All	Overall update of standard

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD RD-04

SIGNAGE STANDARD

Version	Revision 1
Effective Date	March 2020

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UNIVERSITY of GUELPH

Signage Design, Principles & Standards

All signage requests to come to Physical Resources and be initiated through a work order, see Physical Resources website for details www.pr.uoguelph.ca

EXTERIOR:

Major Entries: UofG identifier stainless steel signs

Secondary Entries or Features: to be built into feature walls as engraved back painted stone.

Major Spaces: courtyards and gardens may have stainless steel dimensional Lettering, pin mounted in space as appropriate. See Exterior signs.

Window Treatments:

- Etched/Frosted look - may be used for certain areas, department identification and logos. Must be reviewed with Physical Resources for permissible applications
- Full colour graphics, perforated vu thru, wraps and logos - are not permitted.

To maintain quality and consistency, all signs need to adhere to the guidelines and drawings contained in this document. If the proposed sign is to deviate from the signage depicted herein, the design needs to be developed through Physical Resources, Design, Engineering and Construction, Architectural Services (PR, DEC, Arch. Service). In consultation with Communications and Public Affairs.

INTERIOR:

Standardizing interior signs in important to maintain consistency and establish a familiar sign that is easily recognized by the University of Guelph Community to easily identify interior room numbers, departments, washrooms, donor naming, etc. New or additional signage in existing buildings will follow standards as listed in this document. Convex sign system should replace all old sign systems wherever possible.

All new buildings will employ the current convex system and the proposed interior signage package is to be reviewed by PR, DEC, Arch. Services.

All main entries will have a full colour life safety map and directory as appropriate. Where upgrades occur in existing buildings with older signage systems, typically with 10 or more signs in a general area, the replacement would be the convex system detailed in this document. Life safety maps to be updated with any major renovations or additions. Main internal directional signage will be done in convex system.

NAMING POLICY

All Naming must adhere to the University of Guelph Board of Governors Naming of Facilities Policy approved, Dec. 2nd, 1999, ie. the Board of Governors shall govern the naming of University of Guelph facilities to their set criteria.

All buildings should be clearly named at their main entrances, preferably at the edge of the walkway. Where large buildings have more than one important entrance (or where faculties share buildings but use different entrances) these should also be signed, but less prominent. Building numbers should not be posted as a part of signage. Building naming has to be approved by PRPC in accordance with the policy. ‘New’ should not be used in the name of a Building and ‘Building’ is typically not used. Naming department or unit is to be avoided as this changes too frequently. Any change affects printed maps, sign maps, lists and information with City of Guelph.

Digital, Electronic or Illuminated Signage:

All digital signage must be developed with Kevin Jinde kjinde@uoguelph.ca

UNIVERSITY of GUELPH

University of Guelph Branding

It is important to the campus experience to have consistent signage that fits within the University of Guelph Brand Guide.

For the most current University of Guelph Brand Guide: **http://www.uoguelph.ca/brand-guide/**

Please follow this link to determine best practices for:

LOGO

COLOURS

FONTS/TYPE STYLES

BRAND VOICE

MESSAGING

IMAGERY

ACCESSIBILITY

OTHER RESOURCES

Text Visibility Chart

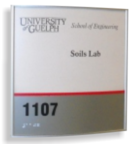
MAXIMUM READABLE DISTANCE	READABLE DISTANCE FOR MAXIMUM IMPACT	LETTER HEIGHT
100’	30’	3”
150’	40’	4”
200’	60’	6”
350’	80’	8”
400’	90’	9”
450’	100’	10”

*Text sizes are to be used as guidlines only. Size should be looked at in context with function in mind when text height is determined.

UNIVERSITY of GUELPH

Interior Way Finding

Primary Sign System - Aluminum Convex and Auxiliary Signs



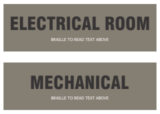
SIGN 1

SIGN 4

SIGN 4A

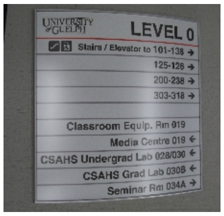
SIGN 6, 6A

SIGN 8



SIGN 2a

SIGN 2b



SIGN 9

SIGN 3

SIGN 3A

SIGN 5

SIGN 7

SIGN 10

Secondary Sign System - Acrylic

used for matching existing systems where necessary

UNIVERSITY of GUELPH

Primary Sign System - Aluminum Convex and Auxiliary Signs

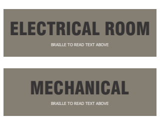
SIGN 1

SIGN 4

SIGN 4A

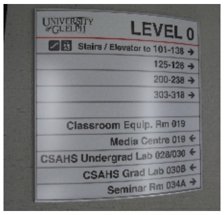
SIGN 6, 6A

SIGN 8



SIGN 2a

SIGN 2b



SIGN 9

SIGN 7

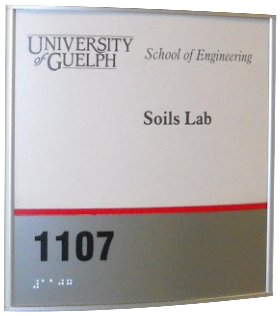
SIGN 3

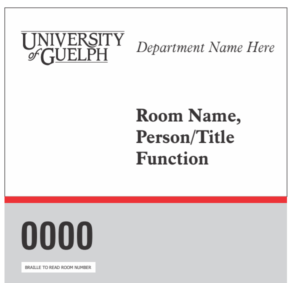
SIGN 3A

SIGN 5

SIGN 10

Office/Room - Sign 1





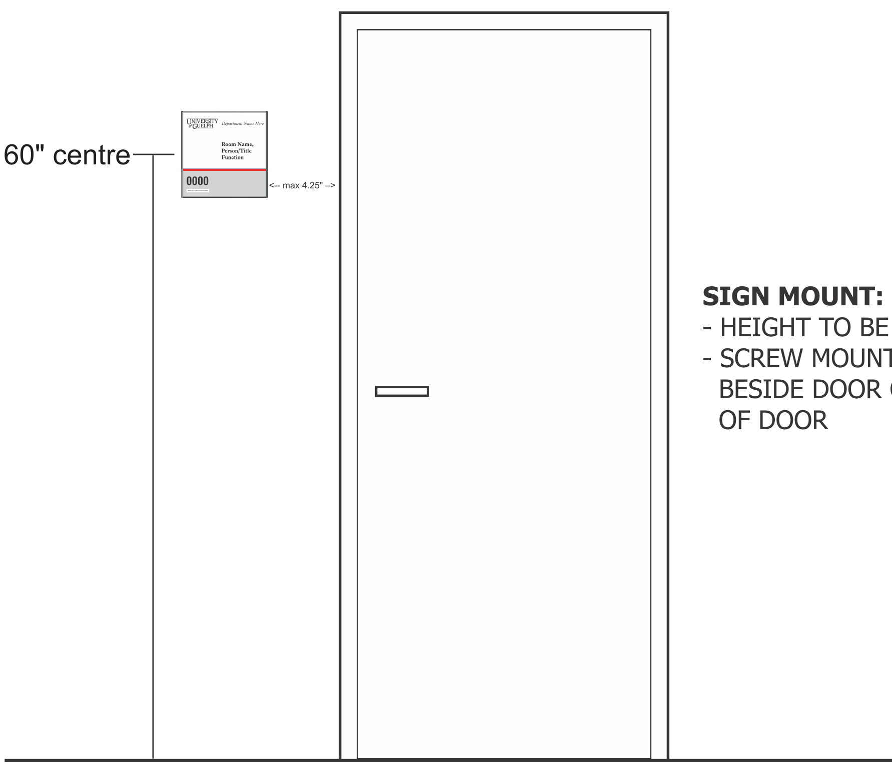
<u>aluminum end caps - top/bottom</u>

<u>top portion:</u>
printed paper insert 8.5" w x 5.625" h
logo top left as shown
font: Aldine 401BT as shown
clear non glare plexi cover 8.5" w x 5.68" h

red gravograph <u>separator strip</u> 8.5" w x 3/16" h
(note: strip alternate color black for library only)

<u>bottom portion:</u>
8.5" w x 2.62" h
black tactile room number - Helvetica narrow bold
Clear Braille room number, below tactile
on 29900 silvery/gray Gravograph

NOTE:
replacement separator strips, top or bottom inserts
can be ordered separately as required



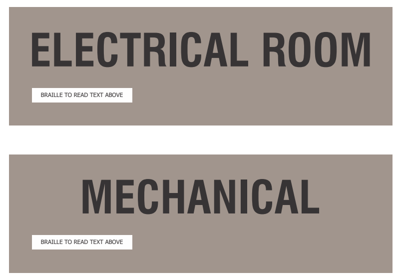
SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- SCREW MOUNT TO WALL SURFACE BESIDE DOOR ON HANDLE SIDE OF DOOR

UNIVERSITY of GUELPH

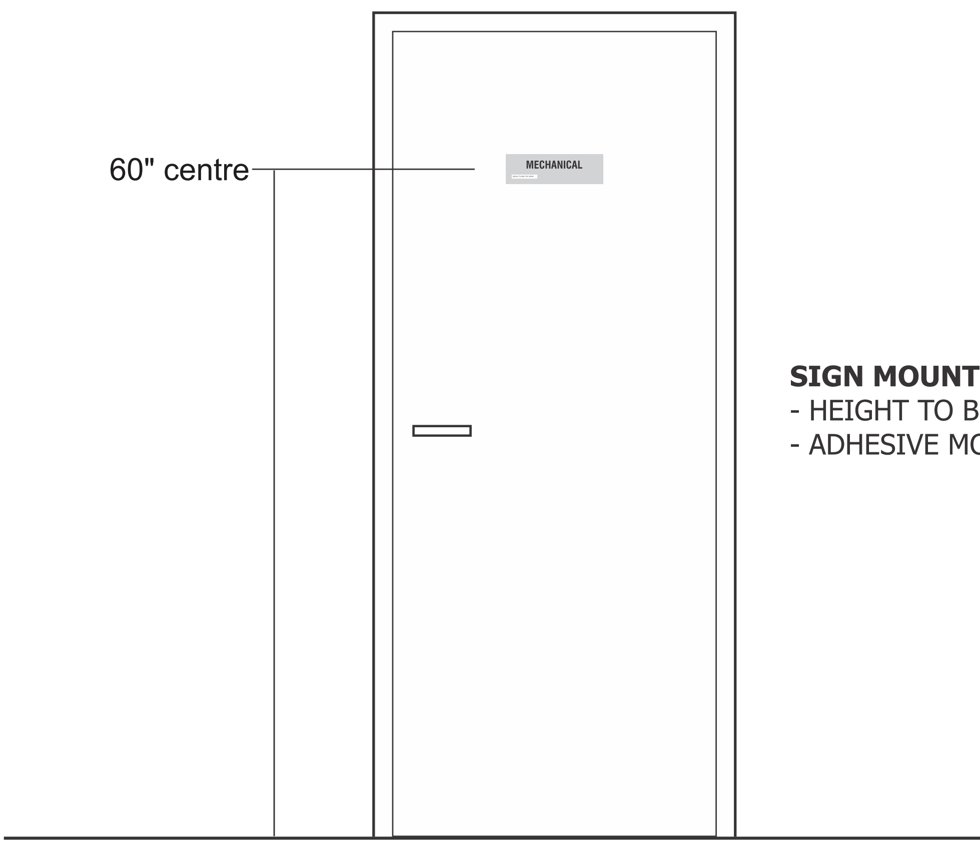
Auxiliary Rooms - Sign 2a

TO BE USED WHEN FULL CONVEX SIGN FORMAT IS NOT REQUIRED

FOR SERVICE ROOMS IE:
ELECTRICAL
HOUSEKEEPING
MECHANICAL
COMMUNICATIONS



BLACK TACTILE
CLEAR BRAILLE
ON 29900 SILVER GRAY GRAVOGRAPH
WITH DS TAPE ON BACK TO MOUNT TO DOORS



SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- ADHESIVE MOUNT TO DOORS

Auxiliary Rooms - Sign 2b

TO BE ORDERED WITH SIGN PACKAGES TO NOTIFY THE MAXIMUM OCCUPANCY OF ANY ROOM USED FOR 60 OF MORE PERSONS.

EACH ROOM TO HAVE (1) TO BE PLACED ON WALL NEAR EACH ENTRY/EXIT TO THE ROOM.

8" H X 10" W
SINGLE SIDED DIGITAL PRINT WITH LAMINATE
ON 1/8" WHITE PVC
MOUNT WITH DOUBLE SIDED TAPE & SILICONE

EXAMPLE:

MAXIMUM OCCUPANCY

39

Bldg. 068 / Rm. 317

Meeting Rooms - Sign 3

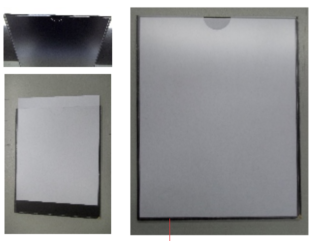
aluminum end caps - top/bottom

top portion:
black tactile "meeting room" - Helvetica condensed bold
blind slider "occupied/vacant" - Helvetica normal caps
on white gravograph
8.5" w x 5.68" h

red gravograph separator strip 8.5" w x 3/16" h
(note: strip alternate color black for library only)

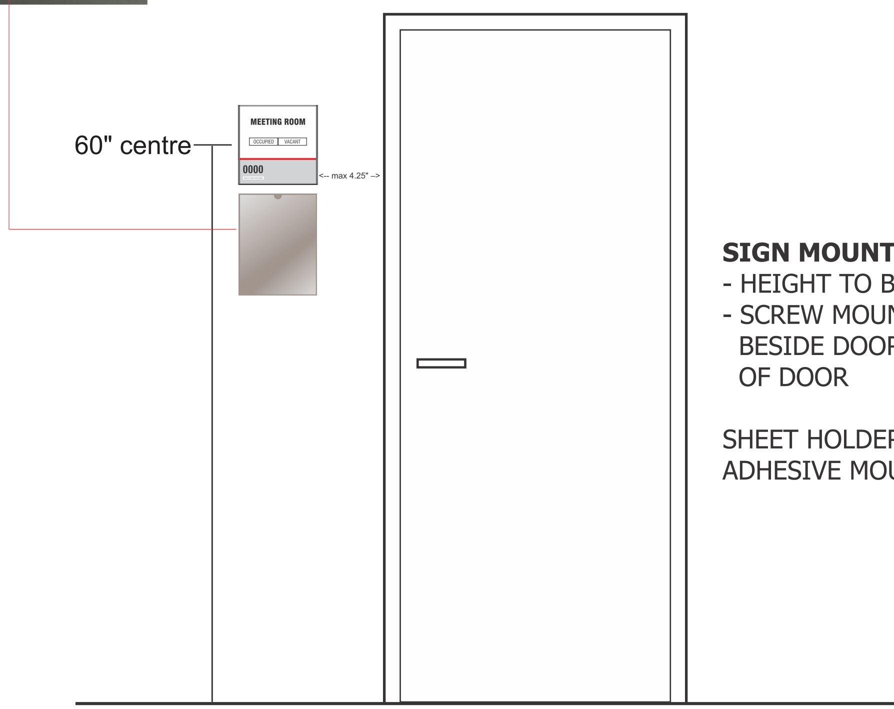
bottom portion:
8.5" w x 2.62" h
black tactile room number - Helvetica narrow bold
Clear Braille room number, below tactile
on 29900 silvery/gray Gravograph

NOTE: replacement separator strips, top or bottom inserts
can be ordered separately as required



OPTIONAL MEETING SCHEDULE SHEET HOLDER SIGN 3A

clear plexi face to fit 8.5" x 11" sheet - thumb notch at top
adhered with 1/16" spacers on sides & bottom to 1/4" thick BLACK or GRAY PVC
for adhesive mount to wall below meeting room sign



SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- SCREW MOUNT TO WALL SURFACE BESIDE DOOR ON HANDLE SIDE OF DOOR

SHEET HOLDERS GENERALLY ADHESIVE MOUNT

Washroom Signs - Sign 4

<u>aluminum end caps - top/bottom</u>

<u>top portion:</u>
black tactile icons
on white
8.5" w x 5.68" h

red gravograph <u>separator strip</u> 8.5" w x 3/16" h
(note: strip alternate color black for library only)

<u>bottom portion:</u>
8.5" w x 2.62" h
black tactile room number - Helvetica narrow bold
Clear Braille room number, below tactile
on 29900 silvery/gray Gravograph

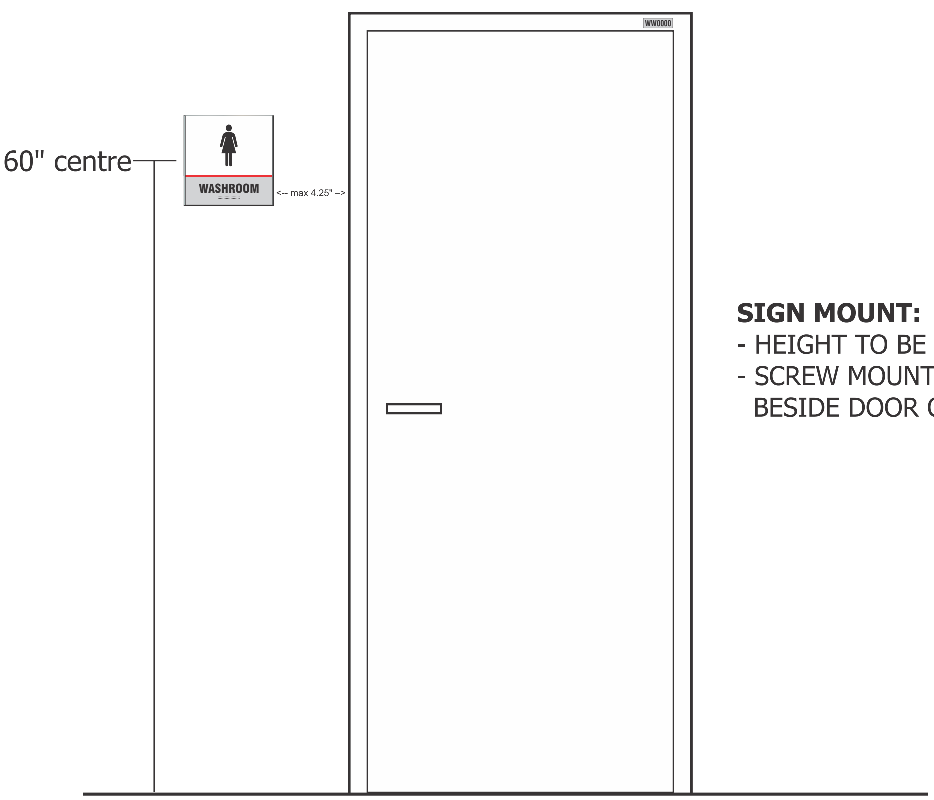
ROOM # TAG - to read
"MW","WW", "WR" + room number
required with all washroom signs as room number
does not go on the braille/tactile area

NOTE:
replacement separator strips, top or bottom inserts
can be ordered separately as required

BRAILLE TO READ: WASHROOM

BRAILLE TO READ: MEN'S WASHROOM

BRAILLE TO READ: WOMEN'S WASHROOM



SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- SCREW MOUNT TO WALL SURFACE BESIDE DOOR ON HANDLE SIDE OF DOOR

Accessible Washrooms - Sign 4a

BRAILLE TO READ:
BARRIER FREE WASHROOM

BRAILLE TO READ:
MENS ACCESSIBLE WASHROOM

BRAILLE TO READ:
WOMENS ACCESSIBLE WASHROOM

<u>aluminum end caps - top/bottom</u>

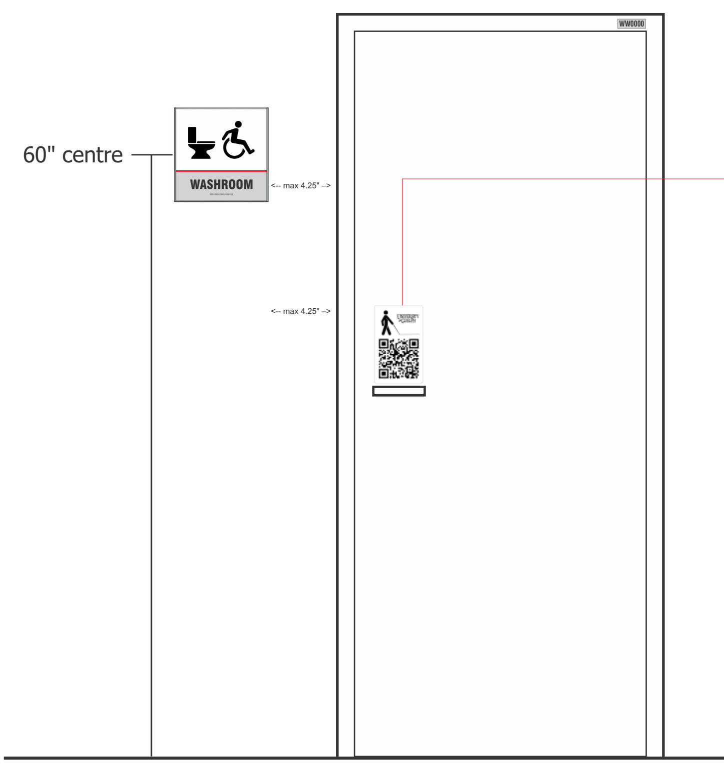
<u>top portion:</u>
black tactile icons
on white
8.5" w x 5.68" h

red gravograph <u>separator strip</u> 8.5" w x 3/16" h
(note: strip alternate color black for library only)

<u>bottom portion:</u>
8.5" w x 2.62" h
black tactile room number - Helvetica narrow bold
Clear Braille room number, below tactile
on 29900 silvery/gray Gravograph

ROOM # TAG - to read "WR + room number"
required with all washroom signs as room number
does not go on the braille/tactile area

NOTE:
replacement separator strips, top or bottom inserts
can be ordered separately as required

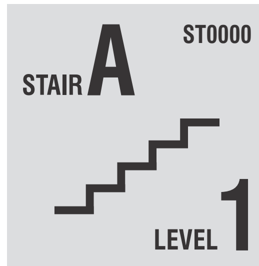


QR BLAZE
ADHESIVE BACK DECAL
BLIND SQUARE IDENTIFIER MUST BE
APPLIED TO EACH UNIVERSAL WASHROOM
OUTSIDE ON DOOR ABOVE HANDLE

<u>INITIATE WORK ORDER WITH</u>
<u>PHYSICAL RESOURCES TO IMPLEMENT</u>

SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- SCREW MOUNT TO WALL SURFACE
  BESIDE DOOR ON HANDLE SIDE OF DOOR

Stairwells - Sign 5

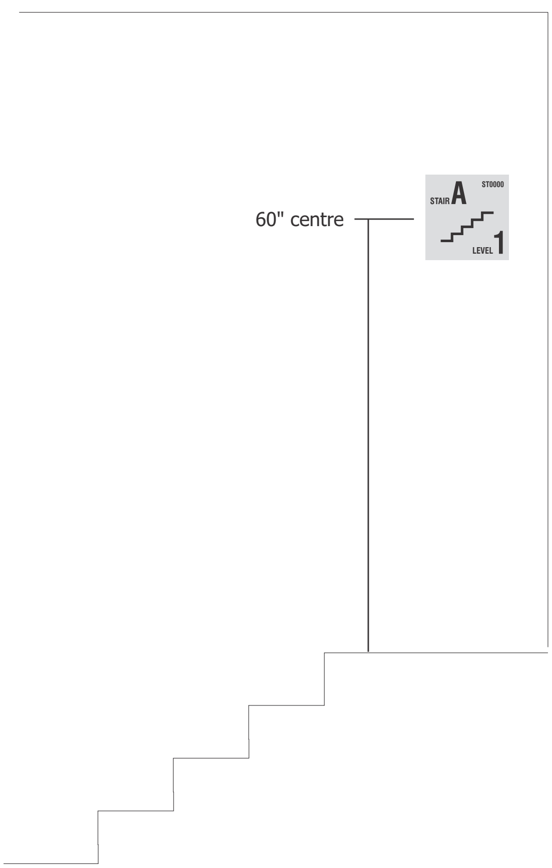


STAIR SIGNS
FRAME: 12" x 12"
SINGLE SIDED WALL SIGN
STANDARD ALUMINUM CONVEX
ALUMINUM END CAPS TOP/BOTTOM

INSERT: BLACK TACTILE GRAPHICS
ON 29900 SILVER/GRAY GRAVOGRAPH

← ↙ →
↗ ↑ ↓

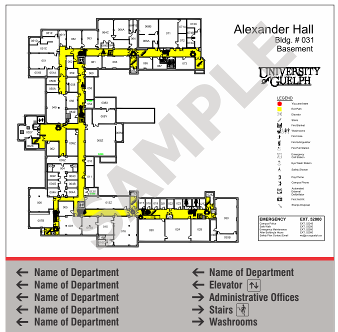
USE STANDARD
STYLE ARROWS



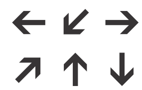
SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- SCREW MOUNT TO WALL SURFACE
- INSTALL ON WALL, CENTRE OF STAIRWELL END WALL WHERE POSSIBLE AT TOP OF STAIRS INDICATING DIRECTION DOWN

TO BE POSTED:
(1) OUTSIDE OF STAIR DOOR
(1) INSIDE STAIRWELL ON STAIR LANDING

Directory with Life Safety Plans - Sign 6

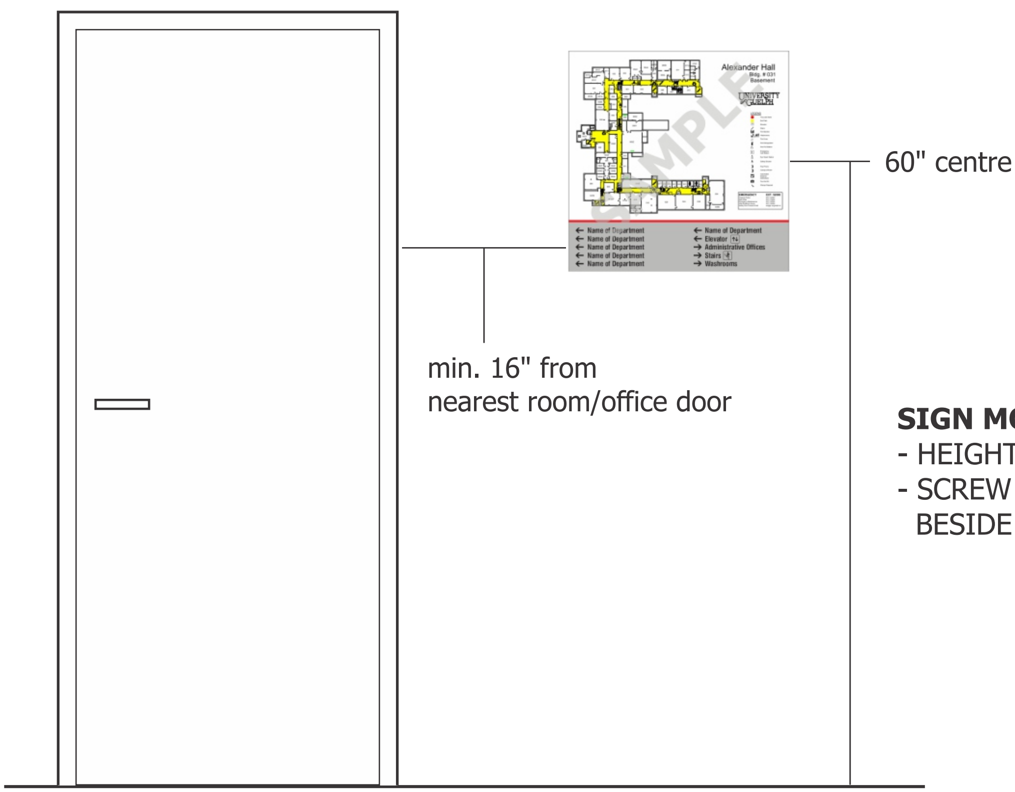


23.625" X 24"
SINGLE SIDED WALL SIGN
STANDARD ALUMINUM CONVEX SIGN FRAME
with ALUMINUM CAPS top/bottom
ALL GRAPHICS SINGLE PRINTED INSERT
with FULL NON GLARE PLEXI OVERLAY
BACKGROUND OF BOTTOM SECTION
TO MATCH 29900 SILVER/GRAY GRAVOGRAPH



USE STANDARD STYLE ARROWS

Directory with Life Safety Plan should be installed in a location viewable upon entry to a building at main entries. See Life Safety Plan standards for details on this insert.



SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- SCREW MOUNT TO WALL SURFACE BESIDE DOOR ON HANDLE SIDE OF DOOR

UNIVERSITY of GUELPH

Life Safety Plan Guidelines

'Life Safety Plans' are part of the University of Guelph Standard Signage.

Their purpose is to enhance basic building information for occupants and are not required under the Ontario Fire Code or authorities having jurisdiction, but may be expected for occupancy.

These signs are to be posted in the main lobby on grade level in a combination sign with the directory. On each floor above and below this, the plan only will be posted in a similar location.

Secondary signs for large buildings will be posted at 50% of main vertical circulation points distributed to cover building, see example life safety plan graphic on the following page. Plans are to be printed 'heads up' (in the orientation of placement) and should be located strategically to minimize the number of orientations required.

The goal is to create a consistent expectation and appearance to Life Safety Plans that communicate to Users in any building on campus the same information. On all major renovations and new builds, Life Safety Plans must be upgraded as a part of the signage package.

Life Safety Plans Requirements:
1. Simplified Plan
a. Locations, orientations and quantities for plans need to be determined with number of orientations being kept as minimal as possible. Choose appropriate template and size:
 - USE FOR SMALLER BUILDING 11” H X 17” W
 - USE FOR LARGER BLDG 18" H X 23.62" W
 - FOR DIRECTORY/LIFE SAFETY PLAN COMBINATION SIGN - 24" H X 23.625"
 The size of the Life Safety Plan should be determined by the building complexity and clarity of details.
 For new signs the final sizing and locations must be approved by Manager Architectural, P.R., DEC.
b. If the building is complex or connected to another building than the Life Safety Plan should show this relationship in an overall Key Plan with the hatched side indicating the applicable area.
c. Remove Elevator, Stairs and Washroom details, add symbols to replace.
d. All main corridors used by the public are shaded yellow
e. The Signage provider can place the 'you are here' dot on plans during printing or install.
f. For the Key Plan outline the building using PLINE on LS_Symbols with a Global Width of .00262628, infill the outline with Hatch style Dots, Scale .00873
g. All walls to be put on layer AWLEXT. Hatch walls with AWLHAT, SOLID.
h. Contact Project Lead or Manager Architectural Design, Engineering and Construction in Physical Resources for layout, design graphic template

2. Safety and General Information
a. Add U of G identifier, Building Number and Level see example life safety plan graphic on following page.
b. Inventory Life Safety features and add standard symbols to legend. The legend for standard symbols should be kept to the right or bottom of the building plan as space best allows. Symbols on plan should be similar in size to the legend. Only safety features in main corridors need to be inventoried and added.
c. Emergency contacts to be added to lower right hand corner of plan. This should only include: Emergency exit., Campus Police ext., Safe Walk ext., After Hours Maintenance, safety plan updates contact email: wo@pr.uoguelph.ca
 This information should have border around it and be below or to the side of the safety symbol legend.

3. Printed Signs and Holders
a. Convex signs per our standard are the preferred holder for printed inserts, see 1a. above for typical sizes. Printed inserts can simply be replaced where holders are in good shape, location and standard sizing.
c. Where quantity or environmental conditions warrant, printed vinyl graphics with matte clear UV laminate on 3mm ACP (Alupanel) panels are acceptable, eg. residences.

for Physical Resources: reference template file: K:\SAFETY PLANS_TEMPLATE.
Plot style available at Drawings/ Safety Plans/Templates/ Plot Styles

On all major renovations and new builds, Project Lead must ensure that the Life Safety Plans are upgraded as a part of the signage package. The consultant engaged on the project is typically the best choice to have this simplified plan and inventory for placement of icons.

Consultants to submit PDF version and CAD version to the University and filed in the building folder under Drawings/ Safety Plans/###(building number), 075N001_LS 2015

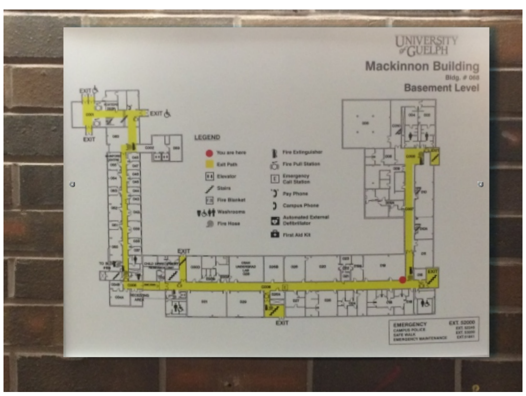
Update locations and orientations on Life Safety Plan tracking spreadsheet, located at G/DEC/Architectural/Signage

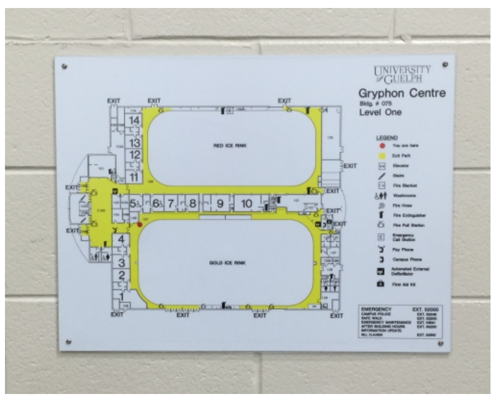
Life Safety Plan Signs - Sign 6A

Choose appropriate template and size:
- USE FOR SMALLER BUILDING 11” H X 17” W
- USE FOR LARGER BLDG 18" H X 23.62" W
- FOR DIRECTORY/LIFE SAFETY PLAN COMBINATION SIGN - 24" H X 23.625" W

The size of the Life Safety Plan should be determined by the building complexity and clarity of details.
For new signs the final sizing and locations must be approved by Manager Architectural, P.R., DEC.

SINGLE SIDED WALL SIGN
STANDARD ALUMINUM CONVEX SIGN FRAME
with ALUMINUM CAPS top/bottom
INSERT - PRINTED ON HEAVY POSTER STOCK with FULL NON GLARE PLEXI OVERLAY



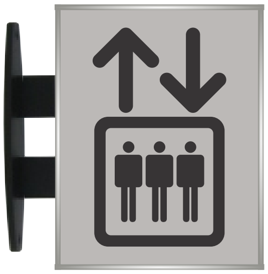


WHERE QUANTITY OR ENVIRONMENTAL CONDITIONS WARRANT,
PRINTED VINYL GRAPHICS WITH MATTE CLEAR UV LAMINATE
ON 3MM ACP (ALUPANEL) PANELS ARE ACCEPTABLE, IE: RESIDENCES
SINGLE SIDED WALL SIGN
HOLE IN EACH CORNER FOR SCREW MOUNT WITH WALL PLUG

NOTE: YOU ARE HERE TO BE CLEARLY NOTED ON ALL LIFE SAFETY PLAN GRAPHICS

UNIVERSITY of GUELPH

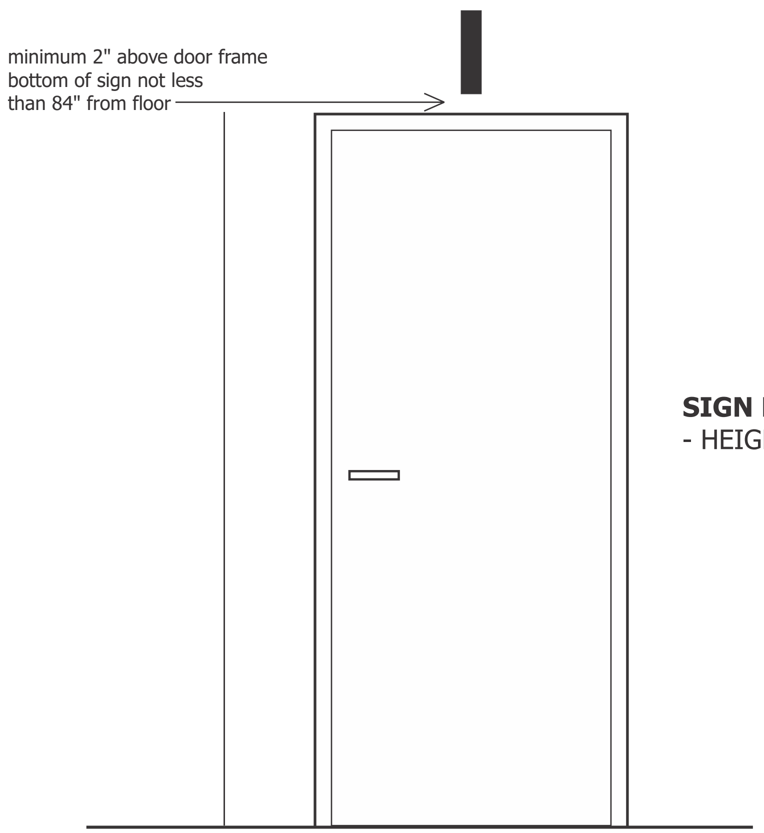
Elevators - Sign 7



ELEVATOR SIGNS - DOUBLE SIDED
8.75" h x 6" w
(2) SINGLE SIDED CONVEX SIGNS
MOUNTED BACK TO BACK ON BLACK METAL CORRIDOR BRACKET
BLACK VINYL GRAPHICS
ON 29900 SILVER/GRAY GRAVOGRAPH

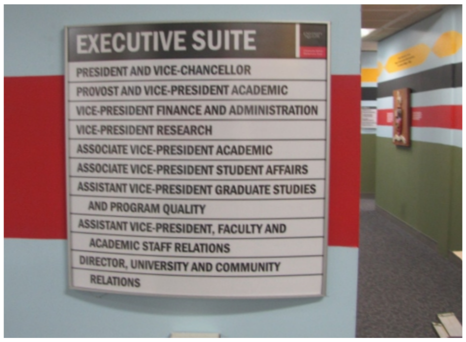
Double Sided Corridor - Sign 8

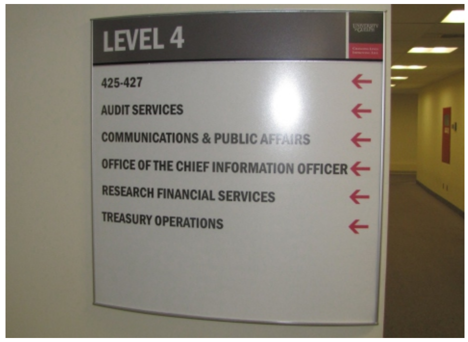
DEPARTMENT or
CORRIDOR DIRECTIONAL SIGNS
- DOUBLE SIDED
6" h x 18" w
(2) SINGLE SIDED CONVEX SIGNS
MOUNTED BACK TO BACK
ON BLACK METAL CORRIDOR BRACKET
BLACK VINYL GRAPHICS
ON 29900 SILVER/GRAY GRAVOGRAPH



SIGN MOUNT:
- HEIGHT TO BE AS SHOWN

Directional Wall - Sign 9



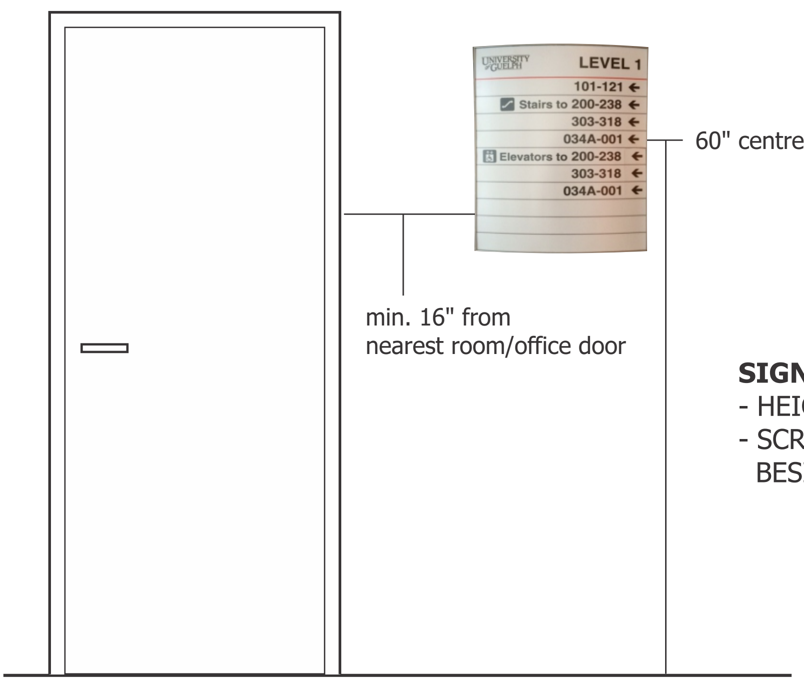


STANDARD SIZES:
12" w x 18" h
16" w x 24" h
24" w x 24" h

← ↙ →
↗ ↑ ↓

USE STANDARD STYLE ARROWS

SINGLE SIDED WALL SIGN
STANDARD ALUMINUM CONVEX SIGN FRAME
with ALUMINUM CAPS top/bottom
INSERT - PRINTED ON HEAVY POSTER STOCK with FULL NON GLARE PLEXI OVERLAY



SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- SCREW MOUNT TO WALL SURFACE BESIDE DOOR ON HANDLE SIDE OF DOOR

Room Numbering Tags - Sign 10

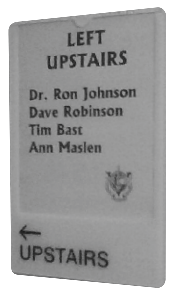
ROOM NUMBERING 1” X 3”
BLACK ENGRAVED LETTERS/NUMBERS
ON BRUSHED SILVER PLASTIC/LAMACOID
BEVELLED EDGES
FULL ADHESIVE BACK

ALWAYS ADHERED TO TOP RIGHT CORNER OF DOOR FRAME

USED FOR WASHROOM ROOM NUMBERS, AND UNNAMED ROOMS

Acrylic Signs

Change system to Convex wherever possible



Acrylic Washroom Signs

CHANGE SYSTEM TO CONVEX WHEREVER POSSIBLE

BRAILLE TO READ: WASHROOM

BRAILLE TO READ: BARRIER FREE WASHROOM

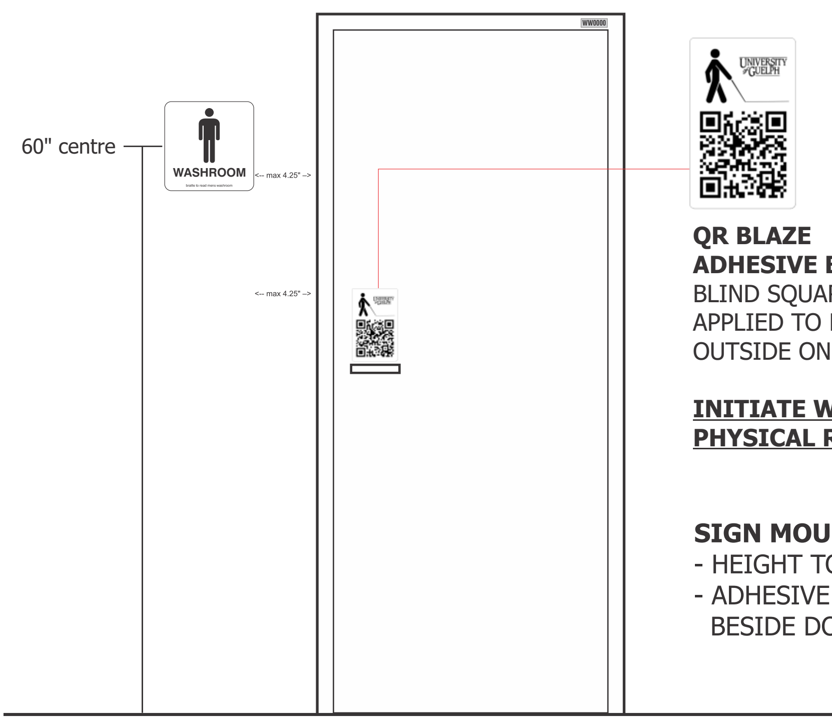
BRAILLE TO READ: MEN'S WASHROOM

BRAILLE TO READ: WOMEN'S WASHROOM

WASHROOM SIGNS

8" x 8" single sided wall sign
black tactile icon
black tactile lettering, clear braille
clear non glare 1/8" plexi
with white opaque block out back up
full adhesive back

ROOM # TAG - to read
"MW","WW", "WR" + room number
required with all washroom signs as room number
does not go on the braille/tactile area



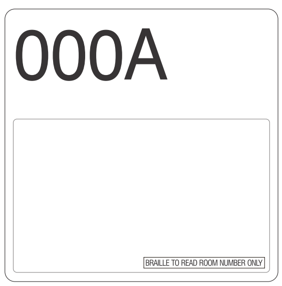
QR BLAZE
ADHESIVE BACK DECAL
BLIND SQUARE IDENTIFIER MUST BE APPLIED TO EACH UNIVERSAL WASHROOM OUTSIDE ON DOOR ABOVE HANDLE

INITIATE WORK ORDER WITH PHYSICAL RESOURCES TO IMPLEMENT

SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- ADHESIVE MOUNT TO WALL SURFACE BESIDE DOOR ON HANDLE SIDE OF DOOR

Acrylic Room/office Insert Signs

CHANGE SYSTEM TO CONVEX WHEREVER POSSIBLE



ROOM SIGNS
single sided wall sign

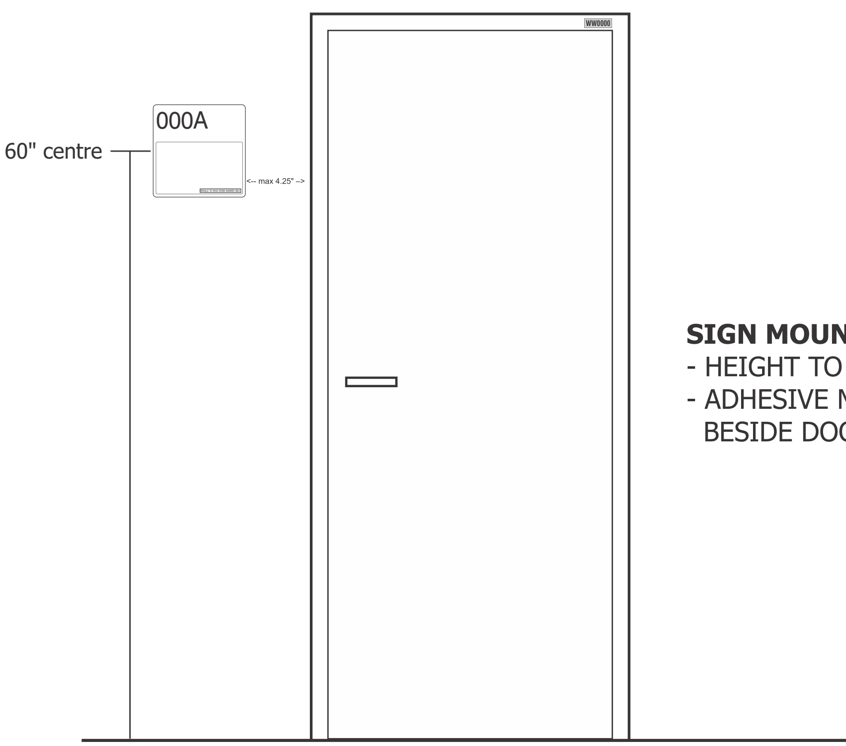
8" x 8"
1/4" radius corners

black tactile room number
on clear non glare 1/8" plexi
white opaque block out border
applied to back
to form sheet holder

clear braille bottom right corner

full adhesive back

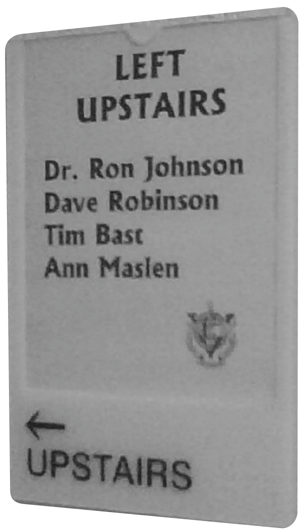
back layer 8"x8" white plexi



SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- ADHESIVE MOUNT TO WALL SURFACE BESIDE DOOR ON HANDLE SIDE OF DOOR

Acrylic Room/office Insert Signs

CHANGE SYSTEM TO CONVEX WHEREVER POSSIBLE



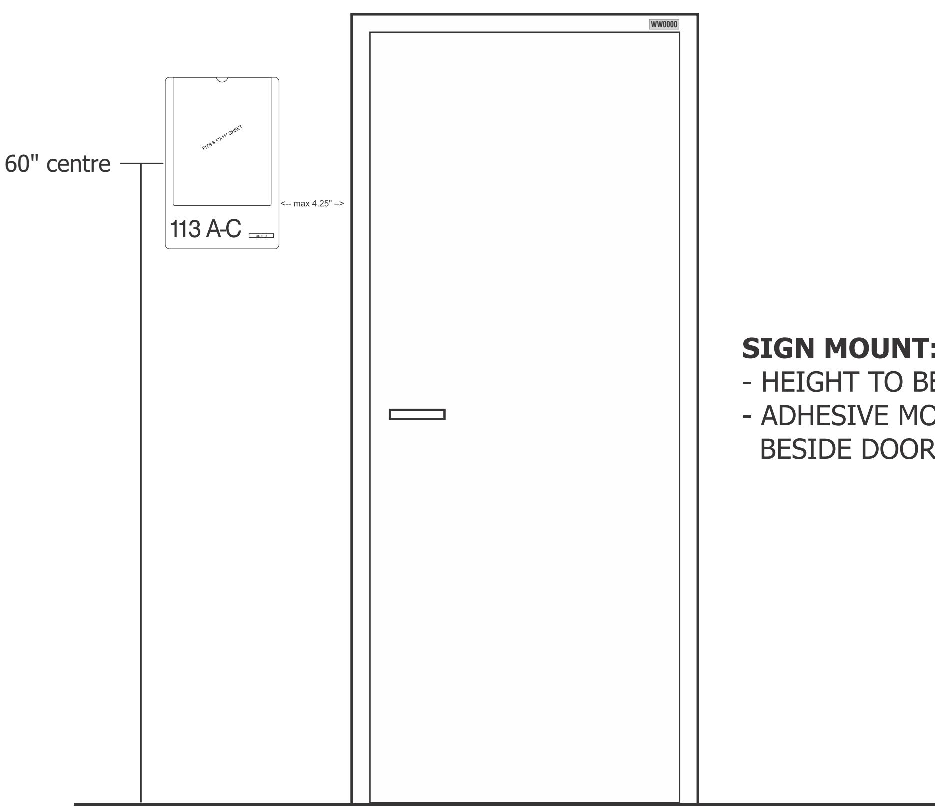
9.625" w x 14.5" h
holds 8.5"x11" paper
1/8" acrylic

1/4" radius corners

front black tactile
room number bottom left
clear braille bottom right

back white vinyl to show through
printed insert

bottom layer white 1/8" plexi



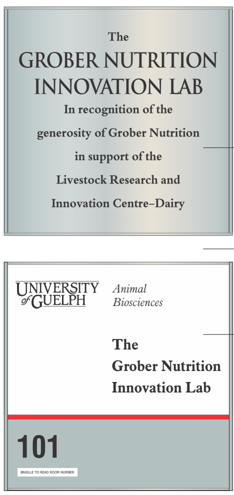
SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- ADHESIVE MOUNT TO WALL SURFACE BESIDE DOOR ON HANDLE SIDE OF DOOR

Specialty Signs

Donor Signage

LEVEL 1 DONOR SIGNAGE - <u>this signage must always be coordinated with Aumni Affairs</u>

up to $ 49,999.00 donations

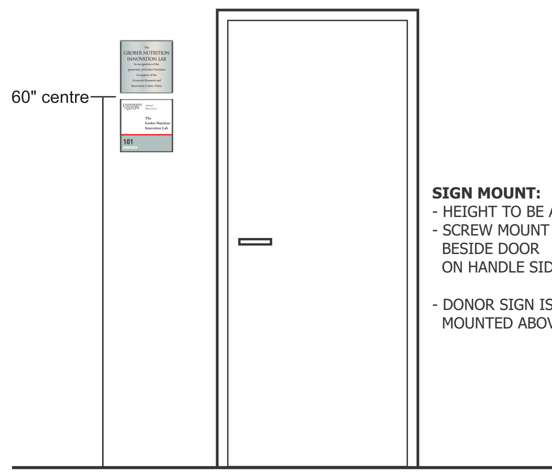


TOP SIGN FOR DONOR INFO:

8.5” h x 8.5” w
SINGLE SIDED WALL SIGN
CONVEX SYSTEM FORMAT
ALUMINUM CAPS
BLACK PRINT ON
BRUSHED SILVER LAMACOID INSERT

1" SPACE BETWEEN SIGNS

BOTTOM ROOM/OFFICE SIGN:
8.5” h x 8.5” w
SINGLE SIDED WALL SIGN
CONVEX SYSTEM FORMAT
ALUMINUM CAPS
TOP: 5.6875" x 8.5"
PRINTED INSERTS WITH NON GLARE OVERLAY
SEPARATOR STRIP: .189" RED
BOTTOM: 2.625" x 8.5"
BLACK TACTILE ROOM NUMBER
BRAILLE ON SILVER 29900 GRAVOGRAPH



SIGN MOUNT:
- HEIGHT TO BE AS SHOWN
- SCREW MOUNT TO WALL SURFACE BESIDE DOOR ON HANDLE SIDE OF DOOR

- DONOR SIGN IS ALWAYS MOUNTED ABOVE ROOM SIGN

LEVEL 2 DONOR SIGNAGE - <u>this signage must always be coordinated with Aumni Affairs</u>

above $ 50,000.00 donations.

BACKER:
WALL SIGN SIZE VARIES
DEPENDING ON CONTENT OF COPY
3/8" THICK CLEAR ACRYLIC
POLISHED EDGES
WITH FULL SUBSURFACE COVERAGE
FROSTED ETCHMARK VINYL
(4) 1" ALUMINUM STAND OFF MOUNTS
LETTERING:
4" HIGH TEXT
1/4" THICK BRUSHED SOLID ALUMINUM
TAPPED FOR BLIND STUD MOUNT TO BACKER
SECURED AT BACK WITH NUTS

Warning & Instructional:

PRINTED ALUPANEL, LAMACOID or PVC SIGNS
to be used for larger signs too extensive to engrave
or for use in harsh interior conditions (ie pool, spa)

DIGITAL PRINT with MATTE FINISH UV LAMINATE
ON 3mm ALUPANEL, 1/8" LAMACOID or .040 STYRENE

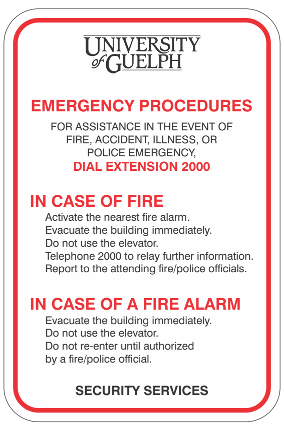
Note: Confirm content, use and colors with Physical Resources.
red is not used in all areas of the campus

Regulation Signs

DIGITAL PRINT
WITH UV LAMINATE
12 GAUGE ALUMINUM SIGNS
ROUNDED CORNERS

OR

ADHESIVE BACK DECALS
FOR INTERIOR DOORS,
GLASS, ETC
9" x 12"
12" x 18"



6" w x 9" h
SINGLE SIDED
DIGITAL PRINT
WITH MATTE UV LAMINATE
3mm ALUPANEL or 1/8" PVC
ROUNDED CORNERS

OR

ADHESIVE BACK DECALS
FOR INTERIOR DOORS,
GLASS, ETC
9" x 12"
12" x 18"

ALL ROOMS WITH 60 or MORE OCCUPANTS
MUST HAVE AN OCCUPANCY SIGN
POSTED NEAR THE EXIT/ENTRANCE DOOR

DIGITAL PRINT WITH LAMINATE
OR ENGRAVED TEXT
SINGLE SIDED
BLACK ON WHITE
1/8" PVC

8" X 10"

DIGITAL PRINT
WITH UV LAMINATE
12 GAUGE ALUMINUM SIGNS
ROUNDED CORNERS

OR

ADHESIVE BACK DECALS
FOR INTERIOR DOORS,
GLASS, ETC
9" x 12"
12" x 18"

BLACK ENGRAVED TEXT/ICON
ON BRUSHED SILVER LAMACOID
ADHESIVE BACK
EXTERIOR USE

6" X 6"

WHITE ENGRAVED TEXT
ON RED LAMACOID
ADHESIVE BACK
EXTERIOR USE

3" x 16"
5" x 24"

Exterior Signs

Directional Signs

Traffic and pedestrian circulation routes in the long-range development plan consist of:
Primary traffic; Ring Roads and McGilvray St.
Primary Pedestrian; A main north south walkway – WineGard Walk, Two main East/West Walkways – Reynolds Walk, Stadium Walk
Signage should reinforce the built environment cues on all of these routes.
Directional pedestrian or vehicular signage as appropriate should be focused on the main routes. Campus maps should be placed at important orientation points along the key routes, always orientated to conventional north.

Location Principles

- Generally one sign will be provided on the turn-off or side road to minimize number of signs.
- Signs must not be located off University property, ie. right-of-ways of municipal roadways.
- Signs must be set back from the road edge suffiiently to allow a driver coming out of the side road a clear view of intersecting street. This type of sign will follow naming guideline above.
- Locations of signs must take into account landscaping, snow plowing and any lighting if applicable.

SIGN A	•	Main Campus Entrances
SIGN B	•	Secondary Campus Entrances
SIGN C	•	Signs for Major Spaces
SIGN D	•	Additional Identifier on Buildings
SIGN E	•	Building I.D. Signage
SIGN E.1	•	Secondary Building I.D. Signage
SIGN F	•	Gateway Maps
SIGN G	•	Post & Blade Street Directional Signs
SIGN H	•	Parking Lot Identifiers
SIGN I	•	Street Signs
SIGN J	•	Map Totem
SIGN K	•	Finger Posts

Exterior Sign A

All signage builds on standards and rules contained in the University of Guelph Brant Guide - https://news.uoguelph.ca/brand-guide/ Any deviations from standard signage standard will be reviewed by Manager Arch. P.R. and Communications and Public Affairs.

Specifically for exterior permanent building, space, and directional signage the following standards will be implemented.

Main Campus Entrances:

At major intersections and entrances to the campus signage and building materials will be consistent with that of the first wall at Gordon and College Avenue. Details of heights and form will change based on need and location but materials and wall design will be uniform at all entrances.   The University of Guelph Identifier in stainless steel (https://news.uoguelph.ca/brand-guide/logos/ - Secondary Logo) will be used at all major entries.

316 Stainless Steel, 3/8" thick, Mount: Flush/#10-24 SS,
Blind stud mount with stainless steel threaded pins and construction adhesive.

Exterior Sign B

All signage builds on standards and rules contained in the University of Guelph Brant Guide - https://news.uoguelph.ca/brand-guide/ Any deviations from standard signage standard will be reviewed by Manager Arch. P.R. and Communications and Public Affairs.

Specifically for exterior permanent building, space, and directional signage the following standards will be implemented.

Secondary Campus Entrances:

Using the same materials and wall detail the secondary entrances will not have the Identifier and will typically be smaller in scale. Signage on these walls will be built into the wall as engraved black painted stone – typically signifying street or nearby feature.

lettering engraved in concrete, infill paint - black, font - helvetica light
All capital letters 5.5" high x appropriate width sized to fit feature wall, wording and location.

Exterior Sign C

All signage builds on standards and rules contained in the University of Guelph Brand Guide - https://news.uoguelph.ca/brand-guide/ Any deviations from standard signage standard will be reviewed by Manager Arch. P.R. and Communications and Public Affairs.

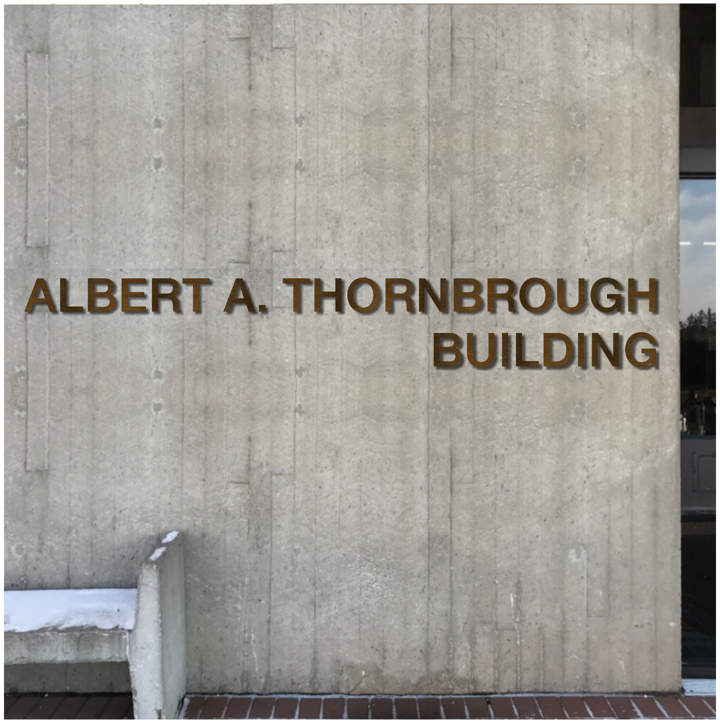
Specifically for exterior permanent building, space, and directional signage the following standards will be implemented.

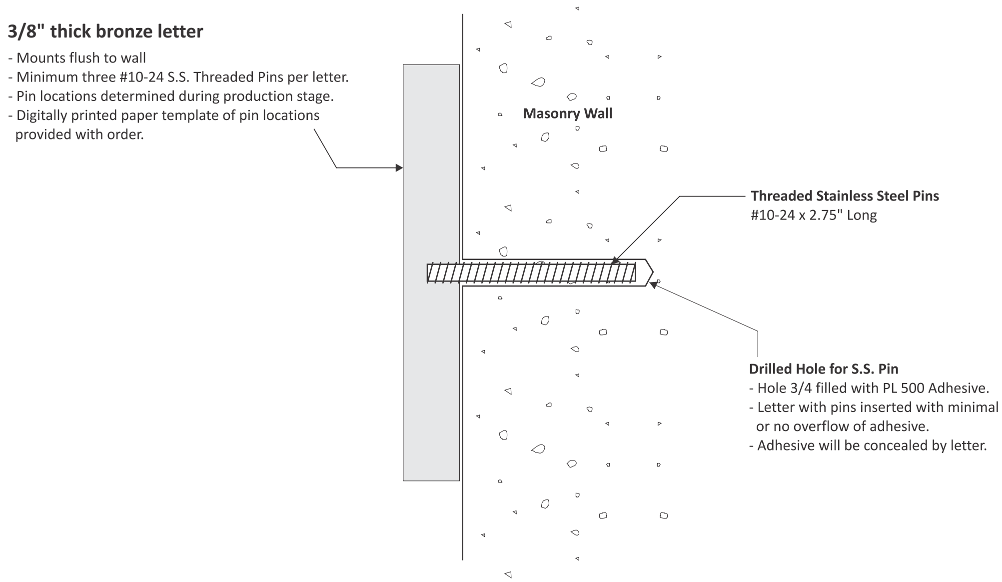
Major Spaces:

Campus spaces and walks will be signed on existing or new walls - as available.
These will be in Helvetica Neue font and be stainless steel for campus wide continuity.
Size will be determined as appropriate for each application.

Additional Identification - Exterior Sign D Dimensional Letters - consult Physical Resources

FONT TO BE USED: HELVETICA NEUE





MATERIAL: STAINLESS STEEL or BRONZE, HORIZONTAL BRUSHED FINISH
THICKNESS: 3/8"
MOUNT FLUSH: #10-24 S.S. THREADED PINS/ADHESIVE

LETTER HEIGHT & MOUNTING PLACEMENT: BASED ON AVAILABLE SPACE, LOCATION, SIZE, ETC.

Exterior Sign E

PRIMARY BUILDING ID SIGNAGE - PLINTH MOUNT and WALL MOUNT

PLAQUE Sign to be anodized Bronze, Br. 40 with engraved copy infilled White.

Font to be Helvetica Light with 5" capital letter height and in Upper and Lower case.

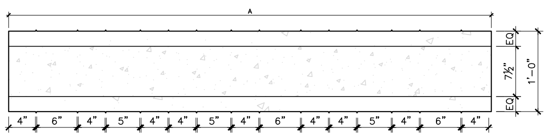
To have concealed mounting hardware, see pages that follow.

PLINTH MOUNT

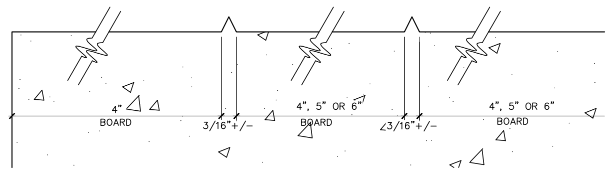
WALL MOUNT

Exterior Sign E cont'd

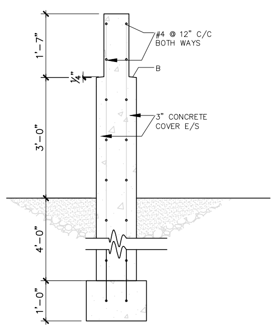
PLINTH MOUNT

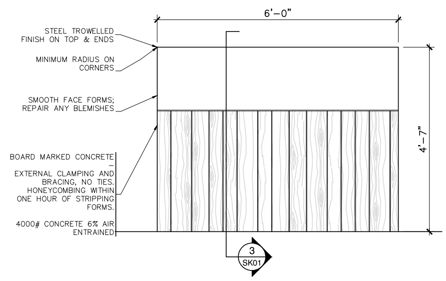


1 PLAN – CONCRETE PLINTH, 'NAMED SIGNS'
SK01 1"=1'-0"



2 PLAN DETAIL
SK01 1'-0" =1'-0"

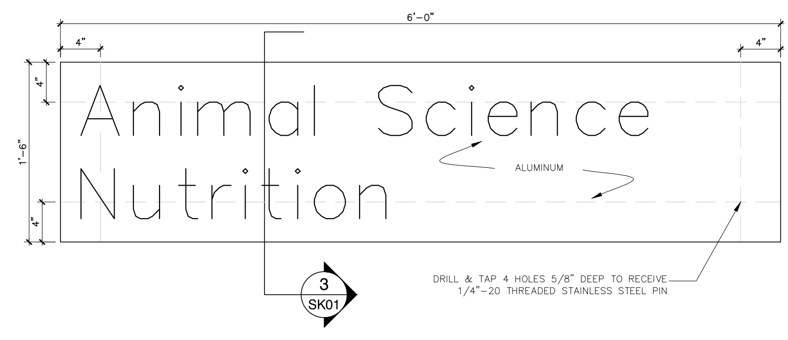




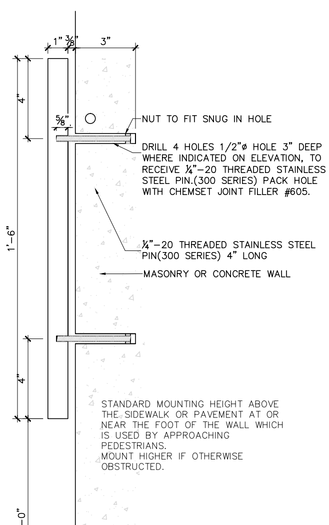
4 ELEVATION – PLINTH
SK01

SIGNS CAN BE 4' or 6' WIDE PLINTH AND/OR WALL MOUNT DEPENDING ON CONTEXT AND LENGTH OF NAME

WALL MOUNT



1 ELEVATION – WALL MOUNTED ALUMINUM SIGNS
SK01



1 SECTION – WALL MOUNTED SIGNS
SK01

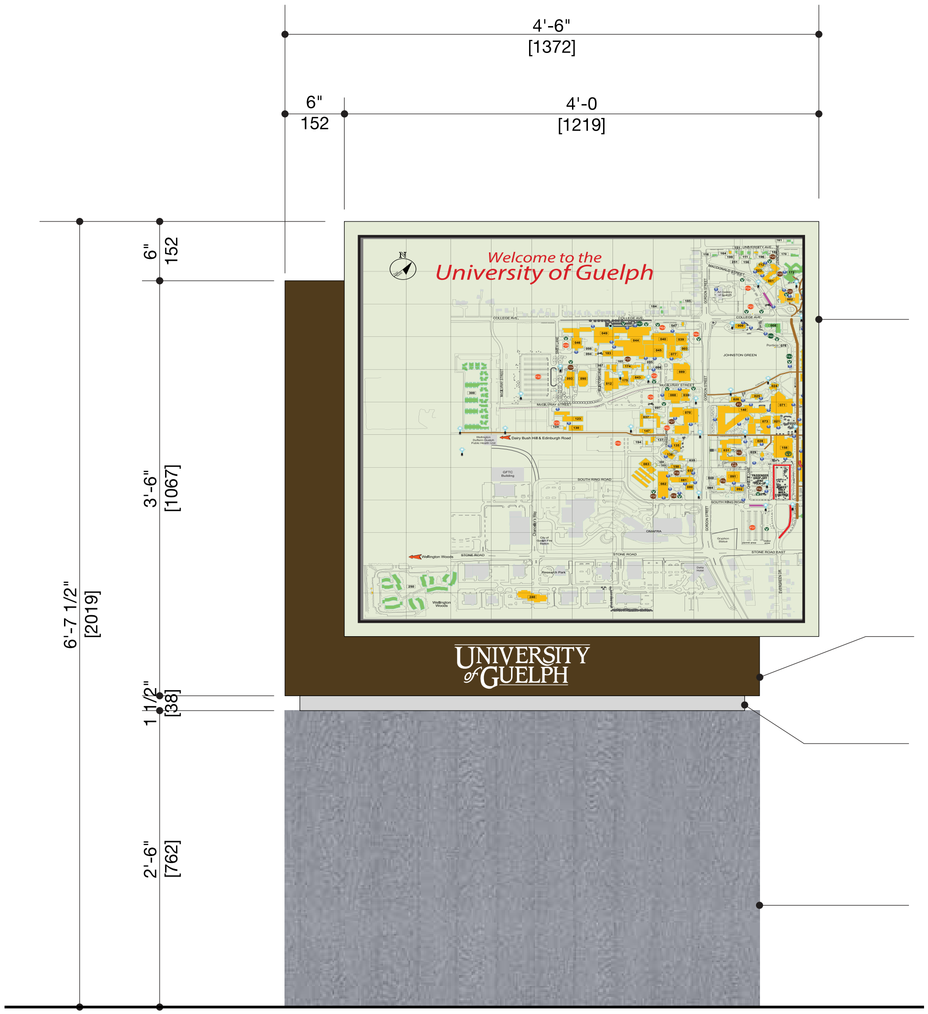
Secondary Exterior Sign E.1

USED FOR LESS PERMANENT AND SECONDARY BUILDING ID SIGNAGE OR INFORMATION.

NOT TO BE USED A PRIMARY SIGNAGE OR DONOR RECOGNITION.

12" - 18" HIGH X 36" WIDE
SINGLE SIDED
6 MM THICK ALUPANEL
WHITE 2MIL LETTERING
SC +900-101-O WHITE
   VINYL LETTERING
WRAPPED VINYL FACES/EDGES
PMS 412 UC 900-198-T

Gateway Map - Sign F

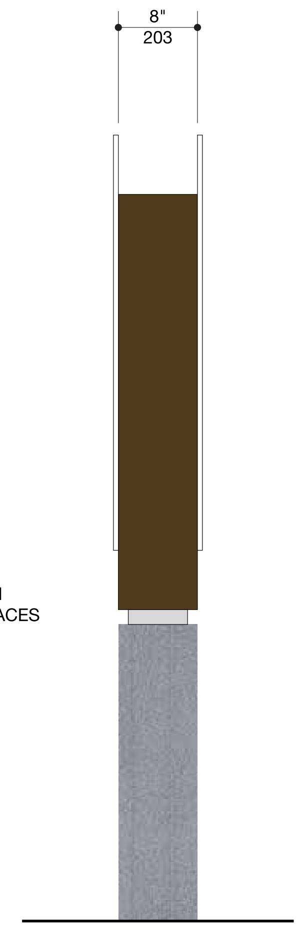


NON-ILLUMINATED MAPS
• FRAMELESS ALUMINUM PANELS WITH DIGITALY PRINTED GRAPHICS *(SAMPLE IMAGE SHOWN)*

SIGN CLADDING
• FORMED ALUMINUM PTD. TO MATCH BRONZE ANODIZED ALUMINUM
• WHITE VINYL GRAPHICS APPLIED TO FACES

REVEAL
• ALUMINUM CONSTRUCTION PTD. SILVER

SIGN BASE
• 'BOARD FORMED' CONCRETE



Face Elevation - Gateway Map

TO MATCH BRONZE ANODIZED

METALLIC SILVER

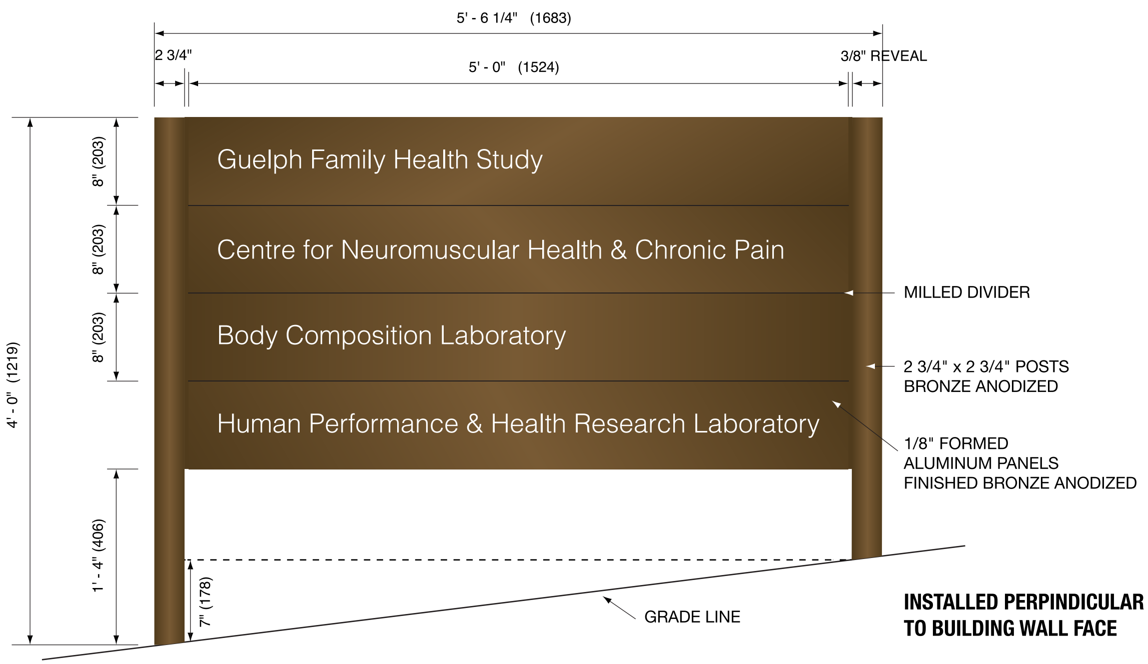
Right Side Elevation

Sign to be located in a safe area for a car to pull over and consult.
Used only at main campus entry points or visitor parking areas.

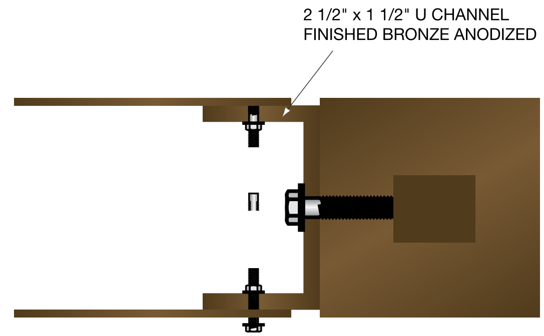
Post & Blade Street Directional Signs G
- consult Physical Resources

Used to provide directions to frequently used non changing departments or features on campus.

TOP VIEW



INSTALLED PERPINDICULAR TO BUILDING WALL FACE



SUPPLY & INSTALL

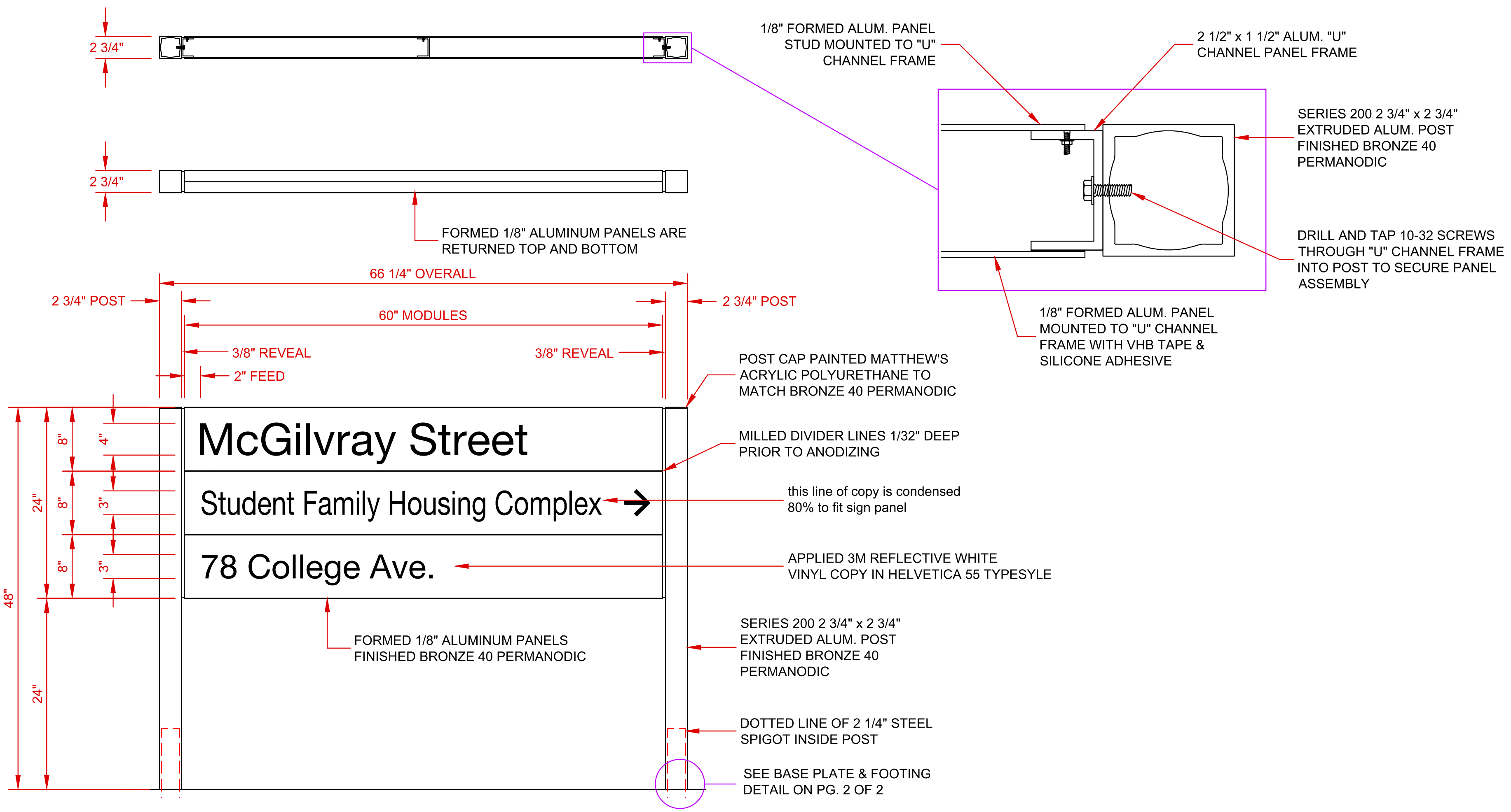
ONE (1) D/S NON-ILLUMINATED GROUND SIGN

- 1/8" FORMED ALUMINUM PANELS
- CUT WHITE VINYL TEXT APPLIED TO FOUR PANELS
- POST AND BLADES TO BE BRONZE ANODIZED
- POST CAPS PAINTED MATTHEWS ACRYLIC POLYURETHANE TO MATCH BRONZE ANODIZED

Vehicular Directional Signs
To provide guidance to drivers of motor vehicles while driver is seated and vehicle is in motion. These signs should be used as a guidance to parking lots, campus information, main sections of campus, directions to buildings frequently visited by non-university people, e.g. War memorial Hall and Small Animal Clinic O.V.C. Directions to truck docks and service entrances of buildings accessible from dead end streets or car parking lots. Directional signs will have a series of panels of standard sizes, see applicable drawing, to simplify production and allow for grouping to avoid clutter.

Post & Blade Street Directional Signs G cont'd

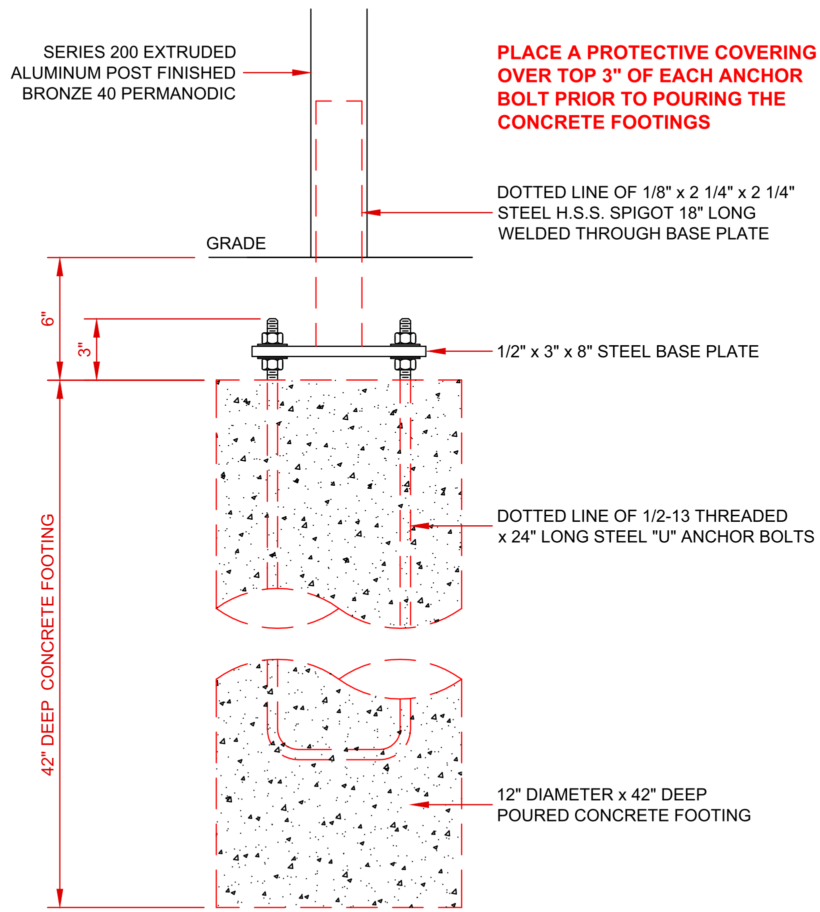
- consult Physical Resources

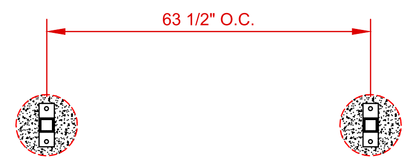


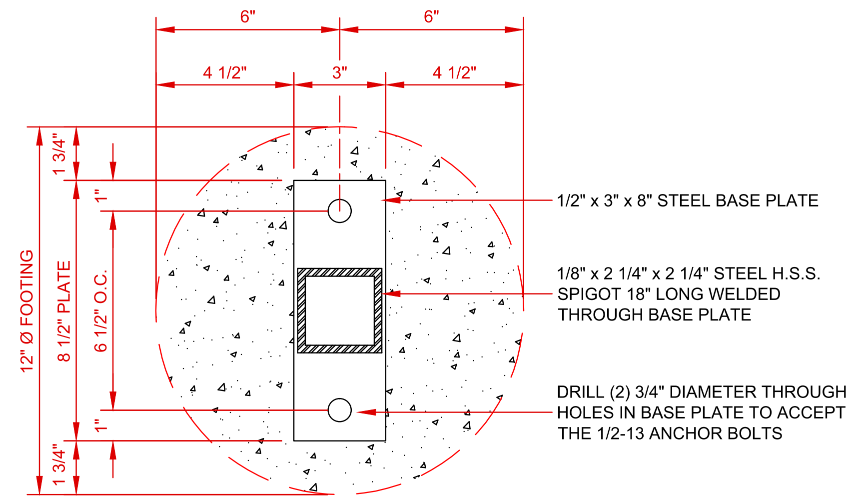
Used to provide directions to frequently used non changing departments or features on campus.

Post & Blade Street Directional Signs G cont'd

- consult Physical Resources



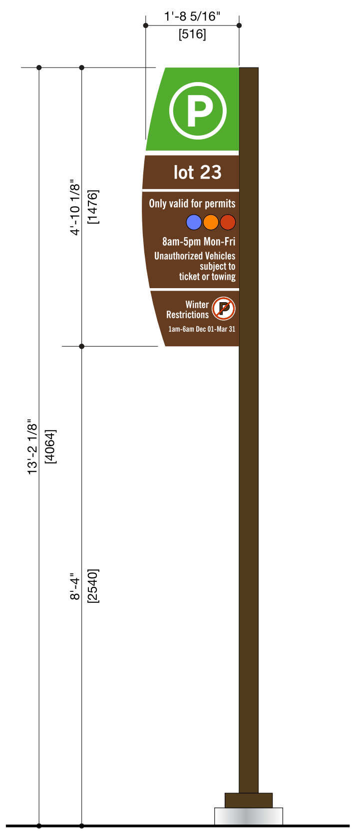




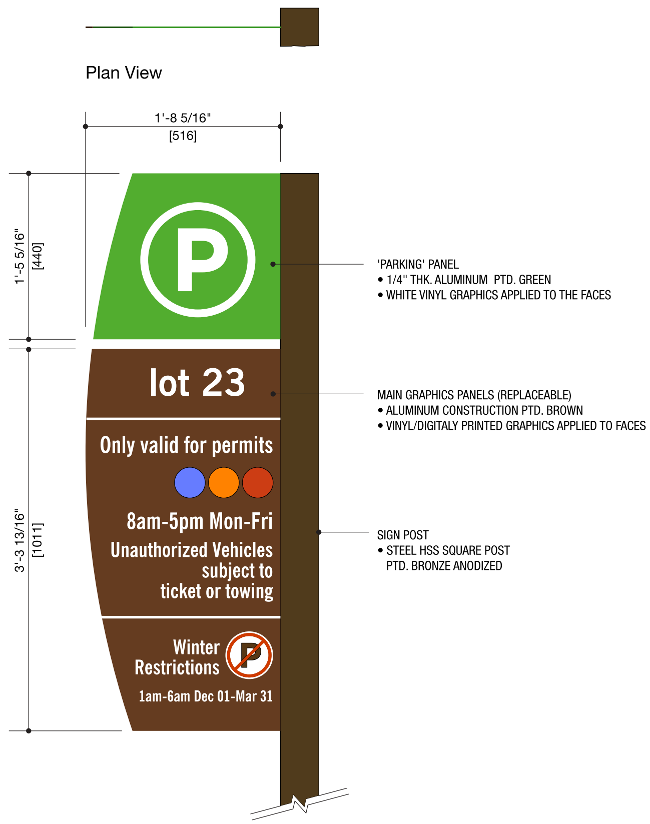
Used to provide directions to frequently used non changing departments or features on campus.

Parking Lot Identifiers H - consult Physical Resources

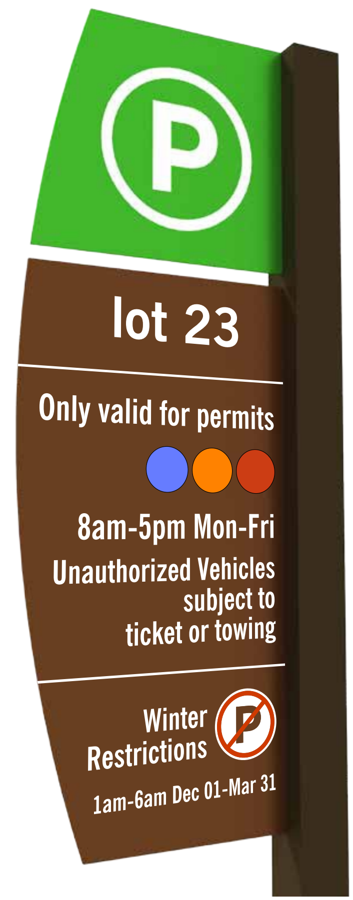
Used to identify parking lots and features/information of lots.



Typ. Elevation - Parking Lot Identifiers



Typ. Graphics Layout - Right Side



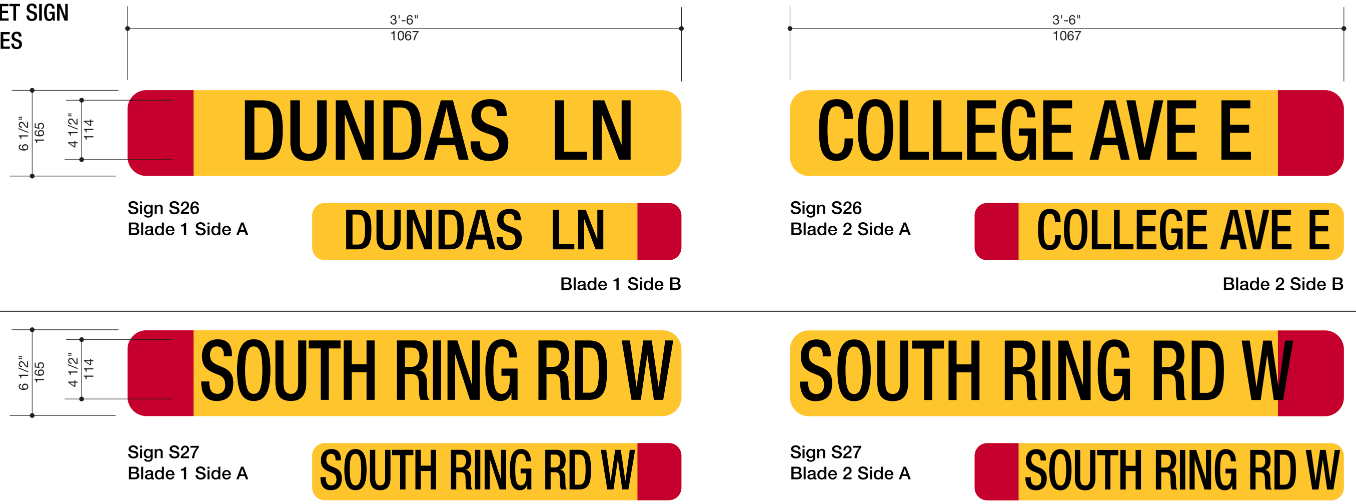
Typ. Perspective

- TO MATCH BRONZE ANODIZED
- PTD. BROWN TO MATCH PMS 161C
- PTD. TO MATCH PMS 361C GREEN

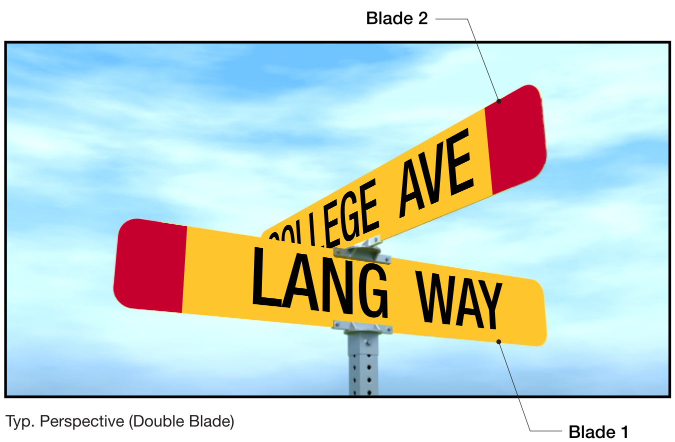
Parking Lot Identification Signs
To identify each lot and the colours of permits permitted in that lot. All designated parking lots are identified with a number between P1 and P70 as per the campus master plan and ministered by Parking Services. All signs are two sided.

Street Signs I - Consult Physical Resources

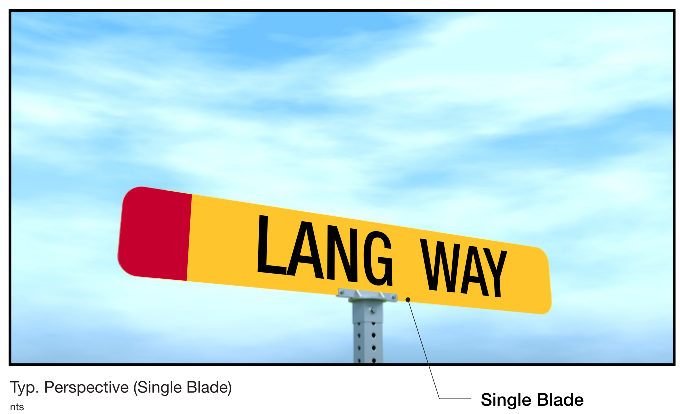
STREET SIGN BLADES



Graphics Layouts
Scale: 1 1/2"=1'-0"



Typ. Perspective (Double Blade)



Typ. Perspective (Single Blade)
nts

PTD. TO MATCH PMS 123C YELLOW

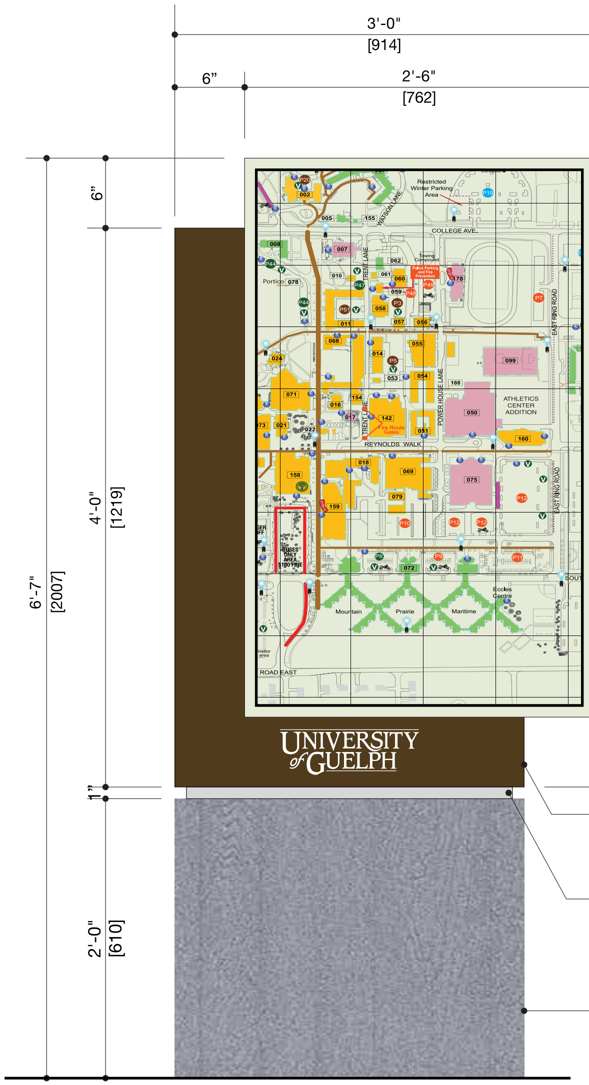
RED REFLECTIVE VINYL

BLACK REFLECTIVE VINYL

Used to identify all internal streets within the campus.

UNIVERSITY of GUELPH

Totem Map J - Consult Physical Resources



TO MATCH BRONZE ANODIZED

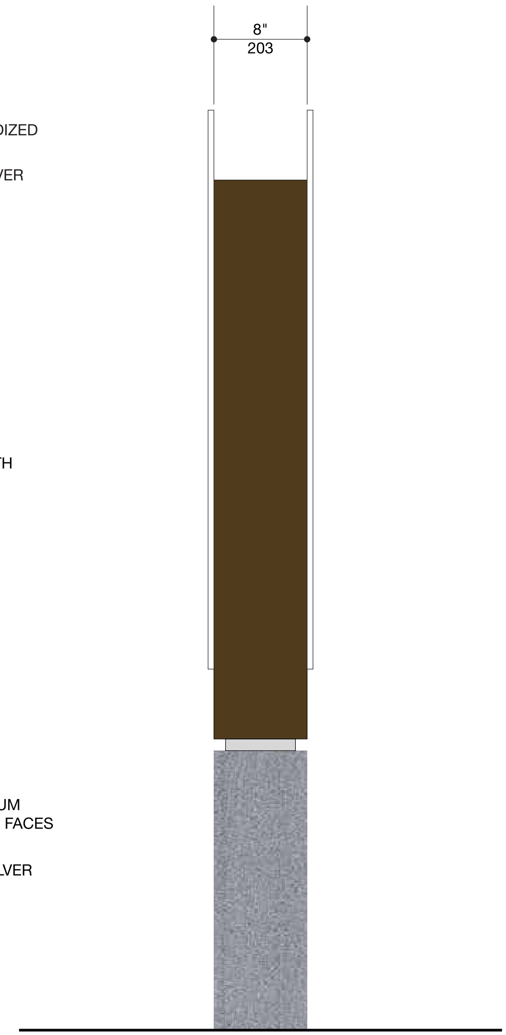
METALLIC SILVER

NON-ILLUMINATED MAPS
- FRAMELESS ALUMINUM PANELS WITH DIGITALY PRINTED GRAPHICS *(SAMPLE IMAGE SHOWN)*

SIGN CLADDING
- FORMED ALUMINUM PTD. TO MATCH BRONZE ANODIZED ALUMINUM
- WHITE VINYL GRAPHICS APPLIED TO FACES

REVEAL
- ALUMINUM CONSTRUCTION PTD. SILVER

SIGN BASE
- 'BOARD FORMED' CONCRETE



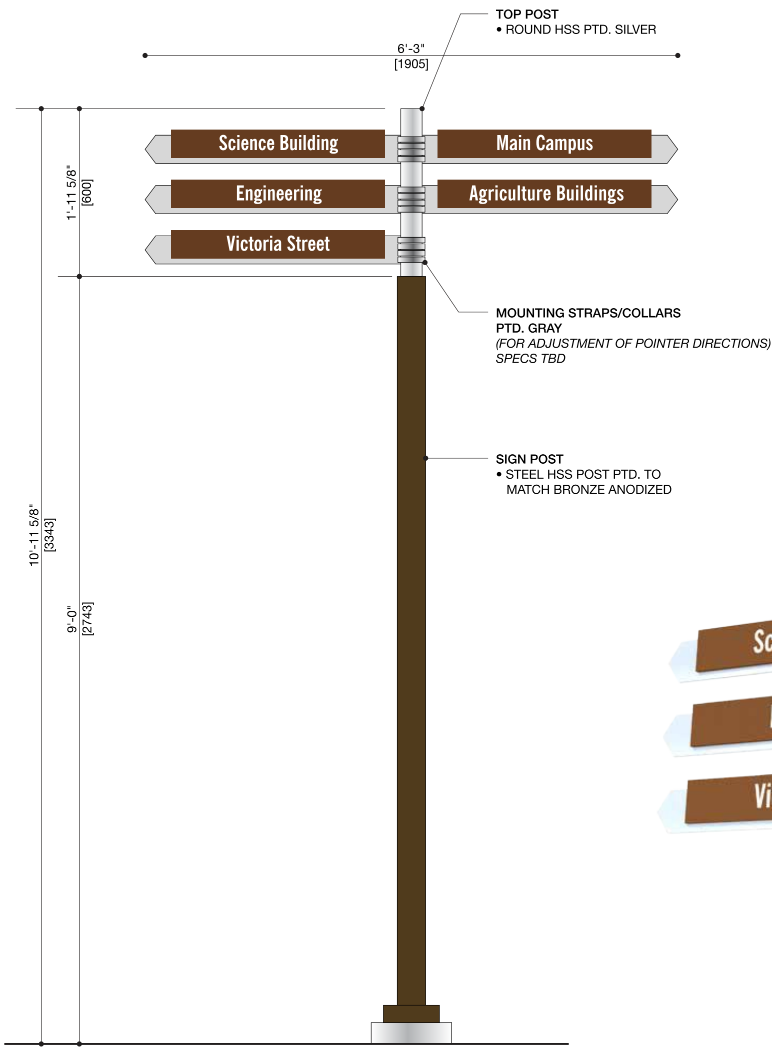
Face Elevation - Totem Map

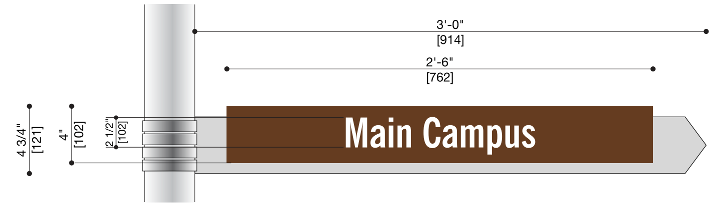
Right Side Elevation

Sign to be located in a safe area to be easily viewed by pedestrians.
Ideally located in hard surface flat grade for accessibility.

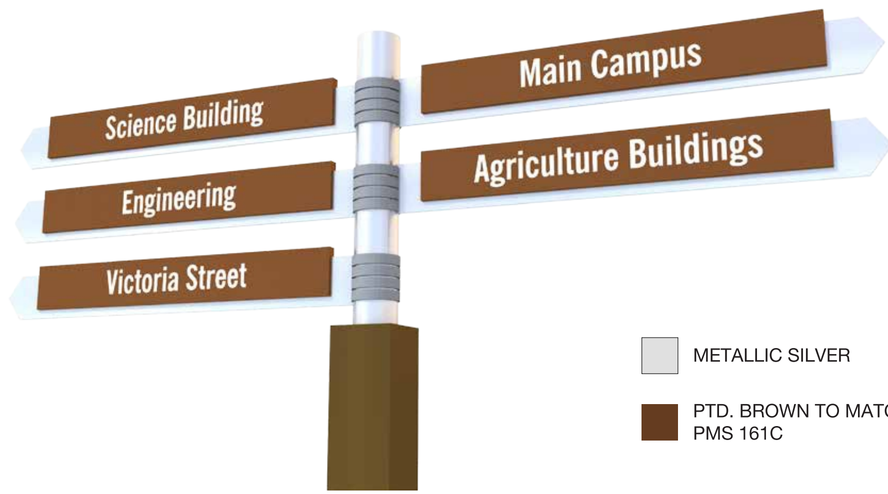
UNIVERSITY of GUELPH

Finger Posts K - Consult Physical Resources





D/S ALUMINUM BLADES / ARROWS
- ALUMINUM ARROWS PTD. SILVER
- ALUMINUM BLADES PTD. BROWN TO MATCH PMS 161C WITH WHITE VINYL GRAPHICS APPLIED TO FACES



METALLIC SILVER

PTD. BROWN TO MATCH PMS 161C

Sign to be located in a safe area to be easily viewed by pedestrians.
Used mainly for pedestrians to indicate main campus features and directions.

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD RD-05

ROOFING

Version	Revision 0	
Effective Date	October 27, 2014	
Approved By		
	Manager, Construction, DEC	
Reviewed By	Dec 1-14	
	Director, MES	

TABLE OF CONTENTS

1.1 Minimum Design Standards – Roofing Systems

1.1.1 General Low Slope Roof System Requirements

1. Three ply cold applied built-up roofing system to be used. Hot kettle or torch applied systems are not permitted.
2. Maintain a minimum 2% slope to roof drains.
3. Installed built-up roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Built-up roofing and base flashings shall remain watertight.
4. Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by built-up roofing manufacturer based on testing and field experience.
5. Provide a roofing membrane identical to component systems that have been successfully tested by a qualified independent testing and inspecting agency to meet the following minimum load-strain properties at membrane failure when tested according to ASTM D 2523:
    1. Tensile strength at failure, at -18 deg. C (0 deg. F): 78.8 kN/m (450 lb./in) machine direction, minimum; 3.0 percent elongation, maximum.
    2. Tensile strength at failure, at -18 deg. C. (0 deg. F. 70.1 kN/m (400 lb. /in) cross-machine direction, minimum; 2.7 percent elongation, maximum.
6. Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with the requirements and recommendations of the most current addition of the NRCA Roofing and Waterproofing Manual.
7. Installer's Extended Warranty: Standard 2 year warranty, commencing from the date of Substantial Performance of the Work.
8. Manufacturer's Extended Warranty: A written guarantee that the manufacturer will replace, at no cost to the Owner, any portion or all of the roofing system down to the existing roof deck for a minimum period of 20 years, commencing from the date of Substantial Performance of the Work. This warranty shall be non-prorated.
9. Manufacturer to provide inspections and maintenance of the roofing system in years 2, 5, 10 and 15 of the warranty period. The following duties, at a minimum, shall be carried out at no extra cost to the Owner as required, by a qualified contractor retained by the Manufacturer:
    1. sealing of flashing seams
    2. filling of pitch pockets
    3. repairs to blisters and ridges
    4. caulking at metal details as required
    5. written inspection report
    6. removal of vegetation and debris from the roof and premises
    7. cleaning of drain screens
10. Documentation shall be provided that the manufacturer has personnel to carry out above noted warranty requirements and has a history of providing these services for a minimum of 5 years.

11. Manufacturer shall update the University's Online Roof Management Program with all new information upon satisfactory completion of the roofing project at no charge to the University.
12. Prior to the expiration of the 2 Year Contractor Warranty, the Manufacturer shall conduct an Infra-Red Analysis of the warranted roof at no additional cost to the University.

1.1.2 Low Slope Roof System Products

1. Roofing Membrane Plies
    1. Basis of design product: Tremco, Burmastic Composite Ply: Non-perforated, asphalt-coated, polyester/fiberglass/polyester reinforced sheet dusted with fine mineral surfacing on both sides which meets the requirements of ASTM D 4601, Type II, suitable for application method specified, and as follows:
        1. Breaking Strength, minimum, ASTM D 146: machine direction, 22 kN/m (130 lab/in); cross machine direction, 22 kN/m (130 lb. /in).
        2. Tear Strength, minimum, ASTM D 4073: machine direction, 979 N (220 lb.); cross machine direction, 930 N (210 7 lb.).
        3. Pliability, 12.7 mm (1/2-inch) radius bend, ASTM D 146: No failures.
        4. Thickness, minimum, ASTM D 146: 1.25 mm (0.050 inch).
        5. Weight, minimum, ASTM D 228: 1.45 kg/sq. m. (30 lb./100 sq. ft.)
        6. Mass of desaturated polyester/glass/polyester mat, ASTM D 228: 107 g/sq. m. (2.2 lb. /100 sq. ft.)
        7. Asphalt, minimum, ASTM D 228: 488 g/sq. m. (10 lb. /100 sq. ft.).
2. Base Flashing Sheet Materials
    1. Flashing Sheet: Basis of design product: Tremco, TRA Elastomeric Sheeting: Elastomeric, polyester-reinforced sheet with EPDM and SBR elastomers and the following physical properties:
        1. Breaking Strength, minimum, ASTM D 751: machine direction 43 kN (250 lb.; cross machine direction 26 kN (150 lb.).
        2. Tear Strength, minimum, ASTM D 751: machine direction 400 N (90 lb.); cross machine direction 220 N (50 lb.).
        3. Elongation at Failure: ASTM D 751: 25 percent minimum.
        4. Low Temperature Flexibility, minimum, ASTM D 2136: -40 deg. C (-40 deg. F).
        5. Thickness, minimum, ASTM D 751: 1.0 mm (0.040 inch).
        6. Weight: ASTM D228: 1.3 kg/sq. m. (4.5 oz. /sq. ft.)
3. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D 1668, Type I.
4. Bitumen Materials
    1. General: Adhesive and sealant materials recommended by roofing manufacturer for intended use and compatible with built-up roofing.
    2. Liquid-type materials shall comply with VOC limits of authorities having jurisdiction.
    3. Adhesives and sealants that are on the interior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
        1. Plastic Foam Adhesives: 50 g/L.

   2. Gypsum Board and Panel Adhesives: 50 g/L.
   3. Multipurpose Construction Adhesives: 70 g/L.
   4. Fiberglas Adhesives: 80 g/L.
   5. Contact Adhesives: 80 g/L.
   6. Other Adhesives: 250 g/L.
   7. No membrane Roof Sealants: 300 g/L.
   8. Sealant Primers for Nonporous Substrates: 250 g/L.
   9. Sealant Primers for Porous Substrates: 775 g/L.

4. Insulation Adhesive: Tremco, Fas-n-Free Adhesive: Solvent-free, cold fluid-applied, bituminous-urethane adhesive formulated to adhere roof insulation to substrate, with the following physical properties:
   1. Asbestos Content, EPA 600/R13/116: None.
   2. Volatile Organic Compounds (VOC), maximum, ASTM D 3960: 20 g/L.
   3. Non-Volatile Content, minimum, ASTM D 1644: 98 percent.
   4. Density at 25 deg. C (77 deg. F), minimum: ASTM D 1875: 1.01 kg/L (8.5 lb. /gal).
   5. Elongation at 25 deg. C (77 deg. F), minimum, ASTM D 412: 1200 percent.
   6. T-Peel Strength at 25 deg. C (77 deg. F), minimum: ASTM D 1876: 66 N (15 lab).
   7. Adhesion Strength in Shear at 25 deg. C (77 deg. F), minimum, ASTM D 816: 552 kPa. (80 psi).
   8. Low-Temperature Flexibility, maximum, ASTM D 816: -51 deg. C (-60 deg. F).
5. Cold-Applied Adhesive: Basis of design product: Tremco, Burmastic Adhesive: One-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with specified roofing membranes and flashings, with the following physical properties:
   1. Asbestos Content, EPA 600 R-93/116: None.
   2. Volatile Organic Compounds (VOC), maximum, ASTM D 6511: 340 g/L.
   3. Nonvolatile Content, minimum, ASTM D 6511: 65 percent.
   4. Flash Point, minimum, ASTM D 93: 38 deg. C (100 deg. F).
   5. Density at 25 deg. C (77 deg. F), minimum, ASTM D 6511: 1.0 kg/L (8.0 lb. /gal).
   6. Uniformity and Consistency, ASTM D 6511: Pass.
   7. Asphalt Content, minimum, ASTM D 6511: 40 percent.
6. Cold-Applied Adhesive: Basis of design product: Tremco, Tremlar/TP-60 Cold-Applied Adhesive: Basis of design product: Tremco, Tremlar/TP-60 Vertical Grade: One-part, cold-applied bitumen modified polyurethane waterproofing adhesive specially formulated for adhering TRA membrane sheet, with the following physical properties:
   1. Tensile Strength: ASTM D 412: 2060 map 1.7MPa (250 psi).
   2. Low Temperature Elongation at -20 deg. C (29 deg. F): ASTM D 412: 500 percent.
   3. Elongation: ASTM D 412: 700 percent.
7. Vapour Retarder

1. Air and Vapour Barrier: 1 mm thick, SBS modified, self-adhesive air and vapour control membrane with slip resistant cross laminated polyethylene surface film; to ASTM D 1970-09.

8. Insulation
   1. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.
   2. R Value: At a minimum, R value to match existing condition R Value for roof replacement projects. R value to meet OBC for new construction projects.
   3. Polyisocyanurate Board Insulation: CAN/ULC-S704 ASTM C 1289, Type II, Class 1, Grade 2, HCFC-free, with felt or glass-fiber mat facer on both major surfaces.
9. Insulation Accessories
   1. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with built-up roofing.
   2. Insulation Cant Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
   3. Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
   4. Cover Board: 1” Mineral Wool, CAN/ULC S704-01, Mineral wool fiber with bitumen saturated surfacing.
   5. Substrate Joint Tape: 150- or 200-mm- (6- or 8-inch-) wide, coated, glass fiber.

10. Flashings
    1. Control or Expansion Joint Flashing: Sheet butyl, metal counter flashings and wood materials, as detailed.
11. Roof Surfacing
    1. White Dolomite gravel, 600# per square.
12. Cants
    1. Fibre Cant and Tapered Edge Strips: Asphalt impregnated wood fibreboard, preformed to 45 degree angle, tapered edge strips, and as additionally detailed.
13. Accessories
    1. General: Accessory materials recommended by roofing manufacturer for intended use and compatible with built-up roofing.
    2. Sheathing Joint Tape: Sheathing manufacturer's recommended self-adhering joint tape.
    3. Insulation Joint Tape: Asphalt treated glass fibre reinforced; 150 mm (6 inches) wide; self-adhering.
    4. Caulking: Dymonic by Tremco Canada Ltd.
    5. Metal Flashings: Shall be 26 ga. Prepainted Steel, 8000 series, ASTM A653 SQ. Gr33, Latest Revision, with designation G90 (Z275).
    6. Ballast: Shall be 3/8” in size, hard, durable, opaque, washed free of clay loam sand and or other foreign material.

1.2 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	2013-10-27		

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

LABORATORY DESIGN STANDARDS, RD – 08

Version	Revision 0
Effective Date	March 3, 2021

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ARCHITECTURAL

1 LABORATORY

1.1 INTRODUCTION

.1 General

.2 This Laboratory Design Standard has been developed to establish the University's minimum expectations and requirements for New Renovations and New Construction on Campus.

.3 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of qualitative and quantitative measures, life safety, materiality, finishes, accessibility, sustainability, systems configuration and performance criteria, installation and operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new installation(s) within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing building elements, including architectural, structural, mechanical and electrical elements.

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the respective disciplinary Manager (Architectural, Mechanical, Electrical Design) from University of Guelph – Design, Engineering and Construction (DEC) before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The System Designer (having Responsible Control) remains responsible for ensuring any proposed design solution are in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the respective disciplinary Manager (Architectural, Mechanical, Electrical Design) from DEC, together with proposed measures for addressing the conflict before the completion of Schematic Design.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 Design Innovation is encouraged. All proposed Design Innovations shall be tabled for consideration by the respective Discipline Manager (Architectural, Mechanical, Electrical Design) from DEC, before the completion of Schematic Design.

1.5 **Reference Documents**

Comply with the latest editions of the following standards, references and guidelines from the following organizations in addition to the Referenced Documents from other sections noted in the Design Standards Introductions, including:

.1 Canadian Standards Association (CSA)

.2 Ontario Animals for Research Act (ARA)

.3 Canadian Council on Animal Care (CCAC)

.4 Health Canada and the Public Health Agency of Canada (PHAC) – Lab Standards, Canadian Biosafety Standard – CBS and Design Guidelines (latest edition)

.5 Canadian Food Inspection Agency (CFIA)

.6 Underwriters Laboratories of Canada (ULC/UL)

.7 Scientific Equipment and Furniture Association (SEFA)

.8 Clinical and Laboratory Standards Institute (CLSI)

.9 International Organization for Standardization (ISO)

.10 Canadian Nuclear Safety Commission (CNSC)

.11 ASHRAE

.12 National Fire Protection Association (NFPA)

.13 Ministry of Labour (MOL)

.14 United States Pharmacopeia (USP)

.15 National Association of Pharmacy Regulatory Authorities (NAPRA)

a. Whole Building Design Group (WBDG) – National Institute of Building Sciences

1.6 **Additional Reference Standards**

The following additional reference standards and guidelines are represented in various forms in the “Reference Documents” sections of the current Standards and Guidelines – this may need to be consolidated and included as an appendix rather than in it’s current variances in each section

.1 Architectural Additional:

Ontario Building Code (OBC)
Accessibility for Ontarians with Disabilities Act (AODA)
University's Campus Master Plan
University Design Standards
LEED

.2 Mechanical Additional (HVAC):

SMACNA
University's Metering Standards
University's Identifications Standards
Campus Steam and Condensate System Piping Schematics
Campus Chilled Water Systems Piping Schematic

.3 Mechanical Additional (Plumbing):

ASPE Standards
Campus Domestic Water System Schematics
Campus Storm & Sanitary Piping Schematic
City of Guelph Cross Connection Bylaw (Backflow Bylaw)

.4 Mechanical Additional (BAS):

Canadian Electrical Code
ASHRAE/ANSI 135 BACnet
ASHRAE/Guideline 13 Direct Digital Control
ANSI/TIA/EIA862 BAS
Federal Communications Commission (FCC)

.5 Mechanical Additional (Fire Protection Systems):

Insurers Advisory Organization (IAO) Risk Management Services (RMS)

.6 Electrical Additional (Power):

Canadian Electrical Code
Campus Power Distribution System Single Line Diagrams

.7 Electrical Lighting Systems:

IESNA Lighting Handbook

2 INTRODUCTION

2.1 General

.1 Applicability - The requirements outlined in the following clauses are applicable to all projects outlined in Clause 1.2 - Compliance Criteria specifically for Laboratories, and as outlined in the University Design Standards; Application specific requirements are outlined under clauses 2.2 – 2.**22**

.2 Unless otherwise noted, the following standards and guidelines will apply when planning for all new laboratories, major renovations and minor renovations (where feasible) Review with DEC if exemptions are proposed. It should be noted that these standards and guidelines are not intended to replace professional judgement. It is recommended that they be used to supplement and enhance the approach and methodology of the designer(s)

.3 These Design Standards are intended as a guidance document to facilitate a consistent campus wide approach and to provide stewardship for the design of laboratories

.4 Room Data Sheets will be created and will be submitted as part of the Detailed Design Process

.5 For the purposes of clarifying the application of this section of the Design Standards, laboratories are defined as controlled environment spaces being used for teaching, research, measurement and experimentation. These activities may involve the use of hazardous materials or may include a hazardous process. Applicability of this definition is at the discretion of the University and should be reviewed and agreed to prior to the implementation of the SD phase.

.6 Prior to project commencing, the designer must consult with the University Discipline Manager from DEC in terms of the University's Environmental Health and Safety (EHS) risk assessment report on the laboratories (if applicable) as it relates to hazardous materials and hazardous process that apply to the subject labs

.7 This document should be read in conjunction with the balance of the related Master List of Design Standards as posted by the University of Guelph

.8 If alternates or deviations from the Design Standards are proposed by the Designer(s), these variances are to be presented to the University Discipline Manager from DEC for discussion and approval – The completion of a Compliance Checklist will be required

.9 Accessibility – Laboratories are to be designed to be fully accessible and compliant with AODA guidelines and the University of Guelph's accessibility standards. It is required that that a percentage of lab workstations and Fume Hoods be provisioned to be barrier free. The percentage to be determined on a case by case basis for each project. Typically, at least one fume hood per floor will be barrier free to avoid transporting hazardous substances in the elevator(s)

.10 Containment – Laboratories are to be designed to be fully compliant with CL2 containment as per Public Health Agency of Canada – Canadian Biosafety Standards.

.11 Sustainability - Laboratory spaces are among the most energy consumptive spaces on the campus. These Design Standards are intended to acknowledge the unique characteristics of laboratories and therefore aim to promote the right-sizing of lab systems to avoid unnecessary energy use associated with overdesign of the systems

.12 Variances and Alternate Compliance – approval form & sign off to be completed prior to completion of the Schematic Design Report

.13 Laboratory Classification – EHS Hazard and Risk Assessment – Designer to solicit this as soon as is feasible and prior to completing the Schematic Design report

.14 Sustainability Design and Energy Conservation Targets to be established as part of the Schematic Design Report

a. Consult with U of G Energy Efficiency Policy – re: new buildings and renovations

b. Energy Use Intensity (EUI) as a minimum standard defined as a percentage better than calculated using ASHRAE 90.1-2013

c. During the design process, demonstrate options that could achieve higher performance compared to ASHRAE 90.1-2013 with a payback calculation in years

d. Minimal LEED aspirations – U of G currently subscribes to the LEED system – but with no formal requirement for registration of the project

e. Other sustainable targets – requirement to describe other sustainable metrics

f. Demand Control Ventilation, Air Quality Monitoring to be considered for every laboratory where applicable

g. Designer Required to provide review and substantiation on energy demands, control, consumption – provide ROI calculations as part of the Schematic Design report

h. Energy Modelling – in concert with the University, define baseline criteria required for implementation

i. Pre-design process – Designer required to demonstrate and solicit approval on overall approach to sustainability – strategies such as low flow/low volume devices, energy recovery strategies, EUI calculations etc.

2.2 Laboratory Metrics

.1 Laboratories are typically planned on a repeatable planning module basis. The typical single planning module should be between 3.2 m and 3.6 m wide and should never be less than 3.2 m wide. Module length should be between 2- and 3-times module width and should not be less than 2 x the module width or more than 3 x the module width. This will provide a minimum lab aspect ratio configuration of 2:1 and a maximum of 3:1. Additional module width may be required on a case by case basis depending on equipment clearances.

.2 Laboratories can be configured on a repeating lab module basis by aligning the single lab modules side by side to create double, triple, quadruple labs in sequence

.3 Aisles widths within labs should be minimally 1.53 m providing a clearance of at least 1.53 m between benches and between bench and equipment. Additional clearances will be required to accommodate large equipment, turning radii and in front of fume hoods and other equipment in compliance with CSA and other standards.

.4 Single aisle configurations (single loaded aisle) should be avoided where every possible. If they must be provided, they should be at least 1.1 m wide

.5 Aisle lengths should be no longer than between 5 m – 6 m before a cross-aisle is introduced. Long dead-end aisles should be avoided

.6 Laboratory clear height requirements will vary greatly from lab to lab and will depend on the functionality of the lab. Ideally, labs should be planned to provide a clear unobstructed height of not less than 3.05

2.3 Lab Location and Zoning

.1 Laboratories should be separated from adjacent public spaces by a lockable door

.2 The circulation within labs should be regular, clear and logical. Aisles and circulation patterns should be planned to provide the most direct route and access to exit from the lab

.3 Labs should be zoned with clear definition and delineation between the major components within the lab (fume hood area, working/bench areas, equipment parking areas, transient spaces/circulation, clean up areas/sinks, safety zones/stations etc.)

.4 Lab casework to be arranged to facilitate line of sight and visual connection to egress locations within labs

.5 Path of travel to an egress point of the lab should not pass through a high hazard zone in lab

.6 Lab services and utilities should be arranged along the common lab planning module that aligns with the lab casework. Location of services should be arranged such that lab reconfigurations will minimize the need to relocate major services

.7 Lab service connection points to be located such that future modifications and configurations of lab casework and equipment will have minimal impact on the delivery of the services to the work bench and equipment

.8 Avoid locating offices/write-up/administrative functions within labs – the preference is to locate non-lab spaces outside of the lab suite. If absolutely necessary to co-locate in the lab, these spaces should be located near the access/egress to the lab and away from the high hazard, contaminated spaces within the lab

.9 As a rule of thumb, laboratories should be separate from adjacent non-lab spaces by a demising fire separation with a minimal FRR of 1 hour. Enhanced FRR may be required in certain circumstances

.10 Laboratory fitments, furniture and equipment should be located to avoid becoming an encumbrance to circulation and air flow within the lab

.11 Locate all areas of high hazard (e.g. fume hoods) away from access/egress points to the lab

.12 Mobile equipment, carts, mobile racks etc. should not be permitted to reduce the effective aisle width to less than 1.2 m.

.13 Where required to be co-located in lab, provide parking spaces within labs for mobile equipment, carts and racks in proximity to access/egress point of lab

.14 Lab casework should be positioned to allow for a robust cleaning and decontamination program including the temporary relocation of mobile casework to facilitate cleaning of spills and to provide access to mechanical and electrical systems (e.g. wall fin units)

.15 Casework construction to be robust, lab grade construction and finish with impervious surfaces. Casework should include fit-up with lab grade hardware.

.16 Surfaces, casework, benchtops and furniture to be cleanable, non-absorbent and resistant to scratches, stains, moisture, chemicals, heat, impact, repeated cycles of decontamination and washing

2.4 Process and Flow

.1 Labs should be planned for an efficient and safe flow of people, materials, equipment, waste and recycling etc.

.2 Prior to completing the Schematic Design phase, provide the discipline manager of DEC with flow diagrams depicting the process and path of travel of the various materials and personnel as noted above

2.5 Safety Stations

.1 Designate an area near the primary egress point of the laboratory for a Safety Station – provide at least one Safety Station per laboratory – frequency, configuration, travel distance to the safety station to be reviewed on a case by case basis. Typically, the safety station will be located within 8-10 seconds of travel from any point in the lab

.2 The Safety Station must be highly visible and signed with the requisite signage designating the location as having an eye wash and deluge shower – design and location of the station should be consistent from lab to lab

.3 The Safety Station must include, among other things: emergency (deluge) shower, hands free eye wash station (in combination or as individual), first aid kit and a fire extinguisher of appropriate type and size to the hazard class within the lab. Include a floor drain with a self-priming trap at each Safety Station. Limit the floor drain to this one location. Locate the floor drain remote from hazardous substances and fume hoods/Bio Safety Cabinets

.4 In addition, and on a case by case basis, the Safety Station will also include a spill kit, and a modesty curtain. Provide a location for the convenient and safe storage of the modesty curtain. If the eye wash and safety shower are individual units, then they must be capable of being operated by the same individual at the same time

.5 Provide a location for personal protective equipment (PPE) near the Safety Station

.6 The Safety Station should accommodate barrier free access and operation

.7 The Safety Station to be defined by a contrasting boarder outlined on the floor for easy recognition of the location for an occupant in distress

.8 In labs designated as Bio-containment Labs, the requisite hand wash sink may be used in combination with the eye wash upon review and approval of the Discipline Manager of the University. The safety station will be based on the sample template provided with this standard

.9 Avoid electrical appliances, outlets and switches within proximity of the Safety Station –

coordinate to ensure that water cannot be splashed over electrical fixtures

.10 Temperature and Volume of water/duration – Refer to mechanical subsection

.11 Provide a display board in a material and finish appropriate for the lab type being considered. Display board to be white board or similar surface and to be cleanable and non-absorbent

2.6 Fume Hoods

.1 Fume hoods shall be located within the laboratory to avoid high traffic areas and so that their location does not impact the egress from the lab (i.e. not near the egress point of the lab). Fume hoods are ideally located in the "back of the room" and where they are least at risk of compromising safe access and egress from the lab and least likely to be disturbed by the flow of personnel, equipment etc.

.2 Avoid fume hood locations near single means of access/egress from a lab

.3 Provide recommended clearances in front of and adjacent fume hood in compliance with the standards governing fume hood location and operation (i.e. CSA standards). In no instances should the clearance in front of a fume hood to another fitment be less than 1.53 m

.4 Fume hoods should not be located in corners – provide the minimal clearances recommended by CSA to adjacent fitments and perpendicular objects that project ahead of the face of the fume hood

.5 Avoid locating fume hood directly apposed to another fume hood, biosafety cabinet, laminar air flow device or seated work stations (any activities that will affect the performance of the fume hood or the safety of the user)

.6 Locate fume hoods so they do not interfere with air circulation or do not contribute to air flow short circuiting

.7 Provide adequate clearance below fume hood to facilitate cleaning underneath fume hood – or otherwise fume hood should be sealed to floor with integral cove base to prevent water and contaminants from getting trapped below fume hood

.8 Fume hood specifications:

.9 Fume hood manufacturers shall be members in good standing with Scientific Equipment and Furniture Association (SEFA)

a. Comply with the latest current edition of CSA Z316, for Fume Hoods and Associated Exhaust Systems

b. Fume hoods are to be tested for containment at the factory in accordance with ASHRAE 110 standards and PWGSC document MD15128 (latest edition)

c. Face velocities to be determined in concert with DEC and EH&S – and will be considered on a case by case basis

d. Fume hoods to be pre-plumbed and pre-wired to a central connection point

e. The fume hood liner and baffles shall be constructed of either 16-gauge Type 316 stainless steel with welded seamless construction or Fibre

Reinforced Plastic (FRP) and with sealed joints – review on a case by case basis for application of surfaces

f. Interior corners shall have a radius of at least 20 mm and smooth surfaces and transitions to facilitate ease of cleaning and decontamination

g. Work surface shall be either solid epoxy or phenolic and be at least 25 mm thick with a 12 mm high anti-spill edge on all sides

h. Sash perimeter openings shall be constructed to minimize eddies and promote smooth entry of air into the hood

i. Provide 50 mm grommet openings with escutcheon plate and closure in each side panel of fume hood to accommodate services into the hood

j. Sash and side panel, rear panel glazing and light lens to be constructed of laminated or tempered safety glass.

k. Sash to be repositioned with minimal force through the full travel path of the sash - the sash should remain stationary when force is removed

l. Fume hoods shall be equipped with both audible and visual low airflow alarm that will sound if the face velocity should drop below a prescribed set point. The audible alarm shall have the ability to be temporarily silenced but the visual alarm must continue to function until face velocity is re-established

m. Cup sinks will be constructed of the same material as the work surface - fully integrated with the work surface with a raised edge (minimum 6 mm) to prevent spills from entering drain cup sink

n. Lighting, plumbing and other gas services are to be remotely operated and to be accessible for servicing outside of the inner lining

o. Service controls and electrical fitments are to be mounted outside of the cabinet on the front fascia

p. All receptacles on fume hoods shall be GFI T-slot 120V/20 A

q. Fume hoods shall operate at a sound level not to exceed 65 dBA at the face of the hood under normal operating conditions

r. Lighting fixture to be LED and to be mounted externally of the inner liner, all serviceable electrical parts are to be accessible from outside of the structure

s. All electrical fixtures will be factory installed and pre-wired to a junction box on the top of the fume hood. All components shall bear the CSA and UL/ULC label

t. Fume hoods shall be supplied with a sash limiting device (sash stop) installed to limit the sash travel to the maximum operational opening of **460**mm as measured from the work surface. Sash stops shall be designed to allow the operator to override them and will automatically reset when the sash is lowered back to below 460 mm. Confirm these opening dimensions with DEC as part of the Schematic Design process. The fume hood must be equipped with an alarm to indicate that the sash is above the maximum operational opening

u. In the case where barrier free construction is required, provide fume hoods with adjustable work surfaces and knee spaces below the work surface

v. Any variances to the fume hood specifications shall be approved by Discipline Manager at DEC and/or EHS

2.7 Biological Safety Cabinets

.1 Locate BSC's away from high volume path of travel, doorways, supply and return ventilation etc. such as those caused by doorways or general ventilation devices. Locate remote from disruptive air currents that will affect the performance of the BSC. BSC "Type" and "Class" to be reviewed with DEC on a case by case basis

.2 Locate BSC's so they are not directly across from, or adjacent to, seated work stations, other biosafety cabinets or fume hood

.3 Provide a minimum 40 cm clearance between the exhaust outlet on top of the BSC and any overhead obstructions. Provide 30 cm clearance on either side of the BSC.

.4 Biosafety Cabinet Specifications:

a. must comply with the Canadian Biosafety Standards and Guidelines (latest edition) and be certified in accordance with NSF/ANSI 49 for Biosafety Cabinetry and with manufacturer's specifications

b. Room exhaust and supply diffusers must be located a minimum distance from BSC measured horizontally from the front face of BSC. Consult with the BSC manufacturer

c. Provide a minimum clearance between the exhaust outlet on top of the BSC and any overhead obstructions as defined by the BSC cabinet manufacturer. Provide 30 cm must be provided on each side of the BSC

2.8 Specialized Storage

.1 Gas cylinders to be stored so as to not be a hazard and an incumbrance to circulation within lab. Gas cylinders should be properly restrained with gas bottle harnesses and to be stored in alcoves if possible

a. Gas cylinders should not be located near access/egress points in labs, paths of travel to exits and in exit corridors

b. Freezers/Fridges and other large floor standing should be located in designated equipment zones so as to not disrupt the activities of the lab

2.9 Hazardous Material Storage/Flammable Storage

.1 Flammable storage cabinets/solvents and acids/corrosives are typically located under or in proximity to a fume hood since that is typically where the hazardous substances are being used. Quantity and type of hazardous and flammable storage will be considered on a case by case basis. As a default, each fume hood should be provided with one hazardous storage cabinet and one acid cabinet below the FH.

.2 Flammable storage cabinets shall not be located within proximity of access/egress to the lab or in a location that would constitute a hazard to egress from the lab

.3 Flammable storage cabinets must conform to standards governing their construction and use including ULC and CSA standards

.4 Flammable storage cabinets are typically not required to be vented for fire protection purposes - venting may compromise the performance of the cabinet. Venting will be considered on a case by case basis only. The default condition will be a non-vented flammable storage cabinet. The cabinet should be supplied with factory furnished vent ports, fitted with flame arrestors, and removable seals. These ports will be leveraged should venting be required for the purposes of protecting workers to exposure of harmful vapours.

.5 If a flammable cabinet is vented, then the exhaust duct, riser and fan must be constructed of materials that will provide the same protection as the cabinet and seals offer to the contents

.6 Corrosion resistant cabinets are required for the storage of acids. These cabinets are to be vented using corrosion resistant material to prevent deterioration due to corrosion or rusting. Venting may be done into adjacent fume hoods as per the manufacturer's specification

.7 In the case of acid cabinets, if the cabinet is vented, the duct should be connected to the port provided in the cabinet. Ducts should be connected to the main fume hood exhaust duct downstream of the fume hood collar and control valve (if applicable)

.8 It is recommended that EH&S be consulted in any case where venting of flammable storage cabinets is requested

.9 In the case where bases are to also be accommodated, they should be stored in appropriate storage cabinets designed for bases and located remote from the acid cabinets

2.10 Laboratory Casework

.1 Laboratory casework to be designed to be of modular configuration and where practical and where possible, to be mobile. Lab casework to be fixed in place at select locations if a mobile solution is not practical or feasible. Material of construction to be appropriate for the application and considered on a case by case basis and reviewed with the University prior to beginning design. Provide a list of pros and cons for the University to consider. Minimal standards for material and construction to be compliant with bio-containment level CL2.

.2 Lab casework should be designed to be robust, flexible, interchangeable and adjustable to the fullest extent possible. Casework on casters or wheels should be considered to maximize flexibility and adjustability and to minimize cost on reconfiguration. Provide load ratings for wall mounted shelving for review and approval by the University. Thickness of shelving, length of shelving and c/c of pilaster supports to be commensurate with the application. C/C of pilaster shelving to be no more than 900 mm o/c unless otherwise noted or approved

.3 All casework to be either "stand off" allowing cleaning behind or sealed to prevent dust and contamination build up

.4 Provide barrier free stations in each lab as a minimal (**5%)** of total work stations unless otherwise defined by the University

.5 Lab bench top to be either solid epoxy or solid phenolic – minimal thickness of 25 mm. Plastic Laminate counter tops will not be acceptable

.6 Lab casework bench height and upper cabinet configurations to be adjustable where possible to facilitate ease of reconfiguration

.7 Provide 15 cm backsplash at all interface of fixed lab casework with walls/equipment

.8 Upper shelving to have adjustable edge restraints - all sides

.9 Laboratory sinks (wash up and hand wash) to have lips to prevent spillage. Wash-up sinks to typically have peg boards mounted above the sink.

.10 Hand wash sinks to be hands-free and hard wired.

.11 Bench tops to be designed with marine edges and drip stops where possible and where required for functionality

.12 Bench depth should be standardized on 760 mm deep units. Deeper or shallower bench tops will be considered in select locations and on a case by case basis

.13 Base cabinets (pedestals) will take on the following configurations unless otherwise designated in the room data sheets:

a. 50/50 split of storage and knee spaces

b. 50/50 split of drawers and doors

i. Lab grade hinges to facilitate 180-degree operation

ii. Mobile tables to facilitate a range of height between sitting height and standing height

iii. Drawers to be one-piece construction, full extension, ball bearing glides and stops

2.11 **Access, Egress, Doors & Door Swings**

.1 Access/Egress doors to/from labs should be used singularly or in tandem to provide adequate clearance widths for the population of the rooms as well as the equipment that will need to pass through the doors. When used in combination, consider a fixed leaf door panel in combination with an active leaf. The fixed leaf door will be secured by way of flush bolts top and bottom – and will be used on occasion when larger pieces of equipment need to be moved

.2 Consider a removable transom panel above door in anticipation of the delivery of large oversized items

.3 Provide clearance on either side of the door for moving of equipment, carts, turning radii etc.

.4 Wherever possible, and in the cases where occupant load requires it, provide two exits from each laboratory

.5 Where possible, it is recommended that the doors to laboratories include glazed panels to facilitate visual contact for security and in the event of emergencies or occupants in distress

.6 Doors should always swing outward from the lab (swing in the path of travel)

.7 Hardware should provide ease of operational and be self closing and latch able/lockable

2.12 **Ratings and Separations**

.1 Laboratories are typically separated from non-lab spaces by way of a fire rated enclosure with a fire resistance rating (FRR) as per building code and fire code provisions. Depending on hazard classification, the fire resistance rating of the enclosure will be at minimal a 1 hr FRR.

.2 Depending on hazardous classification, labs may also be separated from adjacent labs by rated assemblies to create compartmentalization of the lab suite under the provision of the NFC

2.13 **Views and Natural Light**

.1 Provide access to external views and natural light wherever possible. If windows are provided in the laboratory, they should be non-operable

.2 Where ever possible and to the extent feasible, provide visual transparency between labs and adjacent public spaces/corridors for safety and security and occupant wellbeing

.3 Where possible and to the extent feasible, provide visual connection from labs to public spaces and from lab to lab

2.14 **Materials and Finishes**

.1 Wall, ceiling, doors/frames and floor finishes shall be finished with smooth, non-absorbent and washable materials. Finishes should be selected to be robust, abuse resistant and cleanable

.2 Protect exposed corners and walls with corner guards and bumper rails of an appropriate material wherever possible, and on a case by case basis

.3 Floor finish will typically be either a resilient seamless sheet flooring product or a polished concrete with a strippable sealer to facilitate decontamination as required. Selection of floor finish shall be commensurate with requirements for containment, robustness, etc.

.4 Resilient seamless floor should have welded joints and integral 15 cm coved base with top bead sealed to wall – typical at all walls and permanent furniture, curbs etc.

.5 Seamless flooring should be smooth, impervious, washable and chemically resistant. Minimize seams wherever possible to facilitate a smooth surface for carts etc.

.6 All penetrations through floors to be sealed and water tight

.7 Lab casework and other fixtures and furniture should be robust, contiguous with minimal seams to avoid harbouring contaminants and to facilitate cleaning

2.15 **Lab Gases and Emergency Disconnects**

.1 Provide an emergency gas shut off and an electrical disconnect (kill) switch near the egress point from the lab. Refer also to mechanical and electrical sections for further guidance

.2 The emergency shut off and kill switches should also be located in proximity to the Safety Station

.3 All labs requiring natural gas should be provided with an emergency shut-off solenoid valve and mushroom type push button in close proximity to the lab egress point and the lab Safety Station. The push button shall be keyed type for resetting purposes. The natural gas shut off valve shall be set to fail in closed position in the case of a power outrage. Valve should remain closed after power has been re-established. Only plant operations should have the key to reset solenoid valves.

.4 All casework mounted laboratory natural gas turrets to be push/turn type – typical

2.16 **Centralized Vacuum Systems**

.1 Refer to mechanical

2.17 **Centralized Air Systems**

.2 Refer to mechanical

2.18 **Waste, Recycling**

.1 Provide dedicated waste collection area within lab. Provide space in lab for a variety of waste including trash, hazardous waste, broken glass, sharps etc.).

.2 Integrate the waste station into the design of the lab and in the design of the casework if possible

.3 Provide a dedicated recycling area within the lab – integrate into the design of the lab and the casework if possible

.4 Integrate the waste collection and/or the recycling collection infrastructure into a centralized collection protocol if this is available and exists within the building

2.19 **Lab Water**

.1 Refer to mechanical

2.20 **Lab Mock-Ups**

.1 Where-ever possible, specifications should call for the requirement of a mock-up of the various types of casework units as part of the submittals to facilitate a review for conformance and to familiarize the trades with the details, construction and coordination of systems and installation.

2.21 **Sanitary Stations, Wash-up and Gowning, PPE**

.1 In the case of labs designated as containment labs, provide a hands-free hand wash sink adjacent to and near the access/egress to the lab (in compliance with requirements of the agencies governing these lab types – e.g. Public Health Agency of Canada) – at a minimum, default provision for compliance for Sanitary Stations will be to Containment Level CL 2

.2 Locate hooks (where required) near to and adjacent to the hand wash sink as well as the access/egress point to the lab. Avoid hooks that project into the room – use narrow profile wherever possible. Provide sufficient hooks to accommodate both clean and used lab coats

.3 Locate Personal Protective Equipment (PPE) near to and adjacent to had wash and sanitary station

2.22 **Lab Amenities**

.1 Audio-Visual and connectivity (projection, screens, smart boards, data capture, distance learning) are to be fully coordinated with the work of other standards

3 INSTALLATION AND WORKMANSHIP STANDARDS

3.1 **General**

.1 The requirements outlined in the following clauses are applicable to all general and architectural systems; application specific requirements are outlined under clause

3.2 **Extra Inventory**

.1 A recommended inventory list for additional extra stock shall be presented to the Discipline Manager DEC for consideration prior to Issuance for Bid. The amount of required stockage will be reviewed on a case by case basis by the design team. Extra stock will typically include major components specific to this project type such as sheet flooring, ceiling tile, specialized wall coatings etc. This list shall be proposed in consideration for the following:

.2 Likelihood that the inventory material will be required in the short term and mid term (1-5 years)

.3 Amount and application, applicable warranties etc.

.4 If the product is readily available and the procurement lead time

.5 Cost of the product

MECHANICAL

4 INTRODUCTION

4.1 General

.1 This Mechanical Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Mechanical Systems supporting Laboratory spaces.

.2 Laboratories are defined as spaces equipped for scientific research, experimentation or teaching, involving the use and storage of hazardous materials. Laboratory spaces can be divided into the following general types:

a. Biological Laboratories

b. Chemical Laboratories

c. Physical Laboratories

d. Animal Laboratories (Refer to Design Standard DSM-XX, Vivarium's)

.3 The purpose of this standard is to provide guidance and design requirements that support a safe, comfortable and efficient laboratory environment that is highly functional for the researchers, faculty, students and facility operators that occupy it.

.4 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

.5 This Design Standard shall be read in conjunction with the specific physical resources design, engineering and construction standards noted in Section 1.6 below.

4.2 Compliance Criteria

.1 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing mechanical infrastructure.

.2 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Mechanical Design, DEC before the completion of Schematic Design.

4.3 Responsibility of the Designer

.1 The Design Engineer of Record remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Mechanical Design, DEC, together with proposed measures for addressing the conflict.

.3 The Design Engineer of Record is responsible for ensuring the design accounts for all affected systems including concealed conditions. With prior approval by the University, destructive testing may be required to confirm conditions.

.4 Where new work will connect to existing building systems, the Design Engineer of Record is responsible for ensuring the tie-in and interaction of the new systems are compatible with existing infrastructure.

.5 The Design Engineer of Record is responsible for coordinating specific user requirements from all stakeholders including, but not limited to, University Staff, Management, and users of the affected space(s).

4.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovations shall be tabled for consideration by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

4.5 Sustainability Requirements

.1 Wherever possible, sustainable strategies shall be incorporated into the laboratory design while maintaining the safety and functionality goals of the project.

4.6 Standards, Codes and References

.1 Ontario Building Code, Latest Edition

.2 Public Health Agency of Canada – Canadian Biosafety Standard (CBS) Second Edition, March 2015

.3 American Conference of Industrial Hygienists (ACGIH), Industrial Ventilation: A Manual of Recommended Practice, Current Edition.

.4 Canadian Nuclear Safety Commission: RD-52: Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms

.5 ANSI Z358.1: Emergency Eyewash and Shower Equipment

.6 ANSI/AIHA Z9.5: American National Standard for Laboratory Ventilation

.7 ANSI/ASHRAE 62.1: Ventilation for Acceptable Indoor Air Quality

.8 ANSI/ASHRAE 55.1: Standard for Thermal Environmental Conditions for Human Occupancy

.9 ANSI/ASHRAE 90.1: Energy Standard for Buildings

.10 ANSI/ASHRAE 110: Method of Testing Performance of Laboratory Fume Hoods

.11 CSA Z316.5-15: Fume Hoods and Associated Exhaust Systems

.12 CSA B64.10: Selection and Installation of Backflow Prevention Systems

.13 NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals

.14 NFPA 55: Compressed Gases and Cryogenic Fluids Code

.15 NFPA 91: Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Non-Combustible Particulate Solids

.16 NSF/ANSI 49: Standard for Biosafety Cabinetry: Design, Construction, Performance, and Field Certification

.17 University of Guelph Design Standard DSM-01 HVAC Systems*

.18 University of Guelph Design Standard DSM-02 Plumbing Systems*

.19 University of Guelph Design Standard DSM-03 Building Automation Systems*

.20 University of Guelph Design Standard DSM-04 Fire Protection Systems*

.21 University of Guelph Metering Standard*

.22 University of Guelph Identification Standard*

.23 * A copy of this standard is available on the University of Guelph Physical Resources web page

5 HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS (HVAC)

5.1 General

.1 Each laboratory shall be provided with mechanically generated supply air and exhaust air in sufficient quantities to prevent the build-up of fugitive emissions in the Laboratory.

.2 Each laboratory shall be supplied with 100% outdoor air; recirculation of general exhaust air or fume hood exhaust air not permitted.

.3 Local containment and exhaust capture systems such as fume hoods, canopies and extraction arms shall be provided to control emissions at the source.

.4 Fume hoods or other local capture systems shall not be the sole means of room exhaust air. General exhaust air shall be provided as required to maintain ventilation rates and pressurization.

.5 Pressure independent, Variable air Volume (VAV) systems shall be used for all supply air, general exhaust air and fume hood exhaust air systems.

.6 Laboratories shall be maintained under negative pressure in relation to the corridor or other adjacent space deemed less hazardous. Clean rooms and workspaces requiring positive pressure are an exception.

.7 Relative pressurization of spaces shall be maintained through volumetric airflow offsets managed through the pressure independent, variable air volume system. Control regimes using differential pressure monitoring systems are not acceptable.

.8 Ventilation systems serving Laboratory spaces shall be independent of systems serving other occupancies of the building, such as offices, conference rooms and common elements. This to maximize occupant safety and allow for future flexibility and adaptability to change.

5.2 Ventilation Rates

.1 Lab Demand Control Ventilation System:

a. The designer must consider the installation of a Lab Demand Control Ventilation System that is capable of modulating ventilation air rates in response to the measured concentration of contaminants in the occupiable workspace. *To provide for accuracy of measurement and ensure occupant safety, differential type sensors must be included to monitor air quality, stand-alone wall mounted sensors will not be accepted as part of the system proposal.*

b. The recommendation to install this type of system shall be based on a risk assessment, return on investment (ROI) and annual operational cost savings analysis. Submit this analysis to the *Manager, Mechanical Design, DEC, for discussion and review as part of the Schematic Design Phase of Work.*

.2 Laboratories shall be designed to operate at the default ventilation rates indicated below, unless an approved Lab Demand Control Ventilation System is provided in accordance with 2.2.1.

.3 In *Teaching Laboratories*, where it is known that Lab activities will cease to exist when unoccupied; Laboratory ventilation rates and temperature set-points shall be maintained based on occupied or unoccupied modes of operation. Occupancy sensors shall be provided to automatically adjust the above parameters.

.4 Laboratories shall be designed to operate at the following default ventilation rates:

a. Occupied Mode: 10 Air Changes per Hour (ACH) (4-6 ACH permitted with the installation of an approved Lab Demand Control Ventilation System)

b. Unoccupied Mode (Teaching Laboratories): 6 Air Changes per Hour (ACH) (2 ACH permitted with the installation of an approved Lab Demand Control Ventilation System)

.5 As part of the Schematic Design Phase of work, prepare a floor plan indicating relative pressurization of spaces and direction of airflow and submit to the Manager, Mechanical Design, DEC, for review.

.6 Emergency Purge Mode:

a. A highly visible push button located near the emergency exit of the lab shall be provided to enable an increased room ventilation rate and full exhaust airflow of the associated fume hood(s) to quickly evacuate contaminants in the space.

b. Once enabled, the emergency purge mode ventilation rate shall be active for minimum two (2) hours. Activation duration

c. The requirement for emergency purge mode of operation and activation duration shall be confirmed with the University of Guelph's Environmental Health and Safety (EHS) Department as part of the schematic design phase of work, based on a risk assessment of the hazardous materials or processes to be used in the laboratory space.

5.3 Central Air Handling Systems

.1 Air handling systems serving Laboratory Spaces shall be fully custom type, provided in accordance with Design Standard DSM-01, HVAC Systems.

.2 Provide minimum efficiency reporting value (MERV) 8 Pre-filters and MERV 14 final filters for air handling systems serving laboratory spaces. HEPA filters should be provided for specialty spaces where research materials or animals are susceptible to contamination.

.3 Energy Recovery:

a. Must be provided to recover energy from the exhaust air systems to pre-condition make-up outdoor air.

b. Shall be complete with full by-pass to reduce pressure drop during free cooling (economizer) operation and whenever else the fan power energy penalty of passing air through the recovery device exceeds the energy recovered.

c. Shall be complete with a minimum sensible recovery efficiency of 65%.

d. A risk assessment of energy recovery device type shall be complete to ensure cross contamination concerns are addressed while maximizing energy recovery efficiency of the system.

e. Systems to consider include the following:

   i. Heat Recovery Run-Around Loops

   ii. Heat Pipe Systems

   iii. Heat Recovery Chillers

   iv. Others discussed with the Manager, Mechanical Design, DEC and approved based on a hazard risk assessment.

5.4 Exhaust Air Systems

.1 Laboratory exhaust air systems should be designed for high reliability and ease of maintenance. Consideration shall be provided for multiple exhaust air fans and provisions for sectioning of equipment such that maintenance can be performed on any single fan while sustaining operation of the system.

.2 To the extent possible, components of exhaust systems should allow routine maintenance to be performed without exposing personnel to the exhaust airstream.

.3 Exhaust fans from fume hoods or local exhaust control systems should be positioned as close as possible to the point of final discharge, such that exhaust air ductwork routed through the facility is maintained under negative pressure.

.4 Manifolding of fume hood exhaust air systems and connection to one or more common central fans is preferred. However, shall only be permitted for fume hoods with similar types of use and where no chemical reactions can occur.

.5 Fume hoods designed for the exhaust of perchloric acid or radioactive contaminants must be independently ventilated and specifically designed for the application; such as the integration of a wash-down cycle in the instance of a perchloric acid fume hood.

.6 Central fume hood exhaust air systems shall be designed with N+1 redundancy and fed from the essential power system.

.7 Lab exhaust air systems shall be constructed of materials suitable for the chemicals encountered.

.8 The requirement for spark-proof exhaust air system construction should be reviewed for each application, and shall be considered based on the material or exhaust vapor being handled.

.9 Each lab exhaust air fan shall be complete with an up-blast configuration with either a discharge stack or high-plume exhaust.

.10 Exhaust stacks from fume hoods should provide a minimum discharge velocity of 15.2 m/s (3000FPM). Where this exist velocity can not be achieved a dispersion study shall be complete, indicating that a lower velocity will be acceptable.

.11 A minimum distance of 30m (98FT) shall be maintained between fume hood/ contaminated lab exhaust outlets and building intakes. This requirement additionally applies to adjacent building intakes and openings.

.12 Fire detection and alarm systems shall not be interlocked to automatically disable fume hood or local control exhaust air systems handling hazardous materials or emissions.

5.5 Fume Hoods

.1 Proximity occupancy sensors, automatic sash closures and face velocity monitoring systems shall be considered for each fume hood, based on the results of the Functional Programming and Planning exercise.

.2 Fume hood design and face velocity shall be discussed during the Schematic Phase of Design with EHS and the Manager, Mechanical Design, DEC. In general:

a. Existing and legacy fume hoods shall be assumed to operate with a face velocity of 80-120FPM

b. New fume hoods shall be selected to ensure a safe working environment with a face velocity as low as 60FPM.

c. High performance fume hoods certified to ensure a safe working environment with a face velocity below 60FPM are to be investigated on a project-by-project basis.

.3 Refer to the University of Guelph EHS Program for additional information and guidance.

5.6 Miscellaneous Exhaust Devices

.1 Local exhaust air drop(s), Articulating Arm Type Exhaust Air Drop(s), Snorkels and Bench Sweeps shall be provided where a requirement for local point-of-use exhaust is identified through the Functional Programming and Planning exercise.

.2 Miscellaneous exhaust air devices shall be constructed of a material suitable for use with the chemicals encountered.

5.7 Hazardous Material Storage

.1 Flammable storage cabinets are typically not required to be vented for fire protection purposes. Venting will be considered on a case by case basis only. The default condition will be non-vented flammable storage cabinets. The cabinet should be supplied with factory furnished vent ports, fitted with flame arrestors, and removable seals. These ports will be leveraged should venting be required for the purposes of protecting workers to exposure of harmful vapors.

.2 In the unique instance that a flammable cabinet is provided with an active venting system, then the exhaust ductwork and fan must be of non-sparking construction and assembled of stainless steel, fiberglass (FRP), or alternate material suitable for the chemicals encountered. All ductwork shall be protected with a continuous fire rated enclosure to the exterior termination.

5.8 Ductwork:

.1 All ductwork shall be smooth rigid type; flexible ductwork is not permitted under any circumstances.

.2 All exhaust ductwork from chemical fume sources shall be constructed of welded stainless steel. Type shall be based on chemicals encountered.

.3 Plastic may be considered a suitable alternate to Stainless Steel material, and is to be discussed with the Manager, Mechanical Design, DEC during the Schematic Design Phase of work.

.4 Ductwork serving fume hoods shall not be fitted with fire or smoke dampers. Where fume hood exhaust air ductwork must pass through a fire rated assembly, provide suitable fire wrap minimum 3m (10Ft.) on each side of the fire barrier in accordance with NFPA 91 requirements.

.5 Acoustic lining and other liners are not permitted within the airstream of ventilation system ductwork.

5.9 Supply and Exhaust Air Terminal Units

.1 Terminal elements shall consist of venturi valves with pressure independent flow control for variable speed operation.

.2 Terminal units shall be located such that they are readily accessible for maintenance.

.3 Terminal units shall be complete with a maximum 1s speed of response.

.4 Terminal units shall be provided with their own stand-alone system of controls which shall be capable of communicating with the facility Building Automation System without the need for protocol converters or translators (i.e. native BACnet).

.5 Terminal units shall utilize flow tracking to maintain prescribed airflow offsets and associated space relative pressurization.

.6 Terminal units shall be suitable for both horizontal or vertical mounting.

.7 Galvanized, Aluminum or Stainless-Steel valves shall be deployed for general ventilation systems.

.8 Stainless Steel or Heresite Coated valves, suitable for the chemicals encountered, shall be provided for fume hood exhaust air applications.

5.10 Supply and Exhaust Air Outlets

.1 Location of supply air outlets shall be carefully coordinated in each laboratory space containing a fume hood, or other containment device, as to not impact the containment effectiveness.

.2 Laminar flow type supply air diffusers (non-aspirating) are preferred in Laboratory spaces containing a fume hood or other similar containment device.

.3 Preferred location of general exhaust air inlets are at low level at the head of the Laboratory; however, an analysis of types of chemicals and density of gases anticipated shall be complete to determine the final location of general exhaust air grille placement.

6 PLUMBING SYSTEMS

6.1 General

.1 Lab services and utilities should be arranged along the common lab planning module that aligns with the lab casework. Location of services should be arranged such that lab reconfigurations will minimize the need to relocate major services.

.2 Lab service connection points to be located such that future modifications and configurations of lab casework and equipment will have minimal impact on the delivery of the services to the work bench and equipment.

6.2 Sanitary Drainage

.1 Provide in accordance with University of Guelph Design Standard DSM-02 Plumbing Systems.

.2 All drain piping serving Chemistry Laboratories and Wet Laboratories shall be constructed of acid resistant PVDF for the greater of the first 50’-0” or until the effluent is adequately diluted and deemed safe for use with conventional piping materials.

6.3 Water Distribution

.1 Provide in accordance with University of Guelph Design Standard DSM-02 Plumbing Systems.

.2 Water supplies to handwash, emergency eyewash and shower stations shall be extended from the potable water system.

.3 Water supplies to Laboratory sinks, benches, fume hoods and Process Equipment shall be extended from the non-potable water system.

.4 Zone protection in the form of a non-testable device shall be provided for individual labs fed from the non-potable water system.

a. A Lab faucet vacuum breaker shall be provided on each outlet within a Zone Protected Lab where it is necessary to protect individual outlets from self-induced cross-contamination.

.5 Fixtures and equipment fed from the non-potable water system shall be clearly labeled as fed from a non-potable water supply.

.6 Water supply shall be of sufficient pressure to allow for effective operation of fixtures, equipment

6.4 Natural Gas

.1 One (1) strategically located emergency gas master shut off valve shall be provided in a visible location at the exit of the laboratory space, within an enclosure and identified as ”Emergency Gas Shut-Off”.

6.5 Fixtures and Trim

.1 Minimum one (1) dedicated handwash sink shall be provided in each laboratory with handsfree hardwire sensor activated faucet. Water supplies to this handwash sink shall be extended from the Potable Water System.

.2 Minimum one (1) eye/face wash station and emergency drench shower shall be provided in each laboratory. Water supplies to this eye/face wash station shall be extended from the Potable Water System.

.3 Water delivered to each handwash, eye/face wash and emergency drench shower station shall be tempered. Tempered water associated with eye/face wash and emergency drench shower shall be delivered between 18˚C and 24˚C. Tempering valve shall be designed to fail cold.

.4 Floor drains located in laboratories shall be limited to the emergency shower area only.

.5 All services to be provided with service isolation valves upon entry into each lab space. In general, it is preferred that all service valves be located neatly in an accessible area of the ceiling space above the main entry door.

6.6 De-ionized (DI) Water

.1 Provide in accordance with University of Guelph Design Standard DSM-02 Plumbing Systems.

6.7 Compressed Air System

.1 Provide in accordance with University of Guelph Design Standard DSM-02 Plumbing Systems.

6.8 Vacuum System

.1 Provide in accordance with University of Guelph Design Standard DSM-02 Plumbing Systems.

6.9 Specialty Gases

.1 Provide in accordance with University of Guelph Design Standard DSM-02 Plumbing Systems.

7 FIRE PROTECTION SYSTEMS

.1 Provide in accordance with applicable NFPA Standards, Local Code(s) and University of Guelph Design Standard DSM-04 Fire Protection Systems.

- Fire extinguishers appropriate for the chemicals and equipment in use must be installed near the entrance of each laboratory.

8 AUTOMATION AND CONTROL SYSTEMS

.1 Provide in accordance with University of Guelph Design Standard DSM-03 Building Automation Systems

.2 Refer to Typical Laboratory Temperature and Pressure Control Schematic attached to and forming part of this Design Standard.

9 COMMISSIONING AND SYSTEM ACCEPTANCE

.1 The Design Engineer of record shall ensure that the basic commissioning requirements indicated below are included in the appropriate section(s) of the contract specification package. These requirements may be modified should a third-party Commissioning Agent be retained by the University;

a. Ventilation system functional tests, including emergency purge mode of operation, and unoccupied mode set-backs for temperature and airflow, as applicable.

b. Demonstration of relative pressurization achieved, including record submittal of facility floor plan indicating relative pressurization of spaces and direction of airflow.

c. Testing, Adjusting and Balancing (TAB) Reports for exhaust air, and supply air systems.

d. Functional performance testing, labelling and identification of each fume hood and other applicable containment devices in accordance with ASHRAE Standard 110 and University of Guelph EHS Standards.

e. Plumbing fixture functional testing

f. Cross Contamination device testing and identification in accordance with CSA and University of Guelph EHS Standards.

g. Emergency shower and eye/face wash system testing and identification in accordance with ANSI and University of Guelph EHS Standards.

h. Separate user and facility maintenance training modules for laboratory and central equipment / systems.

i. All pressure vessels and fittings built to a registered design shall be complete with a Canadian Registration Number (CRN) to identify that the design has been accepted and registered for use in the province.

ELECTRICAL

10 INTRODUCTION

10.1 General

.1 This Electrical Power Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Electrical Power Systems installed on campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

10.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction and within projects involving significant renovations.

.2 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of the existing Electrical installation.

.3 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Electrical Design, DEC before the completion of Schematic Design.

10.3 Responsibility of the Designer

.1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Electrical Design, DEC, together with proposed measures for addressing the conflict.

.3 The Design Engineer of Record is responsible for ensuring the design accounts for all affected systems including concealed conditions. With prior approval by the University, destructive testing may be required to confirm conditions.

.4 Where new work will connect to existing building systems, the Design Engineer of Record is responsible for ensuring the tie-in and interaction of the new systems does not impact existing operations.

.5 The Design Engineer of Record is responsible for coordinating specific user requirements from all stakeholders including, but not limited to, University Staff, Management, and users of the affected space(s).

10.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovations shall be tabled for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

10.5 Reference Documents

.1 Ontario Building Code

.2 Canadian Electrical Safety Code

.3 Electrical Power Systems Final DSE-01*

.4 Lighting Systems DSE-02*

.5 Fire Alarm Systems DSE-03*

.6 IT & Communications Standard DSE-04*

.7 Access Control Systems DSE-05*

.8 Mechanical HVAC Standard DSM-01*

.9 Campus Power Distribution System Single Line Diagram

* A copy of these standards is available on University of Guelph Physical Resources web page

11 DESIGN STANDARDS

11.1 General

.1 In general, products should be manufactured in North America, but if not, local product representation must be in place, before specifying these products.

.2 Lab benches shall be wired for flexibility. Examples of acceptable configurations:

a. Basic overhead power and data servicing:

i. Overhead services via a Unistrut mounted set of twistlock receptacles and data jacks. Twistlock receptacles shall be face down, while the data jacks shall face to the side or

ii. Stainless steel or galvanized cable tray with wiremold on both sides with separated power and data -power on the bottom and data on the top.

iii. The lab bench is pre-wired by the Lab bench supplier.

.10 Recessed ceiling service panel:

a. This is typically fabricated by the Lab Bench supplier as part of the bench package.

b. Sets of twistlock receptacles and data jacks are recessed into the underside of a metallic ceiling panel with both twistlock receptacles and data jacks facing down.

c. The lab bench is pre-wired by the Lab bench supplier.

.11 Ceiling mounted service pedestal:

a. This is typically fabricated by the Lab Bench supplier as part of the bench package.

b. Sets of twistlock receptacles and data jacks recessed into the sidewalls of a pedestal.

c. The lab bench is pre-wired by the Lab bench supplier.

.12 Do not feed lab benches from the floor slab.

.13 All labs to be compliant with CL2 requirements as a minimum.

.14 Provide silicon to seal all crevices around outlet boxes and conduit stand-offs.

11.2 Conductors and Cables

.1 Refer to Electrical Power Systems Standard DSE-01, for minimum requirements.

.2 In addition to the requirements stipulated in the above named standards, provide:

a. All wiring shall be in conduit.

b. Provide a ground wire in every conduit.

11.3 Grounding and Bonding

.1 Refer to Electrical Power Systems Standard DSE-01, for minimum requirements.

.2 In addition to the requirements stipulated in the above named standards, provide:

a. Provide a green insulated ground wire in each conduit.

11.4 Conduits and Outlet Boxes

.1 All surface mounted outlet boxes shall be FS type or equivalent.

.2 For all surface mounted conduit, stand conduit off the wall to allow for wiping down of conduit all of the way around. Stand-off conduit using conduit clamps that provide a 6 -10 mm gap.

.3 All conduit recessed in partitions separating Lab spaces from adjacent non-Lab spaces must be suitable for installation in a 1 Hour fire separation.

.4 Provide a spare power conduit and a spare data conduit to each Lab bench service grouping as described in item 2.12 above.

11.5 **Cable Trays**

.1 Basket trays are preferred over rigid ladder or cable trays, due to added flexibility and lower weight on supporting structures (except at overhead services above casework).

11.6 **Wiring Devices**

.1 Refer to Electrical Power Systems Standard DSE-01, item for minimum requirements.

.2 In addition to the requirements stipulated in the above named standards, provide:

a. All power outlets over/on Lab Benches and in fume hoods to be GFI protected.

b. In addition to requirements identified in Room Data Sheets, provide a Duplex Outlet every 10’0”.

c. While-in-use covers shall be provided for all wiring devices in wash down areas.

i. Refer to Room Data Sheets for specific wiring device requirements.

ii. Whether new build or renovation, label all receptacles and switches, with wall mounted lamacoid nameplates, colour coded as per item 2.6 of DSE-01.

iii. Receptacles within 1.5 meters of an eyewash or shower must be equipped with a Class A ground fault circuit interrupter.

iv. Above lab counters, use surface mounted raceways, finished to suit environment.

11.7 **Panelboards**

.1 Provide a dedicated breaker panel for each Lab. The panel location must be identified early in the design process. The location must be within the lab and 1 metre access in front must be provided.

.2 Breaker panels to have gasketed door-in-door enclosure.

.3 Provide emergency-power-off (EPO) buttons at the main door and any secondary exit/entry door for all loads in teaching labs, except for loads such as incubators, refrigerators and freezers.

.4 Provide digital metering for all high power use labs and specific equipment.

11.8 Essential Power

.1 The provision of essential power must be raised early in the design process. University of Guelph will indicate availability and approve location if a new generator is required.

.2 The University may require some hoods to continue operation during a power outage and should therefore be connected to a back-up power source. Consult with DEC and EHS prior to design.

.3 Connect all refrigerators and freezers to Essential Power.

11.9 Uninterruptable Power Supplies

.1 For new construction, new centralized 3 phase UPS units shall be provided, in lieu of localized UPS single phase UPS units.

11.10 Lighting

.1 All luminaires to LED type.

.2 Provide lighting levels as per the chart below:

.1 *Provide Task Lighting as necessary to support Functional Needs. Higher number includes task lighting.

Space / Application	Average Illumination Level at Task Height	Average: Minimum	Additional Requirements
Electronic Labs	650 min. - 800 lux*	2:1	
Food Labs	650 min. - 650 lux*	2:1	500 lux average illumination level at floor
Chemistry Labs	550 min. - 650 lux*	2:1	
Biology Labs	550 min. - 650 lux*	2:1	
Bio-containment Labs	650 min. - 700 lux*	2:1	

.2 Colour temperature to be 4000 degrees K. Other colour temperatures may be required for certain labs. White tunable lighting may be appropriate in some labs. Review colour temperature options with the user group and DEC prior to inclusion in the design.

.3 All luminaires, with the exception of specialty fixtures such as “Darkroom In Use” signage, shall have a minimum lumens per watt of 125, with 0-10V or DALI drivers as required by the applicable lighting control system.

.4 CRI shall be +80.

.5 All luminaires must be cleanable to prevent dust accumulation and bacteria growth.

.6 Open ceilings using direct/indirect luminaires are preferred.

.7 All luminaires shall be reviewed with the project's user group, in addition to review by the DEC.

.8 Provide a photometric study of each room type on each project for University of Guelph's review.

11.11 Lighting Control

.1 Provide centralized lighting control wherever possible. All centralized lighting control equipment shall be BACnet compatible.

.2 Access to settings of the centralized lighting control system shall be via the campus network or on-line and shall be password protected to limited access to programming revisions to Physical resources.

.3 Provide dual technology occupancy sensors in all Labs. Occupancy sensors must be able to be over-ridden via the room light switches or scene controllers.

.4 Provide daylight sensors where appropriate. Control of lighting based on available daylight must be dimming (not on-off), fast acting and over-ridable.

.5 All daylight sensors and occupancy sensors in open ceilings shall be dropped down to the appropriate height on using conduit stems.

.6 Provide dimmers in all Labs to allow for decreasing the lighting levels.

11.12 Telecommunications

.1 Provide a minimum of one data outlet per lab.

.2 Refer to Room Data Sheets for specific telecom outlet requirements.

.3 Provide an emergency [phone at the Safety Station.

11.13 Clocks

.1 Provide Primex 120V wireless clocks in locations called for in the RDS.

.2 Provide a receptacle behind each clock location.

11.14 Access Control and CCTV

.1 Refer to the Design Standard for Access Control Systems.

.2 All refrigerators and freezers shown be monitored for common trouble on the Genetec Access Control system.

.3 Provide CCTV cameras in all CL3 labs.

11.15 INSTALLATION STANDARDS

.1 General

a. Refer to Design Standards DSE-01 to 05.

12 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	03-03-2021		Original Issue

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PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

VIVARIUM DESIGN STANDARDS, RD – 09

Version	Revision 0
Effective Date	03-March-2021

TABLE OF CONTENTS

ARCHITECTURAL

1 VIVARIUM

1.1 Architectural Introduction

.1 This Vivarium Design Standard has been developed to establish the University's minimum expectations and requirements for New Renovations and New Construction on Campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of qualitative and quantitative measures, life safety, materiality, finishes, accessibility, sustainability, systems configuration and performance criteria, installation and operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new installation(s) within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing building elements, including architectural, structural, mechanical and electrical elements.

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the respective disciplinary Manager (Architectural, Mechanical, Electrical Design) from University of Guelph – Design, Engineering and Construction (DEC) before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The System Designer (having Responsible Control) remains responsible for ensuring any proposed design solution are in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the respective disciplinary Manager (Architectural, Mechanical, Electrical Design) from DEC, together with proposed measures for addressing the conflict before the completion of Schematic Design.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 Design Innovation is encouraged. All proposed Design Innovations shall be tabled for consideration by the respective Discipline Manager (Architectural, Mechanical, Electrical Design) from DEC, before the completion of Schematic Design.

1.5 Reference Documents

Comply with the latest editions of the following standards, references and guidelines from the following organizations in addition to the Referenced Documents from other sections noted in the Design Standards Introductions, including:

.1 Canadian Standards Association (CSA)

.2 Ontario Animals for Research Act (ARA)

.3 Canadian Council on Animal Care (CCAC)

.4 Health Canada and the Public Health Agency of Canada (PHAC) – Lab Standards, Canadian Biosafety Standard – CBS and Design Guidelines (latest edition)

.5 Canadian Food Inspection Agency (CFIA)

.6 Underwriters Laboratories of Canada (ULC/UL)

.7 Scientific Equipment and Furniture Association (SEFA)

.8 Clinical and Laboratory Standards Institute (CLSI)

.9 International Organization for Standardization (ISO)

.10 Canadian Nuclear Safety Commission (CNSC)

.11 ASHRAE

.12 National Fire Protection Association (NFPA)

.13 Ministry of Labour (MOL)

.14 United States Pharmacopeia (USP)

.15 National Association of Pharmacy Regulatory Authorities (NAPRA)

.16 Whole Building Design Group (WBDG) – National Institute of Building Sciences

1.6 Additional Reference Standards

The following additional reference standards and guidelines are represented in various forms in the "Reference Documents" sections of the current Standards and Guidelines – this may need to be consolidated and included as an appendix rather than in it's current variances in each section

Architectural Additional:

Ontario Building Code (OBC)

Accessibility for Ontarians with Disabilities Act (AODA)
University's Campus Master Plan
University Design Standards
LEED

Mechanical Additional (HVAC):

SMACNA
University's Metering Standards
University's Identifications Standards
Campus Steam and Condensate System Piping Schematics
Campus Chilled Water Systems Piping Schematic

Mechanical Additional (Plumbing):

ASPE Standards
Campus Domestic Water System Schematics
Campus Storm & Sanitary Piping Schematic
City of Guelph Cross Connection Bylaw (Backflow Bylaw)

Mechanical Additional (BAS):

Canadian Electrical Code
ASHRAE/ANSI 135 BACnet
ASHRAE/Guideline 13 Direct Digital Control
ANSI/TIA/EIA862 BAS
Federal Communications Commission (FCC)

Mechanical Additional (Fire Protection Systems):

Insurers Advisory Organization (IAO) Risk Management Services (RMS)

Electrical Additional (Power):

Canadian Electrical Code
Campus Power Distribution System Single Line Diagrams

Electrical Lighting Systems:

IESNA Lighting Handbook

2 DESIGN STANDARDS

2.1 General

.1 Applicability - The requirements outlined in the following clauses are applicable to all projects outlined in Clause 1.2 - Compliance Criteria specifically for Vivarium, and as outlined in the University Design Standards; Application specific requirements are outlined under clauses 2.2 – 2.22.

.2 Unless otherwise noted, the following standards and guidelines will apply when planning for all new laboratories, major renovations and minor renovations (where feasible) Review with DEC if exemptions are proposed. It should be noted that these standards and guidelines are not intended to replace professional judgement. It is recommended that they be used to supplement and enhance the approach and methodology of the designer(s).

.3 These Design Standards are intended as a guidance document to facilitate a consistent campus wide approach and to provide stewardship for the design of vivarium.

.4 Room Data Sheets will be created and will be submitted as part of the Detailed Design Process.

.5 For the purposes of clarifying the application of this section of the Design Standards, vivarium is defined as controlled environment spaces being used for animal housing and animal care (including aquatics), medical and surgical procedures, storage, decontamination, washing, measurement and experimentation. These activities may involve the use of hazardous materials or may include a hazardous process.. Applicability of this definition is at the discretion of the University and should be reviewed and agreed to prior to the implementation of the SD phase.

.6 Prior to project commencing, the designer must consult with the University Discipline Manager from DEC as well as the University of Guelph Animal Care Services in terms of the University's Environmental Health and Safety (EHS) risk assessment report on the vivarium (if applicable) as it relates to hazardous materials and hazardous process that apply to the subject vivarium.

.7 This document should be read in conjunction with the balance of the related Master List of Design Standards as posted by the University of Guelph.

.8 If alternates or deviations from the Design Standards are proposed by the Designer(s), these variances are to be presented to the University Discipline Manager from DEC for discussion and approval – The completion of a Compliance Checklist will be required.

.9 Accessibility – Vivarium are to be designed to be accessible to the extent possible, and to be compliant with AODA guidelines and the University of Guelph's accessibility standards. It is understood that the process and SOP within a vivarium environment does not always facilitate a fully accessible environment. Variations will be considered on a case by case basis. It is required that that a percentage of work stations be provisioned to be barrier free. The percentage to be determined on a case by case basis for each project.

.10 Containment – Laboratories are to be designed to be fully compliant with CL2 -Ag for small animal facilities containment as per Public Health Agency of Canada – Canadian Biosafety Standards.

.11 Sustainability – Vivarium spaces are among the most energy consumptive spaces on the campus. These Design Standards are intended to acknowledge the unique characteristics of vivarium and therefore aim to promote the right-sizing of lab systems to avoid unnecessary energy use associated with overdesign of the systems.

.12 Variances and Alternate Compliance – approval form & sign off to be completed prior to completion of the Schematic Design Report.

.13 Vivarium Classification – EHS Hazard and Risk Assessment – Designer to solicit this as soon as is feasible and prior to completing the Schematic Design report.

.14 Sustainability Design and Energy Conservation Targets to be established as part of the Schematic Design Report.

.15 Consult with U of G Energy Efficiency Policy – re: new buildings and substantial renovations.

.16 Energy Use Intensity (EUI) as a minimum standard defined as a percentage better than calculated using ASHRAE 90.1-2013.

.17 During the design process, demonstrate options that could achieve higher performance Minimal LEED aspirations – U of G currently subscribes to the LEED system – but with no formal requirement for registration of the project.

.18 Other sustainable targets – requirement to describe other sustainable metrics.

.19 Demand Control Ventilation, Air Quality Monitoring to be considered for every laboratory where applicable.

.20 Designer Required to provide review and substantiation on energy demands, control, consumption – provide ROI calculations as part of the Schematic Design report.

.21 Energy Modelling – in concert with the University, define baseline criteria required for implementation.

.22 Pre-design process – Designer required to demonstrate and solicit approval on overall approach to sustainability – strategies such as low flow/low volume devices, energy recovery strategies, EUI calculations etc.

2.2 Vivarium Metrics

.1 Vivarium are typically planned on a repeatable planning module basis to the fullest extent possible. The typical single planning module should be designed with the process and accommodation in mind. If the room is a procedure room or lab process room, the width of the planning module is recommended to be between 3.2 m and 3.6 m wide and should never be less than 3.2 m wide. In a lab process room, the module length should be between 2- and 3-times module width and should not be less than 2 x the module width or more than 3 x the module width. This will provide a minimum lab aspect ratio configuration of 2:1 and a maximum of 3:1. Additional module width may be required on a case by case basis depending on equipment clearances. In procedure rooms, the width and length should be configured for the process and equipment. Planning modules and configurations animal holding rooms will depend on the animal species and the rack/caging, ventilated vs. non ventilated cages for the species in question. Configurations should be explored on a case by case basis.

.2 Vivarium can be configured on a repeating module basis by aligning the single modules side by side to create double, triple, quadruple modules in sequence. Application of a consistent and regular module will result in an efficiently planned suite.

.3 Aisles widths within vivarium should comply with the requirements of CCAC, however should be minimally 1.53 m providing a clearance of least 1.53 m between benches and between bench and procedure tables and other equipment. Additional clearances will be required to accommodate large equipment, turning radii and in front of other equipment in compliance with CSA and other standards.

.4 Single aisle configurations (single loaded aisle) should be avoided where every possible. If they must be provided, they should be at least 1.1 m wide.

.5 Aisle lengths should be no longer than between 5 m – 6 m before a cross-aisle is introduced. Long dead-end aisles should be avoided.

.6 Vivarium clear height requirements will vary greatly from lab to lab and will depend on the functionality of the lab as well as the animal rooms and ancillary rooms Ideally, vivarium should be planned to provide a clear unobstructed height of not less than 3.05 m.

2.3 Vivarium Location and Zoning

.1 Vivarium should be designed as per CCAC Guidelines and as a controlled barrier suite and shall be separated from adjacent public spaces by a barrier and lockable access and egress doors with security features that provision controlled access and prevent unauthorized access by the public.

.2 The circulation within vivarium suite should be regular, clear and logical. Aisles and circulation patterns should be planned to provide the most direct route and access to exit from the rooms within the suite and vivarium in general.

.3 Vivarium should be zoned with clear definition and delineation between the major components within the lab (containment and non containment zones, clean and dirty zones with separate corridors if possible, surgical suites, necropsy suite, animal holding, cage rooms, procedure rooms, cage wash and decontamination rooms, gowning, food and bedding storage rooms, dispensing rooms, isolation rooms, process and working/bench areas, equipment parking areas, transient spaces/circulation, clean up areas/sinks, safety zones/stations etc.).

.4 Provide full separation/barrier between clean and dirty side of the cage wash area and the autoclave area.

.5 Vivarium casework to be arranged to facilitate line of sight and visual connection to egress locations within labs

.6 Path of travel to an egress point of the vivarium should not pass through a high hazard zone

.7 Vivarium services and utilities should be arranged along the common planning module that aligns with the casework or other FFE. Location of services should be arranged such that reconfigurations will minimize the need to relocate major services

.8 Service connection points to be located such that future modifications and configurations of casework and equipment will have minimal impact on the delivery of the services to the work bench and equipment

.9 Offices/write-up/administrative functions are generally discouraged within the vivarium – the preference is to locate non-lab spaces outside of the vivarium suite where possible.

.10 As a rule of thumb, vivarium should be separate from adjacent spaces by a demising fire separation with a minimal FRR of 1 hour. Enhanced FRR may be required in certain circumstances

.11 Vivarium fitments, furniture and equipment should be located to avoid becoming an encumbrance to circulation and air flow within the suite

.12 Locate all areas of high hazard away from access/egress points to the suite

.13 Mobile equipment, carts, mobile racks etc. should not be permitted to reduce the effective aisle width to less than 1.2 m.

.14 Where required to be co-located in vivarium, provide parking spaces for mobile equipment, carts and racks in proximity to access/egress point of lab

.15 Vivarium fitments should be positioned to allow for a robust cleaning and decontamination program including the temporary relocation of mobile casework to facilitate cleaning of spills and decontamination, and to provide access to mechanical and electrical systems

.16 Fitment construction to be robust, hospital grade construction and finish with impervious surfaces. Casework should include fit-up with similar grade hardware

.17 Surfaces, casework, benchtops and furniture to be cleanable, non-absorbent and resistant to scratches, stains, moisture, chemicals, heat, impact, repeated cycles of decontamination and washing.

2.4 Process and Flow

.1 Vivarium should be planned for an efficient and safe flow of animals, people, materials, food, equipment, waste and recycling etc.

.2 Prior to completing the Schematic Design phase, provide the discipline manager of DEC with flow diagrams depicting the process and path of travel of the various materials and personnel as noted above and in consideration for requisite biosafety and biosecurity

2.5 Safety Stations

.1 Designate an area near the primary egress point of the laboratory for a Safety Station – provide at least one Safety Station per laboratory – frequency, configuration, travel distance to the safety station to be reviewed on a case by case basis. Typically, the safety station will be located within 8-10 seconds of travel from any point in the vivarium

.2 The Safety Station must be highly visible and signed with the requisite signage designating the location as having an eye wash and deluge shower – design and location of the station should be consistent from room to room in the vivarium

.3 The Safety Station must include, among other things: emergency (deluge) shower, hands free eye wash station (in combination or as individual), first aid kit and a fire extinguisher of appropriate type and size to the hazard class within the lab. Include a floor drain with a self priming trap at each Safety Station. . Limit the floor drain to this one location. Locate the floor drain remote from hazardous substances and fume hoods/Bio Safety Cabinets

.4 In addition, and on a case by case basis, the Safety Station will also include a spill kit, and a modesty curtain. Provide a location for the convenient and safe storage of the modesty curtain. If the eye wash and safety shower are individual units, then they must be capable of being operated by the same individual at the same time

.5 Provide a location for personal protective equipment (PPE) near the Safety Station

.6 The Safety Station should accommodate barrier free access and operation

.7 The Safety Station to be defined by a contrasting boarder outlined on the floor for easy recognition of the location for an occupant in distress

.8 In all cases, provide a hands-free hand wash sink near the entrance to the vivarium. Coordinate location with safety station configuration

.9 In vivarium designated as Bio-containment Facilities, the requisite hand wash sink may be used in combination with the eye wash upon review and approval of the Discipline Manager of the University. The safety station will be based on the sample template provided with this standard

.10 Avoid electrical appliances, outlets and switches within proximity of the Safety Station – coordinate to ensure that water cannot be splashed over electrical fixtures

.11 Temperature and Volume of water/duration – Refer to mechanical subsection

.12 Provide a display board in a material and finish appropriate for the lab type being considered. Display board to be white board or similar surface and to be cleanable and non-absorbent

.13 Safety stations in a vivarium suite will be entertained in special cases and for certain procedures, but will be required to be isolated and in a contained area separate from animal holding

2.6 Fume Hoods

.1 If Fume hoods are located in a vivarium suite, they shall be located within the vivarium to avoid high traffic areas and so that their location does not impact the egress from the lab (i.e. not near the egress point of the vivarium). Fume hoods are ideally located in the "back of the room" and where they are least at risk of compromising safe access and egress from the lab and least likely to be disturbed by the flow of personnel, equipment etc.

.2 Avoid fume hood locations near single means of access/egress from the vivarium

.3 Provide recommended clearances in front of and adjacent fume hood in compliance with the standards governing fume hood location and operation (i.e. CSA standards). In no instances should the clearance in front of a fume hood to another fitment be less than 1.53 m

.4 Fume hoods should not be located in corners – provide the minimal clearances recommended by CSA to adjacent fitments and perpendicular objects that project ahead of the face of the fume hood

.5 Avoid locating fume hood directly apposed to another fume hood, biosafety cabinet, laminar air flow device or seated work stations (any activities that will affect the performance of the fume hood or the safety of the user)

.6 Locate fume hoods so they do not interfere with air circulation or do not contribute to air flow short circuiting

.7 Provide adequate clearance below fume hood to facilitate cleaning underneath fume hood – or otherwise fume hood should be sealed to floor with integral cove base to prevent water and contaminants from getting trapped below fume hood

.8 Fume hood specifications:

a. Fume hood manufacturers shall be members in good standing with Scientific Equipment and Furniture Association (SEFA)

b. Comply with the latest current edition of CSA Z316, for Fume Hoods and Associated Exhaust Systems

c. Fume hoods are to be tested for containment at the factory in accordance with ASHRAE 110 standards and PWGSC document MD15128 (latest edition)

d. Face velocities to be determined in concert with DEC and EH&S – and will be considered on a case by case basis

e. Fume hoods to be pre-plumbed and pre-wired to a central connection point

f. The fume hood liner and baffles shall be constructed of either 16-gauge Type 316 stainless steel with welded seamless construction or Fibre Reinforced Plastic (FRP) and with sealed joints – review on a case by case basis for application of surfaces

g. Interior corners shall have a radius of at least 20 mm and smooth surfaces and transitions to facilitate ease of cleaning and decontamination

h. Work surface shall be either solid epoxy or phenolic and be at least 25 mm thick with a 12 mm high anti-spill edge on all sides

i. Sash perimeter openings shall be constructed to minimize eddies and promote smooth entry of air into the hood

j. Provide 50 mm grommet openings with escutcheon plate and closure in each side panel of fume hood to accommodate services into the hood

k. Sash and side panel, rear panel glazing and light lens to be constructed of laminated or tempered safety glass.

l. Sash to be repositioned with minimal force through the full travel path of the sash - the sash should remain stationary when force is removed

m. Fume hoods shall be equipped with both audible and visual low airflow alarm that will sound if the face velocity should drop below a prescribed set point. The audible alarm shall have the ability to be temporarily silenced but the visual alarm must continue to function until face velocity is re-established

n. Cup sinks will be constructed of the same material as the work surface - fully integrated with the work surface with a raised edge (minimum 6 mm) to prevent spills from entering drain cup sink

o. Lighting, plumbing and other gas services are to be remotely operated and to be accessible for servicing outside of the inner lining

p. Service controls and electrical fitments are to be mounted outside of the cabinet on the front fascia

q. All receptacles on fume hoods shall be GFI T-slot 120V/20 A

r. Fume hoods shall operate at a sound level not to exceed 65 dBA at the face of the hood under normal operating conditions

s. Lighting fixture to be LED and to be mounted externally of the inner liner, all serviceable electrical parts are to be accessible from outside of the structure

t. All electrical fixtures will be factory installed and pre-wired to a junction box on the top of the fume hood. All components shall bear the CSA and UL/ULC label

u. Fume hoods shall be supplied with a sash limiting device (sash stop) installed to limit the sash travel to the maximum operational opening of **460**mm as measured from the work surface. Sash stops shall be designed to allow the operator to override them and will automatically reset when the sash is lowered back to below 460 mm. Confirm these opening dimensions with DEC as part of the Schematic Design process. The fume hood must be equipped with an alarm to indicate that the sash is above the maximum operational opening

v. In the case where barrier free construction is required, provide fume hoods with adjustable work surfaces and knee spaces below the work surface

w. Any variances to the fume hood specifications shall be approved by Discipline Manager at DEC and/or EHS

2.7 Biological Safety Cabinets

.1 Locate BSC's away from high volume path of travel, doorways, supply and return ventilation etc. such as those caused by doorways or general ventilation devices. Locate remote from disruptive air currents that will affect the performance of the BSC. BSC "Type" and "Class" to be reviewed with DEC on a case by case basis

.2 Locate BSC's so they are not directly across from, or adjacent to, seated work stations, other biosafety cabinets or fume hood

.3 Provide a minimum 40 cm clearance between the exhaust outlet on top of the BSC and any overhead obstructions. Provide 30 cm clearance on either side of the BSC.

.4 Biosafety Cabinet Specifications:

a. must comply with the Canadian Biosafety Standards and Guidelines (latest edition) and be certified in accordance with NSF/ANSI 49 for Biosafety Cabinetry and with manufacturer's specifications

b. Room exhaust and supply diffusers must be located a minimum distance from BSC measured horizontally from the front face of BSC. Consult with the BSC manufacturer

c. Provide a minimum clearance between the exhaust outlet on top of the BSC and any overhead obstructions as defined by the BSC cabinet manufacturer. Provide 30 cm must be provided on each side of the BSC

2.8 Specialized Storage

.1 Gas cylinders to be stored so as to not be a hazard and an incumbrance to circulation within lab. Gas cylinders should be properly restrained with gas bottle harnesses and to be stored in alcoves if possible

.2 Gas cylinders should not be located near access/egress points, paths of travel to exits and in exit corridors

.3 Large floor standing equipment should be located in designated equipment zones so as to not disrupt the activities of the lab

2.9 Hazardous Material Storage/Flammable Storage

.1 Flammable storage cabinets/solvents and acids/corrosives are typically located under or in proximity to a fume hood since that is typically where the hazardous substances are being used. Quantity and type of hazardous and flammable storage will be considered on a case by case basis. As a default, each fume hood should be provided with one hazardous storage cabinet and one acid cabinet below the FH.

.2 Flammable storage cabinets shall not be located within proximity of access/egress to the lab or in a location that would constitute a hazard to egress from the lab

.3 Flammable storage cabinets must conform to standards governing their construction and use including ULC and CSA standards

.4 Flammable storage cabinets are typically not required to be vented for fire protection purposes - venting may compromise the performance of the cabinet. Venting will be considered on a case by case basis only. The default condition will be a non-vented flammable storage cabinet. The cabinet should be supplied with factory furnished vent ports, fitted with flame arrestors, and removable seals. These ports will be leveraged should venting be required for the purposes of protecting workers to exposure of harmful vapours.

.5 If a flammable cabinet is vented, then the exhaust duct, riser and fan must be constructed of materials that will provide the same protection as the cabinet and seals offer to the contents

.6 Corrosion resistant cabinets are required for the storage of acids. These cabinets are to be vented using corrosion resistant material to prevent deterioration due to corrosion or rusting. Venting may be done into adjacent fume hoods as per the manufacturer's specification

.7 In the case of acid cabinets, if the cabinet is vented, the duct should be connected to the port provided in the cabinet. Ducts should be connected to the main fume hood exhaust duct downstream of the fume hood collar and control valve (if applicable)

.8 It is recommended that EH&S be consulted in any case where venting of flammable storage cabinets is requested

.9 In the case where bases are to also be accommodated, they should be stored in appropriate storage cabinets designed for bases and located remote from the acid cabinets

2.10 Laboratory Casework

.1 Vivarium casework to be designed to be of modular configuration and where practical and where possible, to be mobile. Vivarium casework to be fixed in place at select locations if a mobile solution is not practical or feasible. Material of construction to be appropriate for the application and considered on a case by case basis and reviewed with the University prior to beginning design. Provide a list of pros and cons for the University to consider. Minimal standards for material and construction to be compliant with CCAC and bio-containment level CL2.

.2 Casework should be designed to be robust, flexible, interchangeable and adjustable to the fullest extent possible. Casework on casters or wheels should be considered to maximize flexibility and adjustability and to minimize cost on reconfiguration. Provide load ratings for wall mounted shelving for review and approval by the University. Thickness of shelving, length of shelving and c/c of pilaster supports to be commensurate with the application. C/C of pilaster shelving to be no more than 900 mm o/c unless otherwise noted or approved

.3 All casework to be either "stand off" allowing cleaning behind or sealed to prevent dust and contamination build up

.4 Provide barrier free stations in each lab as a minimal **(5%)** of total work stations unless otherwise defined by the University

.5 Bench top and shelving to be stainless steel – typical. Other materials such as solid epoxy will be considered on a case by case basis. Plastic Laminate counter tops will not be acceptable

.6 Bench tops will be acoustically attenuated with sound deadening material compliant with applicable standards and guidelines

.7 Casework bench height and upper cabinet configurations to be adjustable where possible to facilitate ease of reconfiguration

.8 Provide 15 cm s/s backsplash at all interface of fixed casework with walls/equipment

.9 Upper shelving to have adjustable edge restraints - all sides

.10 Sinks (wash up and hand wash) to have lips to prevent spillage.

.11 Hand wash sinks to be hands-free and hard wired.

.12 Bench tops to be designed with marine edges and drip stops where possible and where required for functionality

.13 Bench depth should be standardized on 760 mm deep units. Deeper or shallower bench tops will be considered in select locations and on a case by case basis

.14 Base cabinets (pedestals) will take on the following configurations unless otherwise designated in the room data sheets:

a. 50/50 split of storage and knee spaces

b. 50/50 split of drawers and doors

c. Hospital grade hinges to facilitate 180-degree operation

d. Mobile tables to facilitate a range of height between sitting height and standing height

e. Drawers to be one-piece construction, full extension, ball bearing glides and stops

2.11 Access, Egress, Doors & Door Swings

.1 Access/Egress doors to/from suite should be used singularly or in tandem to provide adequate clearance widths for the population of the rooms as well as the equipment that will need to pass through the doors. When used in combination, consider a fixed leaf door panel in combination with an active leaf. The fixed leaf door will be secured by way of flush bolts top and bottom – and will be used on occasion when larger pieces of equipment need to be moved

.2 Consider a removable transom panel above door in anticipation of the delivery of large oversized items

.3 Provide clearance on either side of the door for moving of equipment, carts, turning radii etc.

.4 Wherever possible, and in the cases where occupant load requires it, provide two exits from the suite

.5 Where possible, it is recommended that the doors to rooms within the suite include glazed panels to facilitate visual contact for security and in the event of emergencies or occupants in distress. In instances where light control is required, glazed panels will not be permitted. Specialized tinted red glazing in door panels will be permitted on a case by case basis for specialized animal holding rooms depending on species. Alternate forms of window treatment will be reviewed on a case by case basis

.6 Doors should always swing outward from the suite (swing in the path of travel)

.7 Hardware should provide ease of operational and be self closing and latch able/lockable

2.12 Ratings and Separations

.1 It is recommended that vivarium is typically separated from non-lab spaces by way of a fire rated enclosure with a fire resistance rating (FRR) as per building code and fire code provisions. Depending on hazard classification, the fire resistance rating of the enclosure will be at minimal a 1 hr FRR.

.2 Depending on hazardous classification, vivarium may also be separated from adjacent spaces by rated assemblies to create compartmentalization of the suite under the provision of the NFC and/or CCAC

2.13 Views and Natural Light

.1 Provide access to external views and natural light wherever possible. If windows are provided in the vivarium, they should be non-operable

.2 Where ever possible and to the extent feasible, provide visual transparency between rooms in the vivarium suite and adjacent public spaces/corridors for safety and security and occupant/animal wellbeing

.3 Where possible and to the extent feasible, provide visual connection from rooms to public spaces and from room to room

2.14 Materials and Finishes

.1 Wall, ceiling, doors/frames and floor finishes shall be finished with smooth, non-absorbent and washable materials. Finishes should be selected to be robust, abuse resistant and cleanable

.2 Protect exposed corners and walls with corner guards and bumper rails of an appropriate material wherever possible, and on a case by case basis

.3 Floor finish will typically be a resilient seamless sheet flooring or troweled on built up coating (epoxy or otherwise) Selection of floor finish shall be commensurate with requirements for cleanliness, containment, robustness, cleanability etc.

.4 Resilient seamless floor should have welded joints and integral 15 cm coved base with top bead sealed to wall – typical at all walls and permanent furniture, curbs etc.

.5 Seamless flooring should be smooth, impervious, washable and chemically resistant. Minimize seams wherever possible to facilitate a smooth surface for carts etc.

.6 All penetrations through floors to be sealed and water tight

.7 Casework and other fixtures and furniture should be robust, contiguous with minimal seams to avoid harboring contaminants and to facilitate cleaning

2.15 Lab Gases and Emergency Disconnects

.1 Provide an emergency gas shut off and an electrical disconnect (kill) switch near the egress point from the suite. Refer also to mechanical and electrical sections for further guidance

.2 The emergency shut off and kill switches should also be located in proximity to the Safety Station

.3 All rooms requiring natural gas should be provided with an emergency shut-off solenoid valve and mushroom type push button near the egress point and the lab Safety Station. The push button shall be keyed type for resetting purposes. The natural gas shut off valve shall be set to fail in closed position in the case of a power outrage. Valve should remain closed after power has been re-established. Only plant operations should have the key to reset solenoid valves.

.4 All casework mounted natural gas turrets to be push/turn type – typical

2.16 Centralized Vacuum Systems

.1 Refer to mechanical

2.17 Centralized Air Systems

.1 Refer to mechanical

2.18 Waste, Recycling

.1 Provide dedicated waste collection area within suite. Provide space in suite for a variety of waste including trash, hazardous waste, broken glass, bedding, sharps etc.).

.2 Integrate the waste station into the design of the suite and in the design of the casework if possible

.3 Provide a dedicated recycling area within the suite – integrate into the design of the casework if possible

.4 Integrate the waste collection and/or the recycling collection infrastructure into a centralized collection protocol if this is available and exists within the building

.5 Consideration to be given for automated technologies such as vacuum system or auger system to transport bedding from dumping station to external dumpsters

2.19 Lab Water and Animal Water

.1 Refer also to mechanical. Consideration will be given to a centralized automated watering system for animal holding rooms on a case by case basis depending on the species, volumes, cage type etc. Decision on automated watering system will be based on what species will be housed

2.20 Lab Mock-Ups

.1 Where-ever possible, specifications should call for the requirement of a mock-up of the various types of casework units as part of the submittals to facilitate a review for conformance and to familiarize the trades with the details, construction and coordination of systems and installation.

2.21 Sanitary Stations, Wash-up and Gowning, PPE

.1 In the case of a room or suite provide a

.2 hands-free hand wash sink adjacent to and near the access/egress to the suite (in compliance with requirements of the agencies governing these lab types – e.g. CCAC, Public Health Agency of Canada)

.3 Locate hooks (where required) near to and adjacent to the hand wash sink as well as the access/egress point to the lab. Avoid hooks that project into the room – use narrow profile wherever possible. Provide sufficient hooks to accommodate both clean and used lab coats

.4 Locate Personal Protective Equipment (PPE) near to and adjacent to had wash and sanitary station

2.22 Vivarium Amenities

.1 Audio-Visual and connectivity (projection, screens, smart boards, data capture, distance learning) are to be fully coordinated with the work of other standards

3 INSTALLATION AND WORKMANSHIP STANDARDS

3.1 General

.1 The requirements outlined in the following clauses are applicable to all general and architectural systems; application specific requirements are outlined under clauses 3.2

3.2 Extra Inventory

.1 A recommended inventory list for additional extra stock shall be presented to the Discipline Manager DEC for consideration prior to Issuance for Bid. The amount of required stockage will be reviewed on a case by case basis by the design team. Extra stock will typically include major components specific to this project type such as sheet flooring, ceiling tile, specialized wall coatings etc. This list shall be proposed in consideration for the following:

a. Likelihood that the inventory material will be required in the short term and mid term (1-5 years)

b. Amount and application, applicable warranties etc.

c. If the product is readily available and the procurement lead time

d. Cost of the product

MECHANICAL

4 Mechanical Introduction

4.1 General

.1 This Mechanical Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Mechanical Systems supporting Vivarium spaces.

.2 A Vivarium can be defined as a facility where animals are housed for scientific observation or research.

.3 The purpose of this standard is to provide guidance and design requirements that support a safe, comfortable and efficient environment that is highly functional for the animals, researchers, faculty, students and facility operators that occupy it.

.4 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

.5 This Design Standard shall be read in conjunction with the specific physical resources design, engineering and construction standards noted in Section 1.6 below.

4.2 Compliance Criteria

.1 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing mechanical infrastructure.

.2 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Mechanical Design, DEC before the completion of Schematic Design.

4.3 Responsibility of the Designer

.1 The Design Engineer of Record remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Mechanical Design, DEC, together with proposed measures for addressing the conflict.

.3 The Design Engineer of Record is responsible for ensuring the design accounts for all affected systems including concealed conditions. With prior approval by the University, destructive testing may be required to confirm conditions.

.4 Where new work will connect to existing building systems, the Design Engineer of Record is responsible for ensuring the tie-in and interaction of the new systems are compatible with existing infrastructure.

.5 The Design Engineer of Record is responsible for coordinating specific user requirements from all stakeholders including, but not limited to, University Staff, Management, and users of the affected space(s).

4.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovations shall be tabled for consideration by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

4.5 Sustainability Requirements

.1 Wherever possible, sustainable strategies shall be incorporated into the laboratory design while maintaining the safety and functionality goals of the project.

4.6 Standards, Codes and References

.1 Ontario Building Code, Latest Edition

.2 Animals for Research Act, R.S.O. 1990, c. A.22

.3 Canadian Council on Animal Care (CCAC) Standards and Guidelines, Current Edition

.4 Canadian Council on Animal Care (CCAC) Heating, Ventilation, and Air Conditioning: Addendum to the CCAC Guidelines on Laboratory Animal Facilities – Characteristics, Design and Development.

.5 Canadian Food Inspection Agency (CFIA) Standards and Guidelines, Current Ediition

.6 Public Health Agency of Canada – Canadian Biosafety Standard (CBS) Second Edition, March 2015

.7 American Conference of Industrial Hygienists (ACGIH), Industrial Ventilation: A Manual of Recommended Practice, Current Edition.

.8 Canadian Nuclear Safety Commission: RD-52: Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms

.9 ANSI Z358.1: Emergency Eyewash and Shower Equipment

.10 ANSI/AIHA Z9.5: American National Standard for Laboratory Ventilation

.11 ANSI/ASHRAE 62.1: Ventilation for Acceptable Indoor Air Quality

.12 ANSI/ASHRAE 55.1: Standard for Thermal Environmental Conditions for Human Occupancy

.13 ANSI/ASHRAE 90.1: Energy Standard for Buildings

.14 ANSI/ASHRAE 110: Method of Testing Performance of Laboratory Fume Hoods

.15 CSA Z316.5-15: Fume Hoods and Associated Exhaust Systems

.16 CSA B64.10: Selection and Installation of Backflow Prevention Systems

.17 NFPA 55: Compressed Gases and Cryogenic Fluids Code

.18 NFPA 91: Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Non-Combustible Particulate Solids

.19 NSF/ANSI 49: Standard for Biosafety Cabinetry: Design, Construction, Performance, and Field Certification

.20 University of Guelph Design Standard DSM-01 HVAC Systems*

.21 University of Guelph Design Standard DSM-02 Plumbing Systems*

.22 University of Guelph Design Standard DSM-03 Building Automation Systems*

.23 University of Guelph Design Standard DSM-04 Fire Protection Systems*

.24 University of Guelph Metering Standard*

.25 University of Guelph Identification Standard*

* A copy of this standard is available on the University of Guelph Physical Resources web page

5 HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS (HVAC)

5.1 General

.1 Each room shall be provided with mechanically generated supply air and exhaust air in sufficient quantities to provide a comfortable and safe environment for the animals and occupants of the facility.

.2 Animal facilities shall be supplied with 100% outdoor air; recirculation of exhaust air is not permitted.

.3 Pressure independent, Variable air Volume (VAV) systems shall be used for all supply air, general exhaust air and fume hood exhaust air systems.

.4 Differential pressures shall be used to create an air barrier between two areas or zones of the facility. Differential pressures between areas of the animal facility should be established so that air flows from the cleaner areas to the dirtier or potentially contaminated areas.

.5 Relative pressurization of spaces shall be maintained through volumetric airflow offsets managed through the pressure independent, variable air volume system. Control regimes using differential pressure monitoring systems are not acceptable.

.6 Ventilation systems serving Designated Containment Laboratory spaces shall be independent of systems serving other occupancies of the building, such as offices, conference rooms and common elements.

.7 The Design Engineer shall coordinate with the various user group(s) and the University to determine if the animals will be housed in locally ventilated racks or those connected directly to the building ventilation system(s).

5.2 Ventilation Rates

.1 Vivarium Demand Control Ventilation System:

a. The designer must consider the installation of a Vivarium Demand Control Ventilation System that is capable of modulating ventilation air rates in response to the measured concentration of contaminants in the space. To provide for accuracy of measurement and ensure occupant safety, differential type sensors must be included to monitor air quality, stand-alone wall mounted sensors will not be accepted as part of the system proposal.

b. The Demand Control Ventilation System shall be considered for the Secondary Enclosure only and shall vary air change rates based on the room environmental conditions, while satisfying heat load demands.

c. The recommendation to install this type of system shall be based on a risk assessment, return on investment (ROI) and annual operational cost savings analysis. Submit this analysis to the Manager, Mechanical Design, DEC, for discussion and review as part of the Schematic Design Phase of Work.

d. The complete system shall be provided in accordance with the Heating, Ventilation, and Air Conditioning: Addendum to the CCAC Guidelines on Laboratory Animal Facilities – Characteristics, Design and Development.

.2 Animal Housing Rooms shall be designed to operate at the default ventilation rates indicated below, unless an approved Vivarium Demand Control Ventilation System is provided in accordance with 2.2.1.

.3 Animal Housing and Research Areas shall be designed to operate at the following default ventilation rates:

a. 15 – 20 Air Changes per Hour (ACH) (Reduced ACH permitted with the installation of an approved Vivarium Demand Control Ventilation System)

.4 As part of the Schematic Design Phase of work, prepare a floor plan indicating relative pressurization of spaces and direction of airflow and submit to the Manager, Mechanical Design, DEC, for review.

5.3 Central Air Handling Systems

.1 Air handling systems serving Laboratory Spaces shall be fully custom type, provided in accordance with Design Standard DSM-01, HVAC Systems.

.2 Central Air Handling Equipment, and associated main service distribution, serving Animal Care Facilities shall be sized with sufficient spare capacity to allow for future flexibility and adaptability to change; review with Manager, Mechanical Design, DEC, as part of the Schematic Design Phase of Work.

.3 Provide Variable Frequency Drives for all Supply and Exhaust Air Fans.

.4 Provide minimum efficiency reporting value (MERV) 14 final filters for animal research laboratories. Local HEPA filters may be required for specialty spaces where research materials or animals are susceptible to contamination. The requirement for local or central HEPA filtration shall be reviewed for each project with the Manager, Mechanical Design, DEC, as part of the Schematic Design Phase of Work.

.5 Central supply and exhaust air handling systems shall operate continuously 24 hours per day, year-round, and shall be provided with suitable redundancy. Duplication of fans and an essential power source are mandatory requirements.

.6 Energy Recovery:

a. Must be provided to recover energy from the exhaust air systems to pre-condition make-up outdoor air.

b. Shall be complete with full by-pass to reduce pressure drop during free cooling (economizer) operation and whenever else the fan power energy penalty of passing air through the recovery device exceeds the energy recovered.

c. Shall be complete with a minimum sensible recovery efficiency of 65%.

d. A risk assessment of energy recovery device type shall be complete to ensure cross contamination concerns are addressed while maximizing energy recovery efficiency of the system.

e. Systems to consider include the following:

i. Heat Recovery Run-Around Loops

ii. Heat Pipe Systems

iii. Heat Recovery Chillers

iv. Others discussed with the Manager, Mechanical Design, DEC and approved based on a hazard risk assessment.

5.4 Miscellaneous Exhaust Devices

.1 Local exhaust air drop(s) shall be provided where a requirement for local point-of-use exhaust is identified through the Functional Programming and Planning exercise.

.2 Surgical and Necropsy suites using anesthetic gases shall be provided with suitable local exhaust air connection points for the express use of hose connections extracting anesthetic waste gases.

.3 Miscellaneous exhaust air devices and associated ductwork shall be constructed of a material suitable for use with the chemicals encountered.

5.5 Ductwork:

.1 All ductwork shall be smooth rigid type; flexible ductwork is not permitted under any circumstances.

.2 Acoustic lining and other liners are not permitted within the airstream of ventilation system ductwork.

5.6 Supply and Exhaust Air Terminal Units

.1 Terminal elements shall consist of venturi valves with pressure independent flow control for variable speed operation.

.2 Terminal units shall be located such that they are readily accessible for maintenance.

.3 Terminal units shall include identification in accordance with the University of Guelph Identification Standard, including location tag.

.4 Terminal units shall be complete with a maximum 1s speed of response.

.5 Terminal units shall be provided with their own stand-alone system of controls which shall be capable of communicating with the facility Building Automation System without the need for protocol converters or translators (i.e. native BACnet).

.6 Terminal units shall utilize flow tracking to maintain prescribed airflow offsets and associated space relative pressurization.

.7 Terminal units shall be suitable for both horizontal or vertical mounting.

.8 Galvanized, Aluminum or Stainless-Steel valves shall be deployed for general ventilation systems.

.9 Real-time audio-visual monitoring of the Environmental Conditions associated with each Animal Holding area shall be provided. System shall be complete with interface to the Building Management System.

.10 Provide sound attenuation to ensure maintenance of acceptable, and consistent, noise levels in Animal Holding Rooms and Research Areas.

5.7 Supply and Exhaust Air Outlets

.1 Location of supply air outlets shall be carefully coordinated in each space containing a containment device, as to not impact the containment effectiveness. Similarly, outlets shall be carefully located to prevent disturbances to animals or the operation of ventilated racks.

.2 Laminar flow type supply air diffusers (non-aspirating) are preferred in spaces housing a containment device.

.3 In animal holding area(s), exhaust air grilles shall be fitted with filters to limit the opportunity of dander, animal hair or other contaminants from entering the ductwork. Minimum efficiency rating and filter material type shall be selected by the design team based on the unique requirements of the associated animal holding room.

6 PLUMBING SYSTEMS

6.1 Sanitary Drainage

.1 Provide in accordance with University of Guelph Design Standard DSM-02 Plumbing Systems.

.2 Floor drains should be avoided in Animal Holding Rooms when not intended to be used frequently as they present a potential source of contamination. Animal holding rooms containing large animals such as Dogs, Sheep, Pigs, Poultry shall be provided with a floor drain.

.3 Where provided, floor drains shall be complete with automatic trap seal primer and provided with a removable cap and basket sediment interceptor.

6.2 Water Distribution

.1 Provide in accordance with University of Guelph Design Standard DSM-02 Plumbing Systems.

.2 Water supplies to handwash, emergency eyewash and shower stations shall be extended from the potable water system.

.3 Water supplies to Laboratory sinks, benches, fume hoods and Process Equipment shall be extended from the non-potable water system.

.4 Water supply shall be of sufficient pressure to allow for effective operation of fixtures, equipment and cleaning of the large animal holding rooms.

.5 Animal drinking water supplies shall be extended from a designated Protected Potable Water System. Automated watering systems are highly recommended.

.6 Zone protection in the form of a non-testable device shall be provided for individual labs fed from the non-potable water system.

a. A Lab faucet vacuum breaker shall be provided on each outlet within a Zone Protected Lab where it is necessary to protect individual outlets from self-induced cross-contamination.

.7 Fixtures and equipment fed from the non-potable water system shall be clearly labeled as fed from a non-potable water supply.

6.3 Fixtures and Trim

.1 Minimum one (1) dedicated handwash sink shall be provided in each animal holding room and/or the associated anteroom with handsfree hardwire sensor activated faucet. Water supplies to this handwash sink shall be extended from the Potable Water System.

.2 All services to be provided with service isolation valves upon entry into each lab space. In general, it is preferred that all service valves be located neatly in an accessible area of the ceiling space above the main entry door.

6.4 Fire Protection Systems

.1 Provide in accordance with applicable NFPA Standards, Local Code(s) and University of Guelph Design Standard DSM-04 Fire Protection Systems.

6.5 Automation and Control Systems

.1 Provide in accordance with University of Guelph Design Standard DSM-03 Building Automation Systems

.2 Each animal holding room shall be provided with a user interface adjacent the entry door that allows temperature and humidity control and feed-back; a local graphical user interface is preferred. All temperature and humidity controls shall be set through the local interface; the central BAS shall be reserved for monitoring and alarm purposes only and shall not be used as a means for adjusting temperature or humidity in animal holding rooms.

.3 The University of Guelph houses a diverse range of lab animals. In order to provide flexibility to the animal holding rooms temperature set-point shall be adjustable between 18°C - 28°C and relative humidity shall be adjustable between 30% RH - 70% RH.

.4 Refer to Typical Animal Holding Room Temperature and Pressure Control Schematic attached to and forming part of this Design Standard.

6.6 Commission and System Acceptance

.1 The Design Engineer of record shall ensure that the basic commissioning requirements indicated below are included in the appropriate section(s) of the contract specification package. These requirements may be modified should a third-party Commissioning Agent be retained by the University;

a. Ventilation system functional tests, including emergency purge mode of operation, and unoccupied mode set-backs for temperature and airflow, as applicable.

b. Demonstration of relative pressurization achieved, including record submittal of facility floor plan indicating relative pressurization of spaces and direction of airflow.

c. Testing, Adjusting and Balancing (TAB) Reports for exhaust air, and supply air systems.

d. Pre-Occupancy Acoustic Performance Testing for all Animal Holding Rooms and other noise sensitive areas of the program.

e. Functional performance testing, labelling and identification of each fume hood and other applicable containment devices in accordance with ASHRAE Standard 110 and University of Guelph EHS Standards.

f. Plumbing fixture functional testing

g. Cross Contamination device testing and identification in accordance with CSA and University of Guelph EHS Standards.

h. Emergency shower and eye/face wash system testing and identification in accordance with ANSI and University of Guelph EHS Standards.

i. Separate user and facility maintenance training modules for laboratory and central equipment / systems.

.2 All pressure vessels and fittings built to a registered design shall be complete with a Canadian Registration Number (CRN) to identify that the design has been accepted and registered for use in the province.

ELECTRICAL

7 ELECTRICAL INTRODUCTION

7.1 General

.1 This Electrical Power Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Electrical Power Systems installed on campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

7.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction and within projects involving significant renovations.

.2 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of the existing Electrical installation.

.3 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Electrical Design, DEC before the completion of Schematic Design.

7.3 Responsibility of the Designer

.1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Electrical Design, DEC, together with proposed measures for addressing the conflict.

.3 The Design Engineer of Record is responsible for ensuring the design accounts for all affected systems including concealed conditions. With prior approval by the University, destructive testing may be required to confirm conditions.

.4 Where new work will connect to existing building systems, the Design Engineer of Record is responsible for ensuring the tie-in and interaction of the new systems does not impact existing operations.

.5 The Design Engineer of Record is responsible for coordinating specific user requirements from all stakeholders including, but not limited to, University Staff, Management, and users of the affected space(s).

7.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovations shall be tabled for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

7.5 Reference Documents

.1 Ontario Building Code

.2 Canadian Electrical Safety Code

.3 Electrical Power Systems Final DSE-01*

.4 Lighting Systems DSE-02*

.5 Fire Alarm Systems DSE-03*

.6 IT & Communications Standard DSE-04*

.7 Access Control Systems DSE-05*

.8 Mechanical HVAC Standard DSM-01*

.9 Campus Power Distribution System Single Line Diagram

.10 CCAC guidelines, specifically C. Characteristics of a Laboratory Animal Facility, item 8. Electrical p52-53.

* A copy of these standards is available on University of Guelph Physical Resources web page

8 DESIGN STANDARDS

8.1 General

.1 In general, products should be manufactured in North America, but if not, local product representation must be in place, before specifying these products.
.2 All labs to be compliant with CL2 Small Animals Standards requirements as a minimum.

8.2 Conductors and Cables

.1 Refer to Electrical Power Systems Standard DSE-01, for minimum requirements for Conductors and Cables.
.2 In addition to the requirements stipulated in the above named standards, provide:
1.1.2.1. All wiring shall be in conduit.
1.1.2.2. Provide a ground wire in every conduit.

8.3 Grounding and Bonding

.1 Refer to Electrical Power Systems Standard DSE-01, for minimum requirements for Conductors and Cables.

.2 In addition to the requirements stipulated in the above named standards, provide:

1.1.2.1. Provide a green insulated ground wire in each conduit.

8.4 Conduits and Outlet Boxes

.1 For all surface mounted conduit, stand conduit off the wall to allow for wiping down of conduit all of the way around. Stand-off conduit using conduit clamps that provide a 6 -10 mm gap.

8.5 Cable Trays

.1 Basket trays are preferred over rigid ladder or cable trays, due to added flexibility and lower weight on supporting structures.

8.6 Wiring Devices

.1 All power outlets to be GFI protected with While-In-Use Water-Proof Covers

.2 Refer to Room Data Sheets for specific wiring device requirements.

.3 Whether new build or renovation, label all receptacles and switches, with wall mounted lamacoid nameplates, colour coded as per item 2.6 of DSE-01.

.4 Receptacles within 1.5 meters of an eyewash or shower must be equipped with a Class A ground fault circuit interrupter.

8.7 Panelboards

.1 All breaker panels shall be door-in-door type.

.2 Locate breaker panels in electrical rooms or closets, not in Vivarium spaces.

8.8 Essential Power

.1 Provide essential power as per the applicable codes and standards.

.2 The provision of essential power must be raised early in the design process. University of Guelph will indicate availability and approve location if a new generator is required.

.3 All Bio Safety Cabinets shall be supported by essential power when used in a Containment Level 2 small animal facility.

.4 Connect all refrigerators and freezers to Essential Power.

8.9 Uninterruptable Power Supplies

.1 For new construction, new centralized 3 phase UPS units shall be provided, in lieu of localized UPS single phase UPS units.

8.10 Lighting

.1 All luminaires to LED type.

.2 Colour temperature to suit the user requirements. White tunable lighting may be appropriate in some labs. Review colour temperature/colour requirements with the user groups and DEC. Red lighting scenes are required in many animal holding spaces.

.3 CRI shall be +80.

.4 All luminaires shall be gasketed, sealed and waterproof, IP66 as a minimum.

.5 All luminaires must be cleanable to prevent dust accumulation and bacteria growth.

.6 All LED luminaires, with the exception of specialty fixtures such as “Room In Use” signage, shall have a minimum lumens per watt of 100, with 0-10V or DALI drivers as required by the applicable lighting control system.

.7 All luminaires shall be reviewed with the project's user group, in addition to review by the DEC.

.8 Provide a photometric study of each room type on each project for University of Guelph's review.

8.11 Lighting Control

.1 The lighting controls must be accessible by all needing to interact with the animals including researchers, technicians and veterinary staff 24/7.

.2 Lighting control devices must be at the entrance to each animal holding room. Each room must be capable of programmable light cycles specific to the developmental stages of the animals and the research program.

.3 Do not use occupancy sensors or daylight sensors.

.4 Local lighting control devices shall be part of a software enabled, centralized system complete astronomical clock control, dimming capability and where appropriate white tunable control.

.5 Access to revise the programming of the lighting control system shall be restricted via usernames and passwords.

.6 All lighting control systems shall be BACnet compatible.

8.12 Telecommunications

.1 Refer to Room Data Sheets for specific telecom outlet requirements.

.2 All telecom outlets to be complete with In-Use Water-Proof Covers.

8.13 Clocks

.1 Provide Primex 120V wireless clocks in locations called for in the RDS.

.2 Provide a receptacle behind each clock location.

8.14 Access Control and CCTV

.1 Refer to the Design Standard for Access Control Systems.

.2 All refrigerators and freezers shown be monitored for common trouble on the Genetec Access Control system.

9 INSTALLATION STANDARDS

9.1 General

.1 Refer to Design Standards DSE-01 to 05.

VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	03-03-2021		Original Issue

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSM-01

HVAC SYSTEMS

Version	Revision 1
Effective Date	April 09, 2019
Approved By	
	Manager, Mechanical Design, DEC

TABLE OF CONTENTS

1 INTRODUCTION

1.1 General

.1 This HVAC Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new HVAC Systems installed on campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new HVAC installation within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing HVAC infrastructure

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Mechanical Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The Design Engineer of Record remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Mechanical Design, DEC, together with proposed measures for addressing the conflict before the completion of schematic design.

.3 The Design Engineer of Record is responsible for ensuring designs account for all affected systems including concealed conditions. With prior approval of the University, destructive testing may be required to confirm conditions.

.4 The Design Engineer of Record is responsible for coordinating specific user requirements from all stakeholders including but not limited to University staff, management, and users of the affected space(s).

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovation shall be tabled for consideration by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

.1 Ontario Building Code

.2 ASHRAE Standards

.3 SMACNA Standards

.4 Public Health Agency of Canada - Laboratory Biosafety Guidelines

.5 Canadian Council for Animal Care

.6 LEED Certification – Measurement & Verification

.7 Mechanical Plumbing Systems Standard DSM-02*

.8 Building Automation Systems Standard DSM-03*

.9 Electrical Power Systems Standard DSE-01*

.10 Architectural Space Planning & Finishes Standard DSA-01*

.11 Campus Site Service Schematics

.12 University's Identification Standard*

.13 Campus Steam and Condensate System Piping Schematic

.14 Campus Chilled Water System Piping Schematic

* A copy of these standards is available on University of Guelph Physical Resources web page.

2 DESIGN STANDARDS FOR SERVICES

2.1 General

2.1.1 Registered Pressure Piping System

.1 All pressure piping systems requiring registration with the Technical Standards and Safety Authority (TSSA) shall be constructed and registered under the University's current P-Number by extending the scope of the existing registration.

2.1.2 Identification

.1 All Equipment and Piping Systems shall be identified in accordance with the University's Identification Standards and numbering convention. Equipment numbers are to be provided by the University's PM Scheduler.

2.1.3 Outdoor Design Conditions

Parameter	*Winter*	*Summer*
Dry Bulb	- 21 ^{0}C	29 ^{0}C
Wet Bulb		23 ^{0}C

2.1.4 Indoor Design Conditions

.1 The Indoor Design Conditions tabulated below apply to all air-conditioned spaces within a facility.

Parameter	*Winter*	*Summer*
Dry Bulb	22 ^{0}C ± 1 ^{0}C	24 ^{0}C ± 1 ^{0}C
Relative Humidity	20-30%	50% - 60%

.2 Indoor Design Conditions for spaces that are “naturally ventilated” and/or “only heated” shall be determined to suit the application. In such instances the chosen Indoor Design Conditions shall be tabled for consideration by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

.1 Ensure that a minimum deadband of 2°C is provided between the heating and cooling setpoints.

.3 Considerations shall be given to the provision of pressurized vestibules at the entry from conditioned to unconditioned, naturally ventilated or heated only spaces to guard against infiltration into the conditioned spaces.

2.2 Ventilation Systems

.1 Air Systems serving Office Areas, Classrooms, Corridors or other General Occupancies shall be separate from those serving Lab Spaces. Exceptions include:

.1 Offices directly attached to or located within a larger Lab Space.

.2 Air Systems serving Office Areas, Classrooms, Corridors or other General Occupancies shall be designed as Variable Air Volume Systems,

.3 Space Noise Criteria shall be based on the current ASHRAE Handbook – HVAC Applications. Refer to the design guidelines provided for HVAC-related background sound in rooms.

.1 Engineered Silencers shall be provided within the main supply, return and exhaust air ductwork and/or at terminal units to achieve the specified NC Limits

.2 Use of internally lined ductwork is not permitted except in the case of Transfer Air Ducts less than 2 meters in length and VAV supplier manufactured attenuator. All lining to be constructed with fully sealed edges.

.4 All Supply and Exhaust fans sized beyond 1HP shall be controlled using Variable Frequency Drives.

.5 100% Outdoor Air systems shall be complete with Heat Recovery system.

.6 Considerations shall be given for the provisioning of Heat Recovery Systems on all ventilation and exhaust systems. A Cost-Benefit Analysis shall be presented for review by the Manager, Mechanical Design, DEC, as a part of the Schematic Design.

2.3 Steam System

2.3.1 General

.1 Steam supplied from the Central Utility Plant (CUP) shall be the primary source of heat to the Building. Heating within the Building including its Air Systems shall be based on the use of Hydronic Distribution Systems

.1 Steam Supply Pressure from the CUP to Building:

.1 Design 150 PSI / Operating 125 PSI (1034 kPa / 862 kPa)

.2 Incoming steam to be extended from the campus mains, include isolation valve.

.3 Incoming steam supply to be metered in accordance with the University's Metering Standard. Meter to be integrated into the Building Automation System and the Schneider ION Utility Metering and Management System.

.2 Design Steam Distribution Pressure within the Building – Design for 10PSI (68.9 kPa).

.3 1/3, 2/3 arrangement for all Steam Pressure Regulating Valves. 1/3 set to 13PSI, 2/3 set to 11PSI. Ensure valves are tagged noting final pressures.

.4 Pressure Regulating Valves shall be Pilot-Operated

.5 Consideration shall be given for wireless monitoring of steam traps with prior approval by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

2.3.2 Existing Building

.1 Modify existing Heating Systems to suit new Work. Maintain the design criteria followed for the existing installation.

2.3.3 Material

.1 All below ground buried steam and condensate piping systems shall be constructed out of schedule 40 steel for steam and schedule 80 for condensate.

.2 To include for expansion joints.

.3 Welded or flanged construction for 2.5” and above.

.4 Threaded construction for < 2.5”.

.5 Direct buried to be insulated with waterproof-ridged insulation and to include identification marker 1 meter above pipe. Direct buried must have prior approval by the Manager, Mechanical Design, DEC, before the completion of Schematic Design

.6 For buried within a chamber or tunnel, shall include fiberglass insulation, new side or top mounted hangers, and be of welded construction.

.7 New chamber constructed to be fully waterproof.

2.4 Condensate System

2.4.1 General

.1 Condensate shall be returned to the CUP via condensate return line.

.2 Preference to be given to capturing flash from flash tank into low pressure steam supply.

.3 Condensate tank shall be vented to atmosphere. Back pressure for condensate pumps to be 207kPa (30PSI) (50PSI for buildings west of Gordon Street) required lift. Condensate tank shall have an electric duplex pump arrangement fed from the building's Essential Power System. Condensate tanks shall be monitored by the BAS.

2.4.2 Material

.1 All below ground buried steam and condensate piping systems shall be constructed out of schedule 40 steel for steam and schedule 80 for condensate.

.2 To include for expansion joints.

.3 Welded or flanged construction for 2.5" and above.

.4 Threaded construction for < 2.5".

.5 Direct buried to be insulated with waterproof-ridged insulation and to include identification marker 1 meter above pipe. Direct buried must have prior approval by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

.6 For buried within a chamber or tunnel, shall include fiberglass insulation, new side or top mounted hangers, and be of welded construction.

.7 New chamber constructed to be fully waterproof.

2.5 Hydronic Heating

2.5.1 General

.1 Separate and dedicated Heating Distribution Systems to service:

  .1 100% Outdoor Air Systems (Air Handling Units) or areas susceptible to freezing

  .2 Perimeter Heating Systems and Heating Coils within Recirculation Type Air Handling Systems.

  .3 Terminal Reheat Systems.

.2 Heating Systems serving 100% Outdoor Air Systems to utilize 50% Propylene Glycol.

.3 Duplex Steam to Hot Water/Glycol Heat Exchangers shall be sized and arranged such that each Heat Exchanger is capable of supporting at least 75% of the peak heating demand.

  .1 In some cases Heat Exchanger must be capable of supporting 100% of peak heating demand. Specific building needs shall be verified with the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

  .2 Considerations shall be given to combining the Heat Exchangers serving Perimeter Heating Systems and Terminal Reheat Systems, with the stipulated system operating temperatures realized through the use of Pumps and Mixing Valves in the distribution piping. A Cost-Benefit Analysis comparing separate heat exchangers versus combined heat exchangers shall be presented for review by the Manager, Mechanical Design, DEC, as a part of the Schematic Design.

.4 Design Temperature and Temperature Differential

.1 100 % Outdoor Air Systems: 82.2 ^{0}C / Delta T: 11.1 ^{0}C

.2 Perimeter Heating and Heating Coils within Recirculation Type Air Handling Systems: 82.2 ^{0}C / Delta T: 11.1 ^{0}C

.3 Terminal Reheat Systems: 60 ^{0}C (140 ^{0}F) Supply / Delta T: 5.6 ^{0}C (10 ^{0}F).

.4 Consideration is to be provided to utilized systems with a higher design delta T for decreased pumping power. Gain approval from the Manager, Mechanical Design, DEC, during the schematic design phase.

.5 Automatic Air Vents c/w manual isolation valves shall be provided at all high points in the system.

.6 Drain Valves (ball) with a garden hose connection c/w screwed cap shall be provided at all low points in the system.

.7 Considerations shall be given for the provisioning of Heat Recovery Systems on all ventilation and exhaust systems. A Cost-Benefit Analysis shall be presented for review by the Manager, Mechanical Design, DEC, as a part of the Schematic Design.

2.5.2 Distribution pumps

.1 shall be duplex, arranged in parallel

.2 Each pump shall be sized for 100% of the circulation rate

.3 Pumps and related control system shall be fed from the building's dedicated Essential Power System

.4 Variable frequency drives shall be utilized with two-way control valves in lieu of three-way control valves.

.5 Shaft grounding is to be provided on all pump motors.

.6 All heating and cooling pumps sized beyond 1HP shall be controlled using Variable Frequency Drives.

2.5.3 Valves

.1 Manual valves shall be provided at a minimum at the following locations:

.1 At individual equipment for isolation.

.2 On every branch pipe serving more than three (3) individual pieces of equipment or having a length in excess of 20m.

.3 Upstream of all control and balancing valves and downstream if longer than 50' to equipment. Include isolation on all bypass.

.4 Valve construction shall be in accordance with the University's Valve Standard.

2.5.4 Materials

.1 Black Steel

.2 Copper – Type L

2.5.5 Jointing Systems

.1 Threaded Connections

.2 Welded Connections

.3 Flanged Connections

.4 Soldered Connections

.5 Grooved Joint System (Victaulic): On accessible locations only (unburied) including accessible ceilings. On mains only within tunnels. Grooved piping is not acceptable where buried or within wall.

.6 Use of Pressfit Joints is not permitted.

2.5.6 Cleaning and Flushing

.1 All heating and cooling piping systems shall be cleaned and flushed according to procedures provided by the University's approved water treatment supplier prior to operation, and before being connected to the University's distribution systems.

.2 Cleaning of strainers must be completed before and after the cleaning and flushing process.

.3 Chemical treatment system shall be provided for the heating water system including pipe line filters. Glycol mixing station required for glycol systems complete with pot feeder and filter.

2.6 COOLING SYSTEMS

2.6.1 General

.1 Modify existing Cooling Systems to suit new Work. Maintain the design criteria followed for the existing installation.

.2 Installation of window-shaker style air conditioners is not permitted without prior consent of Manager, Mechanical Design, DEC.

.3 Provide dedicated point-of-use cooling only as detailed elsewhere in this Standard

.4 Use of DX Cooling Systems including Split Ductless and VFR Units is permitted only in buildings without a chilled water supply from the Central Utility Plant or where it deemed uneconomical to extend chilled water piping to provide point-of-use cooling. In each of these instances comply with the following:

  .1 A choice to use DX Cooling, Split Ductless, or VFR Units is to be tabled for consideration and approval by the Manager, Mechanical Design before completion of the Schematic Design Phase, and

  .2 The capacity permitted for DX Cooling Systems, Split Ductless, or VFR Units is no more than 5 Tons.

  .3 Low ambient kit to be included for DX units being used throughout the winter months

  .4 Domestic water is prohibited to be used as back-up

  .5 Automatic Air Vents c/w manual isolation valves shall be provided at all high points in the system.

  .6 Drain Valves (ball) with a garden hose connection c/w screwed cap shall be provided at all low points in the system.

2.6.2 Chilled Water Distribution

.1 Design Chilled Water Distribution Pressure within the Building:

.1 Design / Operating: 125 / 95 PSI (utilize system pressure)

.2 Design Temperature and Temperature Differential

.1 Supply Water Temperature: 5.5 – 7.2 ^{0}C

.2 Return Water Temperature Differential: 10 ^{0}C

.3 Chilled water distribution system within a building is to be a closed system whereby all chilled water is returned to the main campus distribution system. Sending chilled water to drain is not permitted.

2.6.3 Valves

.1 Manual valves shall be provided at a minimum at the following locations:

.1 At individual equipment for isolation.

.2 On every branch pipe serving more than three (3) individual pieces of equipment or having a length in excess of 20m.

.3 Upstream of all control and balancing valves and downstream if longer than 50' to equipment. Include isolation on all bypass.

.2 Valve construction shall be in accordance with the University's Valve Standard.

2.6.4 New Construction Projects

.1 Chilled Water supplied from the Central Utility Plant (CUP) shall be the primary source of cooling to the Building.

.1 Chilled Water Supply Pressure from the CUP to Building:

.1 Design / Operating: 125 / 95 PSI

.2 Return Pressure Differential: 30 PSI

.2 Incoming chilled water supply/return lines to be metered in accordance with the University's metering standards. Meter to be integrated into the Building Automation System and the Schneider ION Utility Metering and Management System.

.3 Incoming chilled water supply/return lines shall be complete with flow and pressure station to control flow and isolate building chilled water system from pressure fluctuations in the campus mains.

2.6.5 Materials

.1 Black Steel

.2 Copper – Type L

2.6.6 Jointing Systems

.1 Threaded Connections

.2 Welded Connections

.3 Flanged Connections

.4 Soldered Connections

.5 Grooved Joint System (Victaulic): On accessible locations only (unburied) including accessible ceilings. On mains only within tunnels. Grooved piping is not acceptable where buried or within wall.

.6 Use of Pressfit Joints is not permitted.

2.6.7 Cleaning and Flushing

.1 All heating and cooling piping systems shall be cleaned and flushed according to procedures provided by the University's approved water treatment supplier prior to operation, and before being connected to the University's distribution systems.

.2 Cleaning of strainers must be completed before and after the cleaning and flushing process.

.3 Chemical treatment system shall be provided for the heating water system including pipe line filters. Glycol mixing station required for glycol systems complete with pot feeder and filter.

2.7 Air Distribution Systems

2.7.1 General

.1 Designed in accordance with SMACNA Standards to withstand the intended system operating pressure and application.

2.7.2 Balancing Dampers

.1 Shall be provided on every main, sub-main, branch-main and branch ducts (definitions as per ASHRAE systems hand book) and at locations required to perform testing, adjusting & balancing.

2.7.3 Relief Dampers

.1 Shall be provided on every return/exhaust system sized at 4500 L/S or higher and located within or in close proximity to the return/exhaust fan inlet ductwork.

2.7.4 Filtration

.1 Oil impregnated filters shall not be used.

.2 Unless specified elsewhere in this Standard, or required by the application, filters are not required on exhaust systems except upstream of heat recovery/enthalpy wheels.

.3 Standard filter sizes: 12" x 24" and 24" x 24"

2.7.5 Flexible Ductwork

.1 To allow easy location of diffusers flexible ductwork may be used to make the final connection from the sheet metal ductwork.

.2 Maximum length of flexible ductwork shall be 2.0m (78")

.3 Flexible ductwork shall not pass through floors of firewalls

.4 Flexible ductwork shall be a single section of duct (no joints)

.5 Flexible ductwork shall be connected to sheet metal duct and diffusers using duct sealer, minimum of 2 screws (180° apart), and metal draw bands.

.6 Flexible ductwork must be insulated.

2.7.6 Ductwork

.1 Interior lining of ductwork is not permitted without prior approval by the Manager, Mechanical Design, DEC. This excluded attenuator and transfer ducts, which require lining to be completely sealed.

2.7.7 Materials

.1 Galvanized Steel, G90

.2 Stainless Steel, SS 316

.3 Aluminum

2.8 Humidification System

2.8.1 General

.1 When feasible, Humidification Systems shall be designed around the use of direct steam injection systems utilizing Plant Steam.

.2 The use of DI water for humidification is prohibited

.3 The use of inlet steam temperature sensor and flow sensors shall be utilized to avoid the risk of condensing within the duct.

2.8.2 Renovation Projects

.1 Maintain the design criteria followed for the existing installation.

3 DESIGN STANDARD FOR SPACES

3.1 General

.1 The use of VAV is preferred for the design. Alternative designs providing increased energy performance will be considered. Gain acceptance from the Manager, Mechanical Design, DEC during schematic design~~.~~

3.2 Office Areas

.1 A maximum of three (3) offices, with similar loading, may be served by a single Zone Thermostat.

.2 Research Offices intended to be used for experimentation using temperature sensitive or heat generating equipment to be zoned independent of other offices.

3.3 Classrooms:

.1 Each Classroom shall be served by a dedicated Zone Thermostat

  .1 Where the size of a Classroom is greater than 140 m^2, provide multiple thermostat zones to limit the size of a single zone to under 140 m^2.

  .2 Multiple VAV's shall be used where air flow required is greater than a single VAV.

  .3 Where specified by the Functional Program, arrange the Air Distribution Systems to allow a single large classroom to be sub-divided into smaller rooms.

3.4 Laboratories – Chemical/Wet/Bio/Chemistry

.1 Air Systems serving Lab Spaces shall be designed as Constant Air Volume Systems, with a minimum Air Change Rate of 10 Air Changes per Hour (ACH). Exceptions include:

- .1 Labs equipped with Variable Air Flow Exhaust Hoods wherein design provisions shall be made to match supply air volumes to the exhaust air volumes with a minimum offset of 10% to assure desired Pressure Control Regime.
- .2 Labs equipped with Indoor Air Quality Sensors.
- .3 In the case of either of the two (2) exceptions listed above, the Air Systems, Supply & Exhaust, shall be sized to allow an average of 6-8 ACH in all labs.

.2 Provided with Terminal Units or Air Valves (Pressure Independent Air Valves) within the Supply & Exhaust air streams to allow spaces to be maintained at the desired Pressure Control Regime.

.3 Provided with Space Pressure Monitor system (see DSM-03 – Building Automation System)

.4 Supply and Exhaust Systems serving designated Containment Labs

- .1 Independent of systems serving other similar Labs, even if located immediately adjacent.
- .2 Designed with 100% Redundancy in Exhaust Systems.
- .3 Incorporate Pressure-Independent Air Valves on the Supply & Exhaust Air Streams
- .4 Equipped with Dynamic Differential Pressure Controls interfaced with the Pressure Independent Air Valves to maintain desired differential air pressure across the containment zone(s).
- .5 Real-time Audio-Visual Monitoring of the Differential Pressure Control Regime with an interface to the Building Automation System.

.5 Local Exhaust Air Drop, Articulating Arm Type Exhaust Drops and Bench Sweeps shall be provided where a requirement for local point-of-use exhaust is identified through the Functional Programing and Planning exercise.

.6 All exhaust duct from chemical fume sources shall be constructed of welded Stainless Steel.

3.5 Animal Facilities

.1 Air Systems serving Animal Spaces shall be designed as Constant Air Volume Systems, with a minimum Air Change Rate of 10 Air Changes per Hour (ACH). Exceptions include:

- .1 Systems serving Animal Cages, which shall be designed to support the performance requirements of the Cage.
- .2 Spaces equipped with Variable Air Flow Exhaust Hoods wherein design provisions shall be made to match supply air volumes to the exhaust air volumes with a minimum offset of 10% to assure desired Pressure Control Regime.
- .3 Spaces equipped with Indoor Air Quality Sensors

.2 Provided with Terminal Units or Air Valves (Pressure Independent Air Valves) within the Supply & Exhaust air streams to allow spaces to be maintained at the desired Pressure Control Regime.

.3 Laboratory spaces shall be provided with Space Pressure Monitor system (see DSM-03 – Building Automation System)

.4 Supply and Exhaust Systems serving designated Containment Labs

  .1 Independent of systems serving other similar Spaces, even if located immediately adjacent.

  .2 Designed with 100% Redundancy in Exhaust Systems.

  .3 Incorporate Pressure Independent Air Valves on the Supply & Exhaust Air Streams

  .4 Equipped with Dynamic Differential Pressure Controls interfaced with the Pressure Independent Air Valves to maintain desired differential air pressure across the containment zone(s).

.5 Real-time Audio-Visual Monitoring of the Differential Pressure Control Regime with an interface to the Building Automation System.

.6 Source Filtration on return/exhaust air system through the provision of 30% (MERV 8) filters at each Return/Exhaust Air Grille.

.7 Air Handling Units, Exhaust Fans and Supply & Exhaust Air Trunk (Main) Ductwork shall be sized with a 25% Spare Capacity over and above the Day 1 requirements.

  .1 All Supply and Exhaust fans shall be controlled using Variable Frequency Drives.

.8 Spaces to meet all CCAC, CFIA and local codes.

3.6 Electrical Rooms

.1 Air Distribution and Cooling Systems for Main Electrical Rooms to be independent of similar systems serving other Spaces; equipment not to be installed in the Electrical Room. Exceptions include:

  .1 Cooling for Electrical Distribution Closets on a floor can be extended from the HVAC Systems serving the floor.

.2 Cooling Solutions for Main Electrical Rooms shall be designed around the use of Mechanical Ventilation using Outdoor and Recirculation Air. Exceptions include:

  .1 Interior Electrical Rooms without ready access to an exterior wall.

.3 Indoor Environmental Conditions:

  .1 Mechanically Ventilated Electrical Rooms: Maximum 35 ^{0}C

  .2 Mechanically Cooled Electrical Rooms: Maximum 30 ^{0}C, Non-Condensing

    .1 Requirement for Electrical Room Cooling to be reviewed on a project by project basis and will require approval the Manager, Mechanical Design before completion of the Schematic Design Phase.

3.7 Mechanical Rooms

.1 Air Distribution and Cooling Systems for Main Mechanical Rooms to be independent of similar systems serving other Spaces. Exceptions include:

.1 Cooling required for Mechanical Closets on a floor can be extended from the HVAC Systems serving the floor.

.2 Cooling Solutions for Main Mechanical Rooms shall be designed around the use of Mechanical Ventilation using Outdoor and/or Recirculation Air. Exceptions include:

.1 Interior Mechanical Rooms without ready access to an exterior wall.

.3 Indoor Environmental Conditions:

.1 Mechanically Ventilated Mechanical Rooms: Maximum 35 ^{0}C

.2 Mechanically Cooled Mechanical Rooms: Maximum 30 ^{0}C, Non-Condensing

.1 Requirement for Mechanical Room Cooling to be reviewed on a project by project basis and will require approval the Manager, Mechanical Design before completion of the Schematic Design Phase.

3.8 IT / Communication Rooms

.1 Air Distribution and Cooling Systems for IT/COMM Rooms to be independent of similar systems serving other Spaces. Exceptions include:

.1 Cooling for IT/COMM Distribution Closets on a floor and not housing heat generating equipment can be extended from the HVAC Systems serving the floor.

.1 An independent system is vital to ensure that IT rooms maintain 18-24 degrees C at all times.

.2 Cooling Solutions for IT/COMM Rooms:

.1 Shall be designed around the use of Mechanical Cooling Solutions utilizing Chilled Water supplied from the Central Utility Plant

.2 Cooling Coils shall be sized to provide Cooling with an incoming cooling water temperature of 15 ^{0}C (59 ^{0}F)

.3 Redundancy in Cooling for Rooms larger than 46 m^2.

.4 Use of domestic water for back-up cooling is to be avoided where possible. Should domestic water for back-up cooling (to maintain continuity of cooling in the event of a loss of chilled water supply) be required, a request is to be tabled for consideration and approval by the Manager, Mechanical Design before completion of the Schematic Design Phase.

.1 back-up cooling switchover shall be completely automatic, including return to use of chilled water

.2 non-potable water shall be used

.3 parameters to be monitored to trigger switchover may include:

.1 chilled water flow, temperature, pressure

.4 status (open/close) of all valves forming part of the automatic switchover scheme is to be monitored by the BAS

.5 alarming (both local and on BAS) is required

.6 proposed sequence of operation and P&ID sketch to be submitted with Request for consideration

.3 Indoor Environmental Conditions: 18 - 24 ^{0}C, Non-Condensing

3.9 Equipment / Elevator Machine Rooms

.1 Air Distribution and Cooling Systems for Equipment / Elevator Machine Rooms to be independent of similar systems serving other Spaces.

.2 Cooling solutions shall be designed around the use of Mechanical Cooling Solutions utilizing Chilled Water supplied from the Central Utility Plant.

.3 To be tied to BAS for monitoring for water sensor and high temperature sensor. Alarm locally if building does not have BAS infrastructure already in place.

.4 Indoor Environmental Conditions: 28 ^{0}C, Non-Condensing

3.10 Freezer Rooms and Coolers

.1 For coolers only, Ventilation Air shall be extended from the HVAC Systems serving the floor on which the Room is located.

.2 Space Cooling shall be provided using dedicated point-of-use cooling equipment as noted below:

.1 Shall be sized and arranged to provide 100% redundancy; sizing criteria shall be identified on drawings.

.1 Not required for all freezers, review with the Manager, Mechanical Design before completion of the Schematic Design Phase to determine when requirements exist.

.2 Shall be designed around the use of Mechanical Cooling Solutions utilizing Chilled Water supplied from the Central Utility Plant

.3 Cooling Coils shall be sized to provide Cooling with an incoming cooling water temperature of 15 ^{0}C (59 ^{0}F)

.4 Use of domestic water for back-up cooling is to be avoided where possible. Should domestic water for back-up cooling (to maintain continuity of cooling in the event of a loss of chilled water supply) be required, a request is to be tabled for consideration and approval by the Manager, Mechanical Design before completion of the Schematic Design Phase.

.1 Upon approval:

.1 Back-up cooling switchover shall be completely automatic, including return to use of chilled water

.2 Non-potable water shall be used

.3 Parameters to be monitored to trigger switchover may include chilled water flow, temperature, and pressure

.4 Status (open/close) of all valves forming part of the automatic switchover scheme is to be monitored by the BAS

.5 Alarming (both local and on BAS) is required

.6 Proposed sequence of operation and P&ID sketch to be submitted with request for consideration

.7 Indoor Environmental Conditions: 24 ^{0}C, Non-Condensing

.8 Power supplies to the cooling equipment may need to be extended from the building's dedicated Essential Power System. To be reviewed on a case by case basis and will require approval by the Manager, Mechanical Design before completion of the Schematic Design Phase.

3.11 Lab Freezers and Coolers

.1 Temperature control should be done with process temperature control SSR output or 4 - 20ma output. (Non-proprietary)

.2 Alarm to police shall be done with above control based on deviation of set point (High/Low). High/low deviation can be of different values.

.3 Second process temp control identical 1 above that will shut down equipment based on secondary deviation set points (max high/min low). Max high/max min can be set at different values.

.4 Items 1 & 2 above will have the same master set point.

.5 All alarm point shall have the ability to be delayed and adjustable.

.6 System lockout condition/alarm shall be visual by beacon locally at control panel.

.7 System reset button must be present on local panel to reset alarm conditions/time delays.

.8 System alarm time delays to reset to zero after power failure.

.9 Process temperature controllers to be visual from exterior of control panel and lockable from tampering with.

.10 Logging of space temperature to be the responsibility of the client via third-party systems such as "HOBO".

.11 Refrigeration equipment must have High Pressure timing circuits set at 40 min.

3.12 Vestibules

.1 Need BAS to better control varying conditions

.2 Prefer fan coil to convectors

.3 Take pressurization into account.

.4 BAS to provide control of heat in the vestibule space. Ensure that a critical alarm is sent to the BAS for low temperature in the vestibule to reduce risk of freezing.

.5 Provide force flow heaters for space conditioning. Ensure that heating calculations take into account the anticipated usage of the entrance.

4 PRODUCT STANDARDS

4.1 General

.1 The requirements outlined in the following clauses are applicable to all HVAC Systems.

.2 Mechanical Rooms

- .1 Designated and dedicated Mechanical Room(s) shall be provided to accommodate HVAC Plant Equipment and Process Equipment.
  - .1 Provide at least one double door for entry into each Mechanical Room.
  - .2 Provide Elevator Access for each Mechanical Room located above or below the Ground Floor Level.
  - .3 Incorporate measures to facilitate movement of materials into and out of Mechanical Room(s).

.3 When required (Labs / Hospital Environments), drawing shall be developed showing the Building Pressurization Regime as well as the Pressure Control Regime for functional areas and units within the building.

.4 All Equipment, including Isolation and Safety Valves, and System Components shall be arranged and located to allow proper access for service and maintenance.

.5 Mechanical systems shall be installed to maximize the building's usable space while maintaining optimal service clearances for maintenance and repair.

.6 All equipment and materials shall be installed in a neat and orderly fashion.

.7 In finished areas mechanical systems will be concealed. Exceptions are subject to the approval by the Manager, Mechanical Design, DEC.

.8 Equipment Starters shall not be installed above finished ceilings.

.9 Access

- .1 Provide access to all items which may require adjustment and/or interaction, including and not limited to coils, dampers, valves and fixtures.
- .2 The access construction shall include all minimum ratings which apply.
- .3 The size of access shall be minimum 12" x 12" for access of only hand, minimum 18" x 18" for access within arm reach and minimum 24" x 24" for all other access. Larger sizes to be used when required.
- .4 Pressurized access shall be constructed for pressure rating and to maintain pressure. To be sealed to prevent whistling.

4.2 Custom Units (Indoor)

4.2.1 General

.1 New construction shall include an indoor space for all air handling equipment.

.2 Existing outdoor units may be replaced with outdoor units.

.3 Where required, add safety grating in service areas around and within air handling units.

4.2.2 General Unit Construction

.1 Unit casing shall consist at a minimum of 2-inch thick panels with 4.0 lb/ft.3 density insulation sandwiched between 16-gauge galvanized steel exterior liner and a 22-gauge galvanized steel interior liner. Galvanized steel washdown liners with convenience floor drains in wetted sections (cooling, humidification, outdoor air intake plenum). Unit exterior shall be finish painted.

.2 0.12-inch thick aluminum checker plate floors in all sections except where drain pans are required.

.3 Structural steel base rails preferred.

.4 Access doors shall include test ports, windows and Ventlok type access door handles operable from both sides of the door. Access doors shall open against positive pressure. LED marine lights shall be installed in all access sections opposite the access door side of the unit.

.5 Double sloped (IAQ) Stainless steel drain pans shall be provided in cooling coil sections.

.6 Design housekeeping pad and unit mounting sufficient for trap depth requirements.

4.2.3 Cabinet Performance

.1 Leakage shall not exceed 1.0% of the unit air flow at 1.5 times the rated total static pressure.

.2 Factory/Field Leak testing is mandatory for all air handling units at the factory and in the field.

4.2.4 Fans

.1 Fans shall bear the AMCA sticker indicating that they have been tested for both air and sound performance. Non-overloading type fans shall be provided.

.2 Fan wheel classification shall be selected such that they can operate at a minimum of 15% above the RPM of the fan at the duty point.

.3 Motor's shall be sized no less than 15% above the fan operating BHP when all belts and drives have been accounted for. For motors that are required to operate below the nominal motor speed to meet the design conditions, the available motor HP must exceed the system BHP by no less than 15% at the design conditions.

.4 Motor's for use in variable speed applications shall be factory wired to unit mounted ABB VFDs with manual bypass. Motor shaft grounding rings shall be provided on all motors that are controlled by variable frequency drives.

.5 Bearings shall be selected for an L10 life of 200,000 hours at design operating conditions.

.6 All welded structural steel vibration isolation bases shall be provided to support fan and motor assemblies on 2" deflection spring isolators.

.7 Fan static pressure efficiency shall meet the requirements of ASHRAE 90.1.

.8 Fan vibration testing and balancing

  .1 Manufacturers to ensure that fans are balanced according to ANSI/AMCA 204-05.

4.2.5 Heat Transfer Coils

.1 Coils shall be performance tested and certified in accordance with AHRI Standard 410.

.2 Copper Tube (min .030" thick tubes), Aluminum Fin.

.3 Galvanized steel casing on heating coils.

.4 Stainless steel casing on cooling coils.

.5 Heresite coating applied to all coils in corrosive airstream such as lab exhaust (Run around loop, pool chlorine areas, etc).

.6 Size coils for less than 500 FPM.

.7 Individual coil support rack shall allow for removal of individual coils stacked without having to remove all the coils.

.8 Stainless steel cooling coil racks with intermediate drain pans.

4.2.6 Humidifiers

.1 To be connected and supplied by central plant steam.

.2 To provide proper entrainment length or mist eliminator to prevent condensation within the AHU.

4.2.7 Filters

.1 Pre-Filters (MERV 8); 95% Pleated Final Filters (MERV 14).

.2 Dwyer Magnehelic (or Digihelic) filter gauges shall be provided for each filter rack.

.3 Filter racks shall be designed to accommodate filters of no more than two different filter sizes while achieving face velocities no greater than 500 FPM (24 x 24 preferred, 12 x 24 half sizes as required).

4.2.8 Intake Sections

.1 Dampers shall be TAMCO 9000 for outdoor air inlets and exhaust air outlets.

.2 Dampers shall be TAMCO 1000 for return air inlets or dampers internal to the air handling unit.

4.2.9 Electrical

.1 Single point power with non-fused disconnect switch for all large electrical devices (fan motors, energy recovery wheels, gas furnaces, etc.).

.2 Separate power feed requirement for lighting/gfi outlet electrical circuit.

.3 An empty run of ¾" conduit throughout the entire unit with junction boxes in each access section for field control wiring.

4.3 Custom Units (Outdoor)

4.3.1 General

.1 Standards noted above (Custom Units Indoor) not referenced below are applicable to outdoor units.

.2 Unit shall be designed to be supported by a roof curb.

.3 Roof panels shall be broken outward to provide a lapped joint watertight seal. Roofs shall be sloped a minimum of 5/8" away from the access side.

.4 Screws and other similar fastening devices shall not penetrate the roof deck or the top of standing seems.

.5 Units shall have 4" thick walls with 4" thick 4.0 lb. density insulation.

.6 With prior approval by the Manager, Mechanical Design, DEC, a unit exterior may be cladded with architectural louvered panels (shipped loose for field installation). The architectural cladding shall be securely mounted on the unit exterior and shall not require any external support mechanism. Louvers shall be manufactured from galvanized steel, and factory painted to match color as selected by the owner / architect. Provide hinged, operable sections for access to concealed service entry doors where required.

4.3.2 Service Corridor

.1 Supply and install a 60” service corridor the entire length of the supply side of the unit. The corridor shall be a minimum of 87” tall if it houses electrical panel boards accessed from inside the corridor. Casing construction is the same as the rest of the air handler. Factory mount, wire, and pipe the fan motor VFDs and/or starters, DX cooling circuit, hot gas reheat circuit, humidifier, gas burner, water/glycol coils, controls, compressed air, and enthalpy wheel VFD.

.2 Provide an electric/hydronic heater and thermostat sized to offset heat loss of corridor. Provide a propeller exhaust fan and thermostat sized to ventilate the corridor at a rate of 1 CFM/Sq. Ft with motorized intake damper and louver and motorized exhaust damper and louver.

.3 With prior approval by the Manager, Mechanical Design, DEC, the corridor floor may consist of removable welded bar grates spanning the entire width and length. Material shall be equal in quality to Fisher Ludlow style 1-3/16” 19-W-4 welded grates. Provide grates in sections no greater than 60 inches x 48 inches throughout the entire corridor, allowing full access to the roof curb space below for service and inspection of all recessed pipe fittings and gauges.

4.3.3 Louvers

.1 Louver blades shall be fixed on a 45° angle. Blades shall be 4” wide, made of extruded aluminum construction. Bird screen shall be galvanized mesh with 0.5” x 0.5” openings and shall be fixed to the rear with cadmium plated screws. Finish shall be natural mill finish.

4.3.4 Hoods

.1 Fresh air intake hoods shall be provided complete with 1/2" x 1/2" bird screen and finished to match the unit. A rain gutter shall be provided on all edges of the hood. Outside air hoods shall be sized for maximum inlet velocity of 600 FPM.

4.3.5 Electrical

.1 External disconnects shall be provided in a NEMA 4 enclosure for superior water protection. Disconnects must be interlocked with the electrical panels for added personnel safety.

4.3.6 Finish

.1 Outdoor unit shall be finish coated with polyurethane paint. Paint for outdoor units shall be tested to ATSM B117 for 5000hr salt spray endurance.

4.4 Semi-Custom Units (Indoor)

4.4.1 General

.1 Unit casing shall consist at a minimum of 2-inch thick, R13 foam injected panels with 24-gauge interior and exterior liners. Unit exterior shall be finish painted.

.2 0.044-inch thick aluminum checker plate floors in all walk-in access sections except where drain pans are required.

.3 Formed metal or structural base rails shall be provided.

.4 Access doors shall include windows and quarter-turn access door handles. Access doors that do not open against positive pressure shall include a secondary latch to relieve pressure before the access door can swing fully open. LED marine lights shall be installed in all walk-in access sections.

.5 Double sloped (IAQ) Stainless steel drain pans shall be provided in cooling coil sections.

.6 Design housekeeping pad and unit mounting sufficient for trap depth requirements.

4.4.2 Cabinet Performance

.1 The casing leakage rate shall not exceed 0.50 cfm per square foot of casing surface area at design static pressure up to a maximum of +5" w.c. in positive pressure sections and -6" w.c. in negative pressure sections.

.2 Fan vibration testing and balancing (need to discuss details of performance).

.3 Air handling unit performance shall be certified under AHRI testing Standard 430. Alternately, Fans must bear the AMCA seal for air and sound performance.

4.4.3 Fans

.1 Non-overloading type fans shall be provided. Fan wheel classification shall be selected such that they can operate at a minimum of 15% above the RPM of the fan at the duty point.

.2 Motor's shall be sized no less than 15% above the fan operating BHP when all belts and drives have been accounted for. For motors that are required to operate below the nominal motor speed to meet the design conditions, the available motor HP must exceed the system BHP by no less than 15% at the design conditions.

.3 Motor's for use in variable speed applications shall be factory wired to unit mounted ABB VFDs with manual bypass. Motor shaft grounding rings shall be provided on all motors that are controlled by variable frequency drives.

.4 Bearings shall be selected for an L50 life of 200,000 hours at design operating conditions.

.5 Formed steel vibration isolation bases shall be provided to support fan and motor assemblies on 2" deflection spring isolators.

4.4.4 Heat Transfer Coils

.1 Copper Tube (min .030" thick tubes), Aluminum Fin.

.2 Galvanized steel casing on heating coils.

.3 Stainless steel casing on cooling coils.

.4 Moisture eliminators downstream of cooling coils (selected for greater than 500 FPM face velocity).

4.4.5 Humidifiers

.1 To be connected and supplied by central plant steam.

.2 To provide proper entrainment length or mist eliminator to prevent condensation within the AHU.

4.4.6 Filters

.1 Dwyer Magnehelic filter gauges shall be provided for each filter rack.

.2 Filter racks shall be designed to accommodate filters of no more than two different filter sizes while achieving face velocities no greater than 500 FPM. (24 x 24 preferred, 12 x 24 half sizes as required).

4.4.7 Intake Sections

.1 Dampers shall be TAMCO 9000 for outdoor air inlets and exhaust air outlets.

.2 Dampers shall be TAMCO 1000 for return air inlets or dampers internal to the air handling unit.

4.4.8 Electrical

.1 All electrical devices (motors, lights) shall require an individual field power connection.

4.5 Semi-Custom Units (Outdoor)

4.5.1 General

.1 Standards noted above (Custom Units Indoor) not referenced below are applicable to outdoor units.

.2 Outdoor units shall have a solid metal roof cap, intake hoods, exhaust hoods and piping vestibules. Piping vestibules shall be shipped loose for field installation by others.

.3 The unit shall be equipped with a unitized base and shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weather tight seal.

Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

.4 Units shall 4" thick walls with 4" thick 4.0 lb. density insulation.

4.5.2 Hoods

.1 Fresh air intake hoods shall be provided complete with 1/2" x 1/2" bird screen and finished to match the unit. A rain gutter shall be provided on all edges of the hood. Outside air hoods shall be sized for maximum inlet velocity of 600 FPM.

4.5.3 Electrical

.1 External disconnects shall be provided in a NEMA 3R enclosure for superior water protection.

4.6 CONVECTORS

4.6.1 General

.1 To have standard sloped top

4.7 HEAT EXCHANGERS

4.7.1 General

.1 Fully welded stainless steel flooded exchangers utilizing condensate control.

4.8 FLOOR MOUNTED EQUIPMENT

4.8.1 General

.1 Installed on a minimum 100mm concrete housekeeping pads.

.2 Provided with vibration isolation as per ASHRAE between the equipment and the housekeeping pad.

4.8.2 Suspended Equipment

.1 Provided with mounting base frame or suspension brackets as recommended by the equipment manufacturer.

.2 Anchored to structure using Spring Isolation Hangers.

4.9 Preferred Vendors

.1 When reasonable and cost effective, it is preferred that skid package parts are complete with only proposed vendors noted below.

Equipment/System	Proposed Vendor
HVAC Systems	
Custom Air Handling Units	Mafna
	Haakon
	Engineered Air
Semi-Custom Air Handling Units	Mafna
	Daikin

	Engineered Air
VAV	EH Price
	Nailor
	Krueger
	Metalaire
	Titus
Fans	New York Blower
	Barry Blower
	EH Price
	Penn Barry
	Greenheck
	Aeroflo
	Loren Cook
	Twin City
Contaminated Exhaust System	Plastic Air
	Strobic Cook
AHU Coils	Aerofin
	Trane
	Daikin
	Ventrol
AHU Filters	American Air Filter
	Camfil Farr
	Dafco
AHU Humidifiers	Dri-Steem
	Condair (Nortech)
	Armstrong
Fan Coils	Daikin
	IEC
	Trane
Convectors/Unit Heater/Wall Fin/Forced Flow Heater	Sigma
	Engineered Air
	Zehnder Rittling
Sump Pumps	Hydromatic
	Barnes
	Bell & Gossett

	Taco
	Myers
	Grunfos
Centrifugal Pumps	S.A. Armstrong
	Bell & Gossett
	Paco
	Taco
	Peerless
	Grunfos
Condensate Pump Skid	Armstrong
	Bell & Gossett
	Shipco
	Spirax Sarco
Steam to Hot Water / Steam to Gycol Heat Exchangers	Preston Phipps
	Armstrong
	Spirax Sarco
Semi-Instantaneous Steam Hot Water Heaters	Preston Phipps
	Patterson-Kelly
	Spirax Sarco
Steam Pressure Regulating Valves	Preston Phipps
	Leslie
	Spirax Sarco
Steam Traps	Armstrong
	Spirax Sarco
Steam Vacuum Breaker	Armstrong
	Hoffman
	Colton
Safety Relief Valves	Watts
	Conbraco
Triple Duty Valves	S.A. Armstrong
	Bell & Gossett
	Emerson
Air Separators	Taco
	Bell & Gossett
	Amtrol

	S.A. Armstrong
Automatic Air Vents (Viton Seat for Glycol)	Maid-o-Mist
	Taco
	Amtrol
	Spirax Sarco
	Grinnell
	Bell & Gossett
Expansion Tanks	Amtrol
	Taco
	Bell & Gossett
Hydronic System - Gauges (Temperature, Pressure and Differential Pressure)	Weiss
	Winters
	Wika
Air System Meters and Gauges (Temperature, Differential Pressure and Static Pressure)	Dwyer
	Setra
Dampers	Ruskin
	EH Price
	Alumivent
	Tamco
Louvres	Ventex
	EH Price
	Tamco
	Nailor
Air Distribution - Grilles & Diffusers	EH Price
	Nailor
	Metalaire
	Kreuger
	Titus
Fume Arm	Plymovent
	Niderman
VRF	Daikin
	LG
Air Distribution - Pressure Independent Air Valves	Siemens
	Phoenix
Manual Balancing Valves	T.A.

	Armstrong
Pressure Independent Balancing Valves	T.A.
	Siemens
Miscellaneous / Special Systems	
Clean Steam Generators	Dri-Steem
	Preston Phipps
Variable Frequency Drives	ABB
	Danfoss
Vibration	Flexonics
	Metraflex
	Vibro-Sonic
Silencers	Vibro-Acoustics
	IAC
	Kinetics-Vibron
Insulation	Johns Manville
	Apex
Preferred Balancing Contractors	Air Audit
	Dynamic
	Air Wise

5 CHEMICAL CLEANING PROCEDURE – HEATING & COOLING PIPING

5.1 Preferred Supplier:

.1 SUEZ Water Technologies & Solutions

5.2 Closed Loop Systems

.1 Drain system of all stagnant water after hydrostatic testing is completed and you are assured that there are no system leaks. Ensure the system to be cleaned is completely isolated from the Main or Original System if this is a retrofit or an addition to an existing system. A temporary recirculation system will be required for system flow during the procedures listed below and must be of suitable size to ensure a continuous flow of 5 ft. per second. If this is not feasible then the draining and cleaning and retreatment of the entire system may be necessary.

.2 Construction strainers shall be used to catch finer particulates during flushing. It is still necessary to ensure strainers are cleaned before turnover.

.3 Refill the system with clean city water. If you are unsure as to the system volume we recommend that you meter the amount of water required to completely fill the system. This information is useful for calculating cleaner and corrosion inhibitor dosage requirements.

.4 Recirculate system for at least 30 minutes with city water and verify that you do not have any leaks. If the water is unusually dirty drain and refill. Retain a 500 ml sample for our analysis. If this is a retrofit to an existing system, the use of the main recirculation pumps may not be possible without contaminating the existing system. Ensure the original system is completely isolated from the portion of the system being added and do not use the existing system for flushing or final treating.

.5 Once you are sure that you have no leaks and you know the system volume add Ferroquest FQ7103 cleaner at a minimum dosage of 2 % with water. I.e. add 2 gallons for every 100 gallons of system volume. A dosage of 2 gallons per 100 gallons system volume is usually sufficient for the cleaning of new systems. Systems containing process contamination or oils and greases or require optimum passivation should be cleaned with a 4 % to 5 % solution and may require more than one cleaning. Ensure a system flow rate of 5 ft. per second.

.6 Hard city water may be used for cleaning and primary flushing purposes. Softened water or water of reduced hardness to less than 100 ppm (University of Guelph's Domestic Water System) is required for final flushing purposes prior to corrosion inhibitor addition. Glycol systems require 100% softened water during final flushing and glycol solution preparation.

.7 Ensure that the system temperature does not exceed 50 degrees Celsius (122 F) as the ability of the cleaner to remove oil and grease will be greatly reduced and may warrant additional cleanings.

.8 Continually recirculate the system cleaner solution for a minimum of 72 hours (3 days) through the entire system to be cleaned. This time can be shortened to 48 hours if the water temperature can be maintained between 40 and 48 degrees Celsius and the cleaner FQ7103 strength is raised to 4 to 6%. Verify that the cleaner solution is moving through all areas to be cleaned.

.9 Taking a clear bottle and sampling from different sample points and system levels (if there is more than one floor) is recommended. The samples containing cleaner will have a sweet odor and will become and remain foamy upon agitation. Retain 500 ml samples of the cleaner solution from each area for our analysis as soon as the cleaner is mixed through all areas of the system.

.10 After the recirculation period in step 5 is completed, the system is ready for flushing. Allow for at least one to two days for flushing depending on the number of floors and system complexity. Smaller less complex systems may be flushed for the removal of all cleaner solution in one day or less.

.11 If you do not have sufficient time to completely flush out the cleaner after the recirculation period is completed, it is best to leave the cleaner in the system (over a weekend for example). Ferroquest cleaners also contain corrosion inhibitors. Leaving any system drained or full of untreated City Water will promote system rusting and fouling and may result in a system requiring a second cleaning.

.12 City water may be used for the initial flushing. It is recommended that softened or partially softened water to less than 100-ppm total hardness be used for final flushing purposes. This ensures that the final treated water left in the system is of low scaling or deposit forming tendency.

1.3 Glycol systems require zero hardness in the final flush water and for glycol mixing purposes. Zero hardness waters are also best in any system in which the water is to be heated.

.14 The Ferroquest FQ7103 cleaner solution is safe to put to sanitary sewer or a pre-authorized waste stream. The MSDS information is available upon request.

.15 Usually a system dump from the low points followed by refilling, recirculation and dumping will get rid of the bulk of the cleaner solution. The inspection and cleaning of all strainers is recommended after the initial cleaner dump.

.16 A simultaneous flush and fill with system recirculation is best during the final stages of the flushing to ensure that all the air is removed and all the cleaner is out. This is best accomplished by draining from the low points and adding water at the make-up point while ensuring the required system pressure, so as not to cause recirculation pump cavitation, is maintained.

.17 During final flushing verify as to when the Ferroquest FQ7103 cleaner is out by taking samples of the recirculating flush water, from all areas, particularly those areas of reduced flow. We recommend that the final flush water be of low total hardness (<100 ppm). Softened or partially softened water is best, especially in heating or glycol systems.

.18 Your Suez representative must be informed as to when the system cleaning and flushing is to commence and be provided with the 500-ml samples of cleaner solution and of the final flush water from areas representing points close, mid-way and furthest from the recirculation pumps and at different system levels or floors, if applicable, to determine cleaner distribution and to prove it was completely removed from all areas of the system. All samples should be dated and labeled as to the system, date taken and location in that system they were taken from.

.19 If the samples are coloured or foamy upon agitation, further flushing of those areas will be required. Once all areas are clear and non-foamy, you are ready to install your bypass filter cartridges (if applicable) and add the corrosion inhibitor.

.20 As soon as the cleaner is completely flushed from the entire system, stop all system water losses and confirm that there are no leaks. It is time to add the corrosion inhibitor. If you wait even for a few hours you will begin to rust the piping and may have to re-clean the system.

.21 Add Corrshield MD 4102, 4101, 4158 or 4159 as specified for your job at a dosage of one half to one gallon per 100 Imperial gallons (454 L) of system volume or 2.3 to 4.5 Liters per 454 Liters of system volume. Continuously recirculate the system to assist in passivating the system piping and the removal of any residual suspended solids. Corrshield OR4407 is used in systems containing aluminum. The Corrshield OR4407 dosage is 2 liters per 100 gallons of system capacity.

.22 Inhibitor AZ 8104 is used to boost copper inhibitor residuals in all closed loop systems.

.23 Inhibitor AZ8104 is fed once the system is fully treated with Corrshield products and fully mixed and distributed. Inhibitor AZ8104 is fed at a dosage of 100 ml per 100 IG (454L) of system volume.

.24 Install all filter cartridges. Start with the larger micron size filters first. This is indicated on the filter cartridge box. The first few filter changes may be required every few hours to remove any suspended solids not removed by the final flushing. Eventually filter changes will be less frequent as filter inspections reveal clean filters. Then switch to the smaller micron filters and repeat the inspection and filter change process.

.25 Should the final treated system contain high bacterial counts the addition of Spectrus NX1100 biocide may be required. The typical dosage for closed water systems is 1 Liter of NX1100 per 4,540 Liters of system volume.

.26 Contact your GE Water representative to test those samples collected and to final commission any newly installed systems.

5.3 Glycol Systems

.1 The piping is cleaned the same as in steps 1 to 8 above. Ensure 100% softened water is used for final cleaner removal procedures and when making all glycol solutions.

.2 In the case of propylene glycol systems to be filled with Corrshield OR4405 (specialty inhibited propylene glycol) or ethylene glycol systems to be filled with Corrshield OR4404 (specialty inhibited ethylene glycol) add Corrshield NT4206 at a dosage of 40 L per 1,000 IG (4540 L) system volume and continuously circulate with softened water with system filtration in place. This solution can stay in the system prior to draining and glycol antifreeze addition to maintain corrosion control and allow for system passivation and filtration to remove any debris not removed during the previous flushing and cleaning stages.

.3 Once you are ready to add the Corrshield OR4405 or Corrshield OR4405 antifreeze solution it is strongly recommended that you drain all water from the entire system including any expansion tanks, heat exchangers, coils, etc. Simply draining some areas such as coils will not remove all the water. In these cases blowing them out with compressed air until dry is best. Repeat inspections to ensure all the residual water has been removed is critical to achieving the desired glycol strength.

.4 Measure the length or capacity of the glycol mixing tank that will be used to make up batches of glycol. Example: If a 50 % solution of inhibited propylene glycol is specified, add CorrshieldOR4405 to fill the tank to the 60% full level. Then add soft water to the 100 % full level. Mix this solution and pump it into the system. Repeat this procedure until the system is completely full.

.5 If a 40% glycol to water solution is required add the appropriate glycol product to the tanks 50 % full level and add soft water to the 100 % full level and turn the mixer on for 5 minutes.

.6 Please contact us if you are unclear what to do or have any special system requirements not covered in this general procedure.
Mark Keddie – Cell Phone - 519 239 5147
E-mail: Mark.Keddie@suez.com

6 LABELLING

6.1 General

.1 After completion of insulation and/or painting, all piping shall be identified to show the service and direction of flow as described below.

.2 Additional requirements may apply to pipe identification within the Central Utility Plant (building 55), Generator Building (building 56), and service tunnels.

.3 Applicable Codes and Standards:

  .1 CSA Standard B53 – Identification of Piping Systems
  .2 CSA B149.1, Natural Gas and Propane Installation Code.
  .3 Liquid Fuels Handling Code by Technical Standards and Safety Authority (TSSA)
  .4 ANSI/ASME A13.1-2007 – ~~Scheme~~ Standards for the Identification of Piping Systems
  .5 NFPA 99/CGA C-9 Standards for Medical Gas and Vacuum Systems.
  .6 CAN/CSA Z305.1.92 – Standards for non-flammable medical gas piping systems and CGSB standard 1-GP-12 for colour coding.
  .7 Fire protection: Sprinklers in accordance with NFPA 13. Standpipes in accordance with NFPA 14.
  .8 CAN/CGSB-24.3-12 - Standard for Pipe Identification.
  .9 R.R.O. 1990, Reg. 860 - Workplace Hazardous Materials Information System (WHMIS), under the Occupational Health and Safety Act.
  .10 CSA C22.2 No. 130. Standards for heating cables and piping.

6.2 Label Placement

.1 The entire piping system is to be identified, including piping located in ceiling spaces, interstitial spaces, or within pipe chases.

.2 Pipe identification is required:

.1 At every point of entry or exit to a space, on both sides of where the pipe penetrates a wall, floor, service column or enclosure, change in direction;
.2 At every access door
.3 Within 3 ft. (1 m) of pipe termination points
.4 Within 3 ft. (1 m) of valve assemblies or individual valves
.5 Within 3 ft. (1 m) of branching off (or connecting to) a distribution header
.6 At least every 20 ft. (6 m) along pipe lengths.

.3 Pipe identification shall be visible from point of normal approach.
.4 Pipe identification shall be applied to clean, dry surfaces only and installed according to manufacturer's instructions.

6.3 Label Configuration

.1 Pipe identification shall consist of a label identifying the piping system contents, along with directional arrows indicating the flow direction and University of Guelph's standard system designations.
.2 Flow direction arrows shall be located at a minimum of one end of the pipe identification label.
.3 Pipe or duct label shall be properly orientated so wording of the pipe clear and free of interferences.
.4 Electrically traced piping shall have additional identification label indicating "Electric Traced" on the outside of the thermal insulation.
.5 Nylon cable ties shall be used to secure pipe identification labels at both ends, installed with the available methods outlined in Section 6.
.6 Piping installed indoors shall be identified using labels/markers meeting either Option B, C, E or F requirements defined in Section 6 below. Option A to be used with the approval of the mechanical manager prior to the design or installation of any work.
.7 Piping installed outdoors (above grade) shall be identified using labels meeting Option B, C, D, E or F requirements defined in Section 6 below.
.8 Piping installed underground shall be identified with marking tape as outlined in Option C for locating buried services in addition to eliminating potential hazards of excavating in unmarked areas. For best detectability and protection during excavation, tape should be fully buried and installed as close to the surface as possible, no less than 3 feet above the service.

6.4 Label Size

.1 Pipe identification and flow direction markers shall be appropriately sized to match the outer diameter of the finished pipe installation.
.2 Label length and minimum text height shall be determined based on outside diameter of the finished pipe installation as follows:

Outside Pipe Diameter Including Covering	Minimum Length* of Label Field Colour	Minimum Text Height
3/4" – 1-1/4"	8"	1/2"
1-1/2" – 2"	8"	3/4"
2-1/2" – 6"	12"	1-1/4"
8" – 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

*Note: not including flow direction arrows

6.5 Materials

6.5.1 Option A – Adhesive Labels

.1 Only to be used with approval of the Manager, Mechanical Design, DEC prior to the design or installation of any work.

  .1 If approved, application area must be cleaned thoroughly before adhesion.

.2 Non-customized pressure sensitive adhesive label and banding tape:

  .1 minimum 6 mm thick vinyl or polyester with pressure sensitive acrylic adhesive backing; silk-screened with vinyl ink.

  .2 label printed with applicable abbreviation from Section 7 below.

  .3 label and text color as defined in Section 7 below.

  .4 banding tape with directional flow arrows placed at a minimum one end of the pipe, label and wrapped 360° around outside diameter, or include arrows directly on the label.

  .5 banding tape colors to match label color scheme.

  .6 standard of acceptance:

    .1 Brady

    .2 Seton

    .3 SMS – Smillie McAdams Summerlin

    .4 Or equivalent with prior approval by the Manager, Mechanical Design, DEC.

6.5.2 Option B – Semi-rigid Plastic Vinyl

.1 semi-rigid plastic vinyl label with ultraviolet ink surface printing, printed with applicable abbreviation from Section 7 below;

.2 label printed with applicable abbreviation from Section 7 below;

.3 label and text color as defined in Section 7 below;

.4 piping up to 6" OD: coiled vinyl wrapped to snap around pipe and provide 360° visibility;

.5 piping larger than 6" OD: flat vinyl tied down with 36" long nylon cable ties

.6 standard of acceptance:

  .1 Brady

  .2 Seton

  .3 SMS – Smillie McAdams Summerlin

  .4 Dura Label

.5 Or equivalent with prior approval by the Manager, Mechanical Design, DEC.

6.5.3 Option C – Ductwork Stencil

.1 To be used on ductwork supply and return trunk mains.

.2 No less than one stencil per room or at least every 20’

.3 To be added to each main upon entering room.

.4 No less than 6” or greater than 1’ sized black lettering

6.5.4 Option D – Underground Marking Tape

.1 Non-detectable 4mm thick low density polyethylene.

.2 Detectable has 35 gauge aluminum core encased by a protective plastic jacket.

.3 Organic pigmented lead free black ink.

6.5.5 Option E – Medical Gas & Specialty Pipe Markers

.1 6mm thick (+/- 0.05mm soft vinyl)

.2 Pressure sensitive acrylic adhesive

.3 Silk screened ¾” high lettering

6.5.6 Option F – Valve Tags

6.5.6.1 Exterior Valve Tag

.1 Material

.1 0.025” thick yellow brass

.2 Round: 1 1/2” diameter

.3 Hole for chain installation

.2 Lettering

.1 3/8” high

.2 Black filled

.3 Can include identifier on top line

6.5.6.2 Interior Valve Tag

.1 Material

.1 1 ½” square, 1/16” thick lamacoid plastic hole for chain installation

.2 Lettering

.1 3/8” engraved lettering

.2 Two (2) contrasting letters, yellow with black lettering

.3 3/8” engraved lettering

6.5.7 Ceiling Dot Labeling

.1 Applies to all ceiling panels. Locations based on identification of valves and equipment.

.1 Red Dot - Fire Damper

.2 Blue Dot - Heating & Cooling (coil, valves, etc.)

.3 Yellow Dot – VAV

.4 Green Dot - Potable & Non-Potable Water, DI Water

6.6 Label Legend

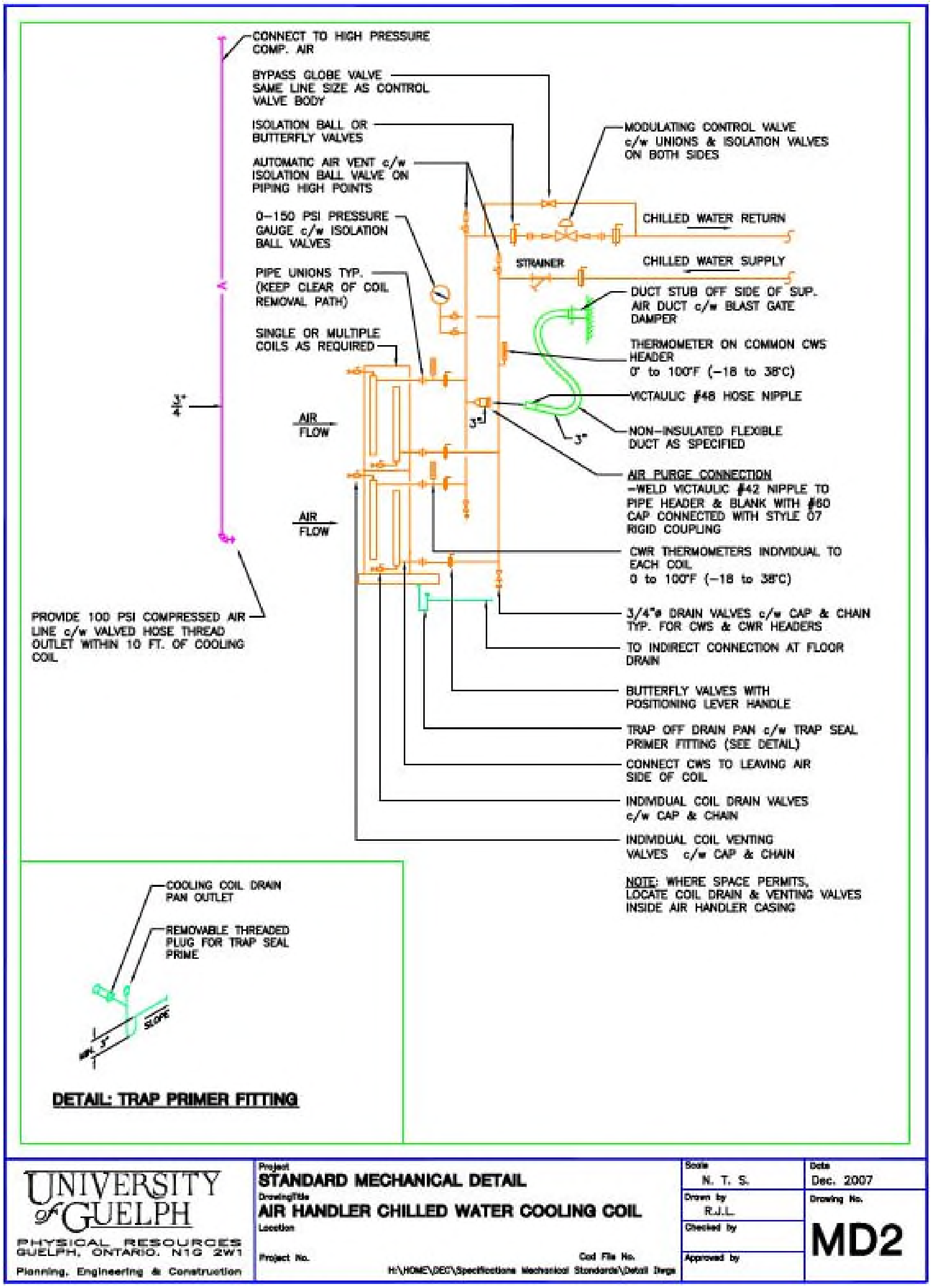
.1 Do not use custom made labeling. Labelling must meet the legend below or receive approval of the Manager, Mechanical Design, DEC for any deviations.

Label Abbreviation	System, Pipe Contents	Label Colors (Text - Background)
PIPING		
ACETYLENE	Acetylene	Black - Yellow
ACID	Acid	Black - Yellow
BIOHAZARD VENT	Biohazard Vent	Black - Yellow
BIOHAZARD WASTE	Biohazard Waste	Black - Yellow
BLOW-OFF	Blow-Off	Black - Yellow
BOILER BLOWDOWN	Boiler Blowdown	Black - Yellow
BOILER FEED WATER	Boiler Feed Water	Black - Yellow
CHEMICAL FEED	Chemical Feed	Black - Yellow
CHILLED WTR. RET.	Chilled Water return	White - Green
CHILLED WTR. SUP.	Chilled Water Supply	White - Green
COMPRESSED AIR	Compressed Air	Black - Yellow
COMPRESSOR VENT	Compressor Vent	White - Green
CONDENSATE	Condensate	Black – Yellow
COOLING TOWER RET.	Cooling Tower Return	White – Green
COOLING TOWER SUP.	Cooling Tower Supply	White – Green
DEIONIZED WATER	Deionized Water	White – Green
DISTILLED WATER	Distilled Water	White – Green
DIESEL FUEL RETURN	Diesel Fuel Return	Black - Yellow
DIESEL FUEL SUPPLY	Diesel Fuel Supply	Black - Yellow
DISTRICT HTG. RET.	District Heating Return	Black - Yellow
DISTRICT HTG. SUP.	District Heating Supply	Black - Yellow
DUAL TEMP. RET.	Dual Temperature Return	Black - Yellow
DUAL TEMP. SUP.	Dual Temperature Supply	Black - Yellow
EXHAUST / EXH.	Exhaust Air	Black - Yellow
FIRE PROT. WATER	Fire Protection Water	White - Red
FIRE STANDPIPE	Fire Standpipe	White - Red
FIRE	Fire Suppression Water	White - Red
FIRE (DRY)	Fire Suppression (Dry Pipe)	White - Red
FIRE (insert gas/chemical type)	Fire Suppression (Gas or Chemical)	White - Red
FUEL OIL RETURN / F.O.R.	Fuel Oil Return	Black - Yellow
FUEL OIL SUPPLY / F.O.S.	Fuel Oil Supply	Black - Yellow
FUEL OIL VENT / F.O.V.	Fuel Oil Vent	Black - Yellow
GAS VENT	Gas Vent	Black - Yellow
GLYCOL HTG. RET. / GLY.H.R.	Glycol Heating Return	Black - Yellow
GLYCOL HTG. SUP. / GLY.H.S.	Glycol Heating Supply	Black - Yellow
GLYCOL MAKE-UP / GLY.FILL.	Glycol Make-up (confirm)	Black - Yellow
HEAT RECLAIM RET.	Heat Reclaim Return	Black - Yellow
HEAT RECLAIM SUP.	Heat Reclaim Supply	Black - Yellow
HEATING WTR. RET.	Heating Water Return	Black - Yellow
HEATING WTR. SUP.	Heating Water Supply	Black - Yellow
HIGH PRESS. COND.	High Pressure Condensate	Black - Yellow
HIGH PRESS. STEAM	High Pressure Steam (≥125psi)	Black - Yellow
LOW PRESS. COND.	Low Pressure Condensate	Black - Yellow
LOW PRESS. STEAM	Low Pressure Steam (≤15psi)	Black - Yellow
LAB VACUUM	Lab Vacuum	White - Green
MED. PRESS. COND.	Medium Pressure Condensate	Black - Yellow
MED. PRESS. STEAM	Medium Pressure Steam (>15psi,<125psi)	Black - Yellow
MAKE-UP WATER	Make-up Water	Black - Yellow

NATURAL GAS	Natural Gas (all piping painted yellow)	Black - Yellow
PUMPED CONDENSATE / P.COND.	Pumped Condensate	Black - Yellow
REFRIG. LIQUID / R.L.	Refrigerant Liquid	Black - Yellow
REFRIG. SUCTION / R.S.	Refrigerant Suction	Black - Yellow
REHEAT WATER RETURN	Reheat Water Return	Black - Yellow
REHEAT WATER SUPPLY	Reheat Water Supply	Black - Yellow
SPRINKLER WATER / SPR.W.	Sprinkler Water	White - Red
VACUUM	Vacuum	White - Blue
VENT	Vent (non-plumbing)	Black - Yellow
PLUMBING		
CAPTURED RAIN WATER	Captured Rain Water	White - Green
DOM. H.W. RECIRC./ D.H.W.R.	Domestic Hot Water Recirculation	White - Green
DOM. H.W. SUPPLY / D.H.W.S.	Domestic Hot Water Supply	White - Green
DOM. COLD WATER / D.C.W.	Domestic Cold Water	White - Green
DOM. HOT WATER / D.H.W.	Domestic Hot Water	White - Green
DRAIN	Drain	White - Green
GREY WATER	Grey Water	White - Green
NON POT ANIMAL CW	Non Potable Animal Water	White - Green
NON POTABLE COLD WTR.	Non Potable Cold Water	White - Green
NON POT H.W. RECIR.	Non Potable Hot Water Recirculation	White - Green
NON POT HOT WTR.	Non Potable Hot Water	White - Green
POTABLE WATER	Potable Water	White - Green
POT CW	Potable Cold Water	White - Green
POT HW	Potable Hot Water	White - Green
POT HWR	Potable Hot Water Recirculation	White - Green
PROTECTED POT CW	Protected Potable Cold Water	White - Green
PROTECTED POT HW	Protected Potable Hot Water	White - Green
PROTECTED POT HWR	Protected Potable Hot Water Recirculation	White - Green
R W L	Rain Water Leader	White - Green
RAW WATER	Raw Water	White - Green
SANITARY DRAIN / SAN.	Sanitary Drain	White - Green
STORM DRAIN / STM.	Storm Water Drain	White - Green
TEMPERED WATER	Potable Tempered Dom. Water - Safety Eqpt	White - Green
VACUUM	Vacuum	White – Green
VENT	Sanitary Vent	Black - Yellow
MEDICAL GAS		
ARGON	Argon	Black - White
CARBON DIOXIDE	Carbon Dioxide	Black - Yellow
HELIUM	Helium	White - Brown
MEDICAL AIR	Medical Air	White - Black
MED VAC	Medical Vacuum	Black - Yellow
NITROGEN	Nitrogen	White - Black
NITRUOUS OXIDE	Nitrous Oxide	White - Blue
OXYGEN	Oxygen	White - Green

7 DETAILS

7.1 Air Handler Chilled Water Cooling Coil



8 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	15-09-2014	Entire Standard	Original Issue
1	08-04-2019	Entire Standard	Update of overall standards

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSM-02

PLUMBING SYSTEMS

Version	Revision 1
Effective Date	April 09, 2019
Approved By	
	Manager, Mechanical Design, DEC

TABLE OF CONTENTS

9 VERSION CONTROL SUMMARY

1 INTRODUCTION

1.1 General

.1 This Plumbing Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Plumbing Systems installed on campus.

.2 The University's minimum expectations and requirements for new Fire Protection Systems installed on campus are covered under Standard DSM-03.

.3 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new Plumbing installations within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing Plumbing infrastructure.

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Mechanical Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The Design Engineer of Record remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Mechanical Design, DEC, together with proposed measures for addressing the conflict before the completion of schematic design.

.3 The Design Engineer of Record is responsible for all investigation and to ensuring designs account for all affected systems including concealed conditions. With prior approval of the University, destructive testing may be required to confirm conditions.

.4 The Design Engineer of Record is responsible for coordinating specific user and equipment requirements from all stakeholders including but not limited to University staff, management, and users of the affected space(s).

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovation shall be tabled for consideration by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

.1 Ontario Building Code

.2 ASHRAE Standards

.3 ASPE Standards

.4 LEED Certification

.5 Mechanical HVAC Systems Standard DSM-01*

.6 Building Automation Standards DSM-03*

.6 Mechanical Fire Protection Systems Standard DSM-04*

.7 Site Servicing Standard DS-01*

.8 Campus Site Service Schematics

.9 City of Guelph Cross Connection Bylaw (Backflow Bylaw)

* A copy of these standards is available on the University of Guelph Physical Resources web page

2 DESIGN STANDARDS FOR SERVICES

2.1 Domestic Water

2.1.1 General

.1 The requirements outlined in the following clauses are applicable to all Plumbing Systems.

.2 Water pressure is supplied by City onto campus at approximately 60PSI and suppled from the Central Utility Plant at approximately 80PSI.

.3 Potable water system design temperature:

.1 cold water: 13.3 ^{0}C (56 ^{0}F)

.2 hot water: 60 ^{0}C (140 ^{0}F)

.1 Distribute at 49°C (120°F) with mixing station as per OBC.

.4 Balancing

.1 To be pressure independent type. Recirculation systems to have fully stainless steel type TA series 76X.

.5 Typical building water systems:

System Configuration	*Definition*	*Typical Applications*
	Potable Water Systems	
Potable Water System (cold and/or hot)	Water Distribution System delivering cold and/or hot water suitable for human consumption.	Washrooms, Hand Washing Sinks, Pantry Supplies, Drinking Fountains, Sterilizers,

		Coffee Machines, Soda/Pop Machines, etc.
Tempered Potable Water System	Water Distribution System delivering tempered potable water suitable for human consumption.	Eyewash Stations, Emergency Showers, Hand washing Sinks, etc.
Protected Potable Water System (cold and/or hot), Animal Drinking Water System (cold)	A Process Water Distribution System derived from the Potable Water Distribution System but separated from the same through the use of Cross-Connection (Backflow) Protection Devices. Water delivered through this system is only suitable for Food Contact or Animal Consumption within the protected zone.	Food Preparation, Inspection & Testing Laboratories, Animal Facilities (for Animal Drinking) and Areas required by the Canadian Food Inspection Agency to be serviced with water supplies suitable for human consumption.
Non-potable Water Systems		
Non-Potable Water System (cold and/or hot)	A Process Water Distribution System derived from the Potable Water Distribution System (cold and/or hot) but separated from the same through the use of Cross-Connection (Backflow) Protection Devices. Water delivered through this system is not suitable for human consumption.	Lab Sinks & Lab Supplies, Fume Hood Supplies, Process Equipment Supplies, Hose Bibbs, Janitor/Slop Sinks, Laundry Supplies,
Raw Water System	Water Distribution System delivering untreated well water not suitable for human consumption	Aqua Lab, CUP, Greenhouse
RAIN (CISTERN) SYSTEM – DEFINITION – GREY WATER, IRRIGATION,		
Other Water Systems		
Fire Protection Water	A Process Water Distribution System derived from the Potable Water Distribution System but separated from the same through the use of Cross-Connection (Backflow) Protection Devices. Water delivered through this system is strictly for fire suppression and is not suitable for human consumption.	Fire suppression sprinkler and stand-pipe systems and Dry and Wet systems. See fire protection standards for reference.

2.1.2 Incoming Water

.1 Incoming water service shall be extended from the University's Premise Protected Campus Water Distribution Main.

.2 All install and/or removed backflow must include all related City of Guelph to meets the related bylaw.

2.1.3 Below Ground

.1 All below ground buried domestic water piping systems shall be constructed out of Schedule 80 PVC.

.2 To avoid the use of tunnel system for running pipe. Exceptions are subject to the approval by the Manager, Mechanical Design, DEC.

.3 To include gate isolation valves with one piece plastic valve box, copper tracer wirer, 12" x 12" cement pad, and copper tag number (number by University) at valve cap. Locate where line feeds into building, by-pass or where main branches.

2.1.4 Above Ground

.1 All above ground domestic water piping systems shall be constructed out of Type L Copper, Soldered, Schedule 80 PCV, or Schedule 10 S.S. Wirsbo compression acceptable for lines 3/4" and below (include strapping).

  .1 Galvanized pipe is prohibited.

.2 All Valves shall be in accordance with the University's Valve Standard.

.3 Isolation valves shall be provided on all Branch Piping and at individual fixtures and equipment connections. Branch piping feeding 3 or more items, or above 50 feet, shall include isolation valves for branch piping.

.4 Joints & Fittings:

  .1 All copper joints and fittings shall use soldered connections, except at connection to valves, specialties or equipment where threaded or flanged connections shall be used. Any other types of joints and fittings are subject to an approval by the Manager, Mechanical Design, DEC; table requests for approval prior to completion of the Schematic Design phase.

  .2 Grooved piping is not acceptable where buried or within wall.

2.1.5 Backflow

2.1.5.1 General

.1 Premise Protection against Cross-Connection shall be provided in accordance with the City of Guelph Backflow Bylaw for the Building Hazard Classification. Exceptions include:

.2 Buildings classified as "Light" or "Moderate" Hazard do not require Premise Protection on the incoming water service as the University's Campus Water Distribution Main is already Premise Protected from the City Water Service. However, in such instances the incoming water service piping shall be arranged with a flanged spool piece to allow a Reduced Pressure Backflow device c/w an upstream & downstream isolation valve to be installed at any time. Zone or source isolation is still required where a specific hazards exists.

.3 A Funnel Floor Drain shall be provided in the immediate vicinity of any Backflow Device, whether installed or provisioned for.

.4 City of Guelph requires a cross-connection survey to be performed and submitted with all building upgrades – form is available on the City's website. Work to be included in tender documents and performed by the contractor.

.5 Water closets, urinals and mop sinks may be on non-potable water systems where approved by the University. Where mop sinks are on potable water and a soap injector system is provided, a separate cold water connection protected by a RP or air gap type BFP is to be provided (zoned where possible).

.6 New ice machines may have a suitable air gap protection built-in. For machines without built-in air gap protection, machines will require DCVA type backflow prevention. (Zoned where multiple sources exist).

.7 Maximum mounting height of BFP's to be 1500mm – If exceptions are necessary, revisions must be reviewed on site with City of Guelph prior to installation.

.8 Lead Free Backflows will be supplied which meets this standard. Alternates must be approved by University.

.9 Vacuum breaker type air barriers are acceptable on mop sinks, laundry sinks and residential type washing machines (non-chemical injecting). Detergent injecting type machines require RP type BFPs.

2.1.5.2 Building Classification

.1 This classification is intended to group buildings based on the Activities envisaged within the buildings now and in the future. In each instance the University's own Building (Hazard) Classification is equal to or higher than the Hazard Classification assigned by the City of Guelph Backflow bylaw.

.2 Building Hazard Classified as "Light", "Moderate" or "Severe"; classification identified by the Manager, Mechanical Design, DEC, before the commencement of Schematic Design.

2.1.5.3 BACKFLOW INSTALLATION

.1 Cross-Connection Protection Device on the incoming water service shall be installed between upstream & downstream isolation valves. These isolation valves may be shared with the water meter installation. Connections shall be completed using unions for piping NPS 3 or smaller and flanges for piping NPS 4 and larger.

.2 Discharge from the Cross-Connection Protection Device shall be directed to a floor drain located directly underneath or in the immediate vicinity of the device; drain piping shall be arranged with a fixed air gap.

.3 Use two parallel backflow devices for each location unless otherwise approved by Mechanical Manager, DEC.

.4 Cross-Connection Protection Device shall be installed in the same Service Room or Mechanical Room as the Water Meter.

.5 Comply with the City of Guelph's Backflow By-law requirements.

2.1.6 Water Distribution Systems

2.1.6.4 Renovation Projects

.1 Modify existing Plumbing Systems to suit new Work. Maintain the design criteria followed for the existing installation.

.2 Provisions to protect against cross-connection: Create a new Non-Potable Water System (Loop) to limit the number of new testable devices required to protect against cross-connection.

  .1 To limit the amount of testable devices it is the preference of the University to provide a zoned non-potable water loop to protect against cross-connection. Where this is not practical or economical, provide source protecting with cost-benefit analysis after confirmation with the University Mechanical Design Manager, DEC, at the design stage.

2.1.6.5 New Construction Projects

.1 Potable Water Booster Pumping System

  .1 A Potable Water Booster Pumping System shall be provided, as necessary, to support the Facility Potable Water Demand (Flow and Terminal Pressure)

  .2 Sizing supported by Connected Load and Demand Load Calculations.

  .3 Potable Water Booster Pumping System shall be configured as follows:

  .4 A Variable Speed Duplex Pumping System with each pump sized accordingly.

  .5 Confirm if available water pressure is sufficient at building site prior to designing booster pump system.

    .1 Booster pumps to be designed such that the pumps are disabled once pressure setpoint has been met for a given time period to reduce pump power during unoccupied periods."

  .6 Shall include isolation valves on inlet and outlet.

2.1.6.6 Potable Water Systems

.1 A Potable Cold Water System shall be provided to support the building's potable cold water demand.

.1 Potable cold water for the Protected Potable Water System (where provided) shall be extended from the Potable Water System; cross-connection protection devices shall be provided on the potable water supply piping to protect the Potable Water System.

.2 A Potable Hot Water System shall be provided to support the building's potable hot water demand.

.1 Potable hot water for the Protected Potable Water System (where provided) shall be extended from the Potable Water System; cross-connection protection devices shall be provided on the potable hot water supply piping and recirculation piping to protect the Potable Water System.

.3 The Potable Hot Water System shall be configured as follows:

.1 Use Plant Steam supplied from the CUP as the primary source of input heat.

.2 Alternate measures (such as gas-fired heaters, point-of-use electric heaters, etc.) for hot water production for small demands may be considered and shall be presented for review by the Manager, Mechanical Design, DEC at the Schematic Design Stage.

.3 A recirculation loop of the hot water system is preferred by the University. All other designs shall be approved by the University Mechanical Design Manager, DEC, at the design stage.

.4 The Potable Water Distribution Systems shall be sub-divided into a Protected Potable Water System as needed.

.5 Sizing supported by Connected Load and Demand Load Calculations.

2.1.6.7 Non-potable Water Systems

.1 A Non-potable Water System shall be provided to support the building's non-potable water demand, and limit the number of testable backflow devices installed.

.2 A separate Non-potable Hot Water System may be required depending on the application and calculated demand.

.3 Sizing supported by Connected Load and Demand Load Calculations.

.4 Non-potable Hot Water System shall have dedicated hot water heaters (independent of potable hot water heaters) configured as follows:

.1 Use Plant Steam supplied from the CUP as the primary source of input heat.

.2 Alternate measures (such as gas-fired heaters, point-of-use electric heaters, etc.) for hot water production shall be presented for review and approval by the Manager, Mechanical Design, DEC at the Schematic Design Stage

.3 A recirculation loop of the hot water system is preferred by the University. All other designs shall be approved by the University Mechanical Design Manager, DEC, at the design stage.

2.2 Storm Drainage Systems

2.2.1 GENERAL

.1 All Roof Drains shall be of the "controlled flow" type.

.2 To the extent feasible, storm drainage systems shall be designed for gravity flow.

.3 All non-pressurized pipe constructed from PVC. Cast iron is not acceptable.

.4 Sump Pump Systems

  .1 Where required to handle storm water inflow from a weeper system or storm drains that cannot flow to the storm sewer under gravity, a duplex self-priming sump pump system with automatic alternation shall be provided.

  .2 Storm water from weeping tile shall be collected via a sand interceptor pit.

  .3 Each pump shall be capable of supporting 100% of the calculated storm water inflow.

  .4 Sump levels shall be monitored with High and High High Levels alarmed with the Building Automation System.

.5 All clean–outs to be accessible with access hatch without the use of a ladder.

  .1 Power supply to the sump pumps shall be extended from the facility's Essential Power System.

.6 Rain Water Leaders shall not be routed along any exterior wall or in an area that has the potential to freeze.

2.2.2 Service Tunnel

.1 Floor drains and sump pits within a Service Tunnel should be directed to a Sanitary Drain. Comply with the requirements of Sanitary Drainage Systems listed under Clause 2.8 and 9.4.

2.2.3 Material

.1 All below ground buried storm drain piping systems shall be constructed out of PVC Schedule 40.

.2 All above ground storm drain piping systems 65mm (2-1/2") or larger shall be Schedule 40 PVC DWV. 50mm (2") and smaller shall be hard temper DWV copper or PVC. The use of fire rated PVC is acceptable (XFR).

.3 All pumped storm drain piping systems shall be constructed out of rigid type "L" copper pipe or Schedule 80 PVC.

.4 All drain piping serving Chemistry Labs and Wet Labs shall be shall be constructed out of acid resistant PVDF for the greater of the first 50'-0" or until the effluent is neutralized and deemed safe for use of more conventional drain piping materials.

2.3 Sanitary Drainage Systems

2.3.1 General

.1 Floor Drains shall be provided at a minimum in the following locations:

  .1 A combination funnel floor drain at each equipment or group of equipment to serve as a point to drain condensate from equipment or a point of drain to serve piping systems.

  .2 Piping to be directed into funnel floor drain to avoid splashing

  .3 Floor drains in each mechanical room and service room for housekeeping.

.4 A floor drain at each eyewash and emergency shower

.5 Location of drain shall prevent pipe running into drain to avoid tripping hazard

.2 Sanitary drainage systems shall be designed for gravity flow.

.3 All non-pressurized pipe constructed from PVC or copper. Cast iron is not acceptable.

2.3.2 Automatic Trap Priming

1. System in the form of an Electronic Trap Seal Primer connected to the non-potable water system and shall include a timer, a solenoid valve and a vacuum breaker shall be provided for each floor drain or a group of floor drains; exceptions include:

.2 For renovations including 6 or less floor drains where food processing is not being completed, the preference of using an insertion type Trap-Guard Primer can be used. A Mechanical Pressure Drop Type Primer may be used with the prior approval by the Manager, Mechanical Design, DEC at the Schematic Design Stage.

.3 Intent to use such alternate measures shall be identified and presented for approval prior to completion of the Design Develop.

.4 Where tying into a potable water source the electronic trap seal primer shall be equipped with an air gap.

.5 Wirsbo compression piping can be used for piping of trap primer.

2.3.3 Sump Pump Systems

.1 Where required to handle sanitary drains that cannot flow to the sanitary sewer under gravity, a duplex self-priming sump pump system with automatic alternation shall be provided.

.2 Each pump shall be capable of supporting 100% of the calculated sanitary water inflow.

.3 Sump levels shall be monitored with High and High High Levels alarmed at the Building Automation System.

.4 Power supply to the sump pumps shall be extended from the facility's Essential Power System.

.5 Sump pit covers shall be gasketed to ensure an air-tight seal. Vent piping shall be extended to the outside.

.6 Provide check valve and isolation valve on discharge where tied into common line.

2.3.4 Elevator Pits

.1 Elevator pits shall be drained to the sanitary drainage system.

.2 Include water alarm system tied into BAS system.

.3 Include a backwater valve.

2.3.5 Service Tunnel Drainage

.1 Weeper drains associated with a Service Tunnel should be directed to a storm drain. Comply with the requirements of Storm Drainage Systems listed under Clause 2.8 and 9.4.

2.3.6 Material

.1 All below ground buried sanitary drain piping systems shall be constructed out of PVC Schedule 40.

.2 All above ground sanitary drain piping systems 65mm (2-1/2") or larger shall be Schedule 40 PVC DWV. 50mm (2") and smaller shall be hard temper DWV copper or PVC. The use of fire rated PVC is acceptable (XFR). Cast iron is not acceptable.

.3 All pumped sanitary drain piping systems shall be constructed out of rigid type "L" copper pipe or Schedule 80 PVC.

.4 All drain piping serving Chemistry Labs and Wet Labs shall be shall be constructed out of acid resistant PVDF for the greater of the first 50'-0" or until the effluent is neutralized and deemed safe for use of more conventional drain piping materials.

2.4 Rain Water Harvesting

2.4.1 General

.1 In all new construction, supply water piping to Water Closets and Urinals shall be ran independent of all other supply water piping systems. This will allow ease of switching over to the Grey Water System.

2. Shall be considered where a cost-benefit analysis demonstrates the viability of such a system. Viability shall be demonstrated to the Manager, Mechanical Design, DEC prior to completion of Schematic Design.

.3 Rain Water Systems are to be designed to allow city domestic cold water to directly supply the fixtures during periods when rain water is not available.

   .1 Code-required backflow prevention is to be provided on the connection between the domestic water supply and the rainwater system. Refer to OBC requirements and the latest requirements of the City of Guelph's Backflow Prevention Bylaw.

   .2 If possible, avoid the use of domestic to directly fill the rain water cistern/tank.

.4 Rainwater systems shall utilize pre-filters (Vortex style) to remove large debris prior to the rainwater entering the cistern/storage tank.

.5 Cistern/storage tank design to include calming inlet and floating suction filters to ensure cleanest water is drawn from the tank at all times.

.6 Final filtration system requirements are to be reviewed with the Manager, Mechanical Design, DEC at the Schematic Design Stage.

.7 System design is to include a properly sized pump and draw-down tank matched to the requirements.

.8 System to be configured to automatically switch to city domestic cold water supply during rainwater system pump failure.

.9 Pump failure alarm is to be provided to the BAS.

2.4.2 Material

.1 All below ground buried piping systems shall be constructed out of PVC Schedule 40.

.2 All above ground piping systems 65mm (2-1/2”) or larger shall be Schedule 40 PVC DWV. 50mm (2”) and smaller shall be hard temper DWV copper or PVC. The use of fire rated PVC is acceptable (XFR).

.3 All pumped piping systems shall be constructed out of rigid type “L” copper pipe or Schedule 80 PVC.

.4 No rainwter supply to be piped using Copper. Drainage to be PVC.

2.5 Deionized (DI) Water System

.1 The Campus DI Water Distribution Main shall be the preferred source of DI Water. All multiple point use systems shall include a recirculation loop. Exceptions where a new standalone DI Water System may be considered with prior approval from the Manager, Mechanical Design, DEC include:

- .1 An application with a very low DI Water demand where it is more economical to provide a dedicated “Centralized” or a “Point-of-Use” DI Water System, or
- .2 A facility located remote from the DI Water Distribution Main, making it impractical and economically unfeasible to extend piping from the Campus DI Water Distribution Main, or
- .3 The Campus DI Water Plant located in the CUP and/or the sizing of the Campus DI Water Distribution Main does not support the calculated facility DI Water demand

.2 Where a “Centralized” or a “Point-of-Use” DI Water System is envisaged, the same shall be provided to support the facility DI Water needs.

- .1 A Centralized DI Water System shall be arranged with a continuously recirculating loop.
- .2 System shall be sized & configured with due consideration to peak and average demands and level of redundancy and availability identified in the functional program.
- .3 DI Water System shall not be used for humidification.
- .4 Approval by the Manager, Mechanical Design, DEC at the Schematic Design Stage is required for DI Water to be used in specialty systems.
- .6 Provide adequate saddles for DI Water System to prevent pipe sagging.
  - .1 Refer to manufacturer specific requirements for required supports.

2.5.1 Material

.1 All DI Water piping shall be Stainless Steel SS 316, Chlorinated polyvinyl Chloride (CPVC), or Poly fluoride (PVDF) plastic.

2.6 Lab Vacuum System

.1 A “Centralized” or a “Point-of-Use” Lab Vacuum System shall be provided to support vacuum outlet needs within the facility.

.2 System shall be sized & configured with due consideration to peak and average demands and level of redundancy and availability identified in the functional program.

.3 Vacuum equipment shall be air-cooled type or utilize closed loop cooling via the campus chilled water system. Use of a compressed air venturi cooling system, aeration, etc. is not permitted.

.4 Vacuum distribution systems shall be equipped with vacuum traps & filters at or close to the vacuum outlets for contaminant capture at source.

2.6.1 Material

.1 All Lab Vacuum System piping shall be Copper Type K soldered or threaded black steel.

2.7 Compressed Air System

2.7.1 General:

.1 All compressed air piping systems requiring registration with the Technical Standards and Safety Authority (TSSA) shall be constructed and registered under the University's current P-Number by extending the scope of the existing registration.

.2 A Compressed Air System shall be provided to support the facility compressed air needs.

- .1 System shall be sized and configured with due consideration to peak and average demands and level of redundancy and availability identified in the functional program.
- .2 A minimum sized ¾" compressed air outlet shall be provided in the vicinity of each air handling unit cooling coil to facilitate winterization of the coil.
- .3 Communicate the compressed air requirements to the University before the completion of the Schematic Design Phase and verify that the Central Compressed Air Plant located in the CUP and the sizing of the Campus Compressed Air Distribution Main (see clause 2.7.3.2 below) is adequate to support the identified compressed air needs.
- .4 A compressed air meter shall be provided on the building incoming compressed air service.
- .5 Meter shall have a BACNet output for interface with the University's Building Automation System or the Schneider ION System.
- .6 Refer University's Metering Standards for additional details.

.3 The Campus Compressed Air Distribution Main, operates at 100 PSI (690 kPa) (at Central Utility Plant) shall be the preferred source of compressed air. Exceptions where a new standalone Compressed Air System may be considered must meet approval by the Manager, Mechanical Design, DEC at the Schematic Design Stage.

- .1 An application where it is more economical to provide a "Point-of-Use" compressor, or
- .2 A Facility located remote from the Campus Compressed Air Distribution Main, making it impractical and economically unfeasible to extend piping from the Campus Compressed Air Distribution Main, or

.3 The Central Compressed Air Plant located in the CUP and/or the sizing of the Campus Compressed Air Distribution Main does not support the calculated facility compressed air demand.

.4 Any new standalone Compressed Air System shall incorporate the following:

.1 Sized & configured with due consideration to peak and average demands and level of redundancy and availability identified in the functional program plus a 20% future spare capacity.

.2 Compressor must include auto-start and be wired to essential power.

.3 Compressors shall be air-cooled or utilize closed loop cooling via the campus chilled water system.

.4 Compressed air distribution system shall incorporate point-of-use filtration and oil-separation devices where the application demands a very high quality air supply.

.5 Compressed air supplied by the Campus Compressed Air Distribution Main or any new standalone Compressed Air System shall not be used to support "Bubblers" and/or "Cleaning/Housekeeping" equipment.

2.7.2 Material Compressed Air System:

.1 All Compressed Air System piping shall be Copper Type K brazed or threaded steel.

.2 High Pressure Stainless Steel Flexible Tubing may be used for the final connection; length less than 36".

.3 Specification to include requirements for pressure testing at 1.5x maximum operating pressure to investigate for leaks.

.4 Include isolation valves at each branch serving 3 or more sources, or exceeding 50 feet, and at location of equipment.

.5 Include filter, regulator, and lubricator at each location of equipment. Exceptions are subject to the approval by the Manager, Mechanical Design, DEC during the schematic design stage.

2.8 Specialty Gases

2.8.1 General

.1 A Storage and Distribution System for Specialty Gases shall be provided if required by the functional program

.1 Specialty Gases could include amongst others: Oxygen, Carbon Dioxide, Nitrogen and Helium.

.2 All material used to install the system shall to match chemical resistance of the gas supplied

.3 Installed per TSSA Standards.

.2 Consideration shall be given to the use of Bulk Storage & Distribution Systems where anticipated gas consumption rates could require a frequent swap-out or replacement of cylinder(s) or cylinder banks.

.1 Where bulk storage tanks are provided, the same shall be installed outdoors, on a 150mm (6") concrete pad and within a lockable fenced enclosure.

.2 Where a Multi-Tank Manifold System serves as the source of a specialty gas, the same shall be installed in a dedicated room or a closet, readily accessible from a circulation corridor; exceptions include:

.1 Instances where a specialty gas is required in one single room (space) and it is more practical to locate the gas cylinder(s) within the space served.

.3 'Dewar' is a suitable option if approved by the Manager, Mechanical Design, DEC at the Schematic Design Stage.

2.8.2 Material

.1 Oxygen, carbon dioxide, nitrogen and helium gas piping

.1 Medical grade copper. Brazed. To confirm compatibility.

.2 High Pressure Stainless Steel Flexible Tubing may be used for the final connection; length less than 36".

.3 Include requirement for pressure testing at 1.5x maximum operating pressure.

.2 Liquid nitrogen and helium piping

.1 Vacuum Jacketed stainless steel welded.

.2 Include requirement for pressure testing at 1.5x maximum operating pressure.

3 LABORATORIES (Wet Labs, Chemical Labs & General Labs)

.1 Water supplies to Lab Sinks, Lab Benches, Fume Hoods and Process Equipment shall be extended from the Non-Potable Water System

.1 Zone Protection in the form of a non-testable device shall be provided for individual labs fed from the Non-Potable Water System

.1 A Lab Faucet Vacuum Breaker shall be provided on each outlet within a Zone Protected Lab where it is necessary to protect individual outlets from self-induced cross-contamination.

.2 A Hose Connection Vacuum Breaker shall be provided on each hose connection.

.3 Fixtures/Equipment shall be clearly labeled as fed off a Non-Potable Water Supply.

.2 Each Lab shall be provided with at least one (1) hand-washing sink (hands-free) near the point of entry; water supplies to this sink shall be extended from the Potable Water System.

.3 Each Lab shall be provided with at least one (1) Eyewash/Emergency Shower Assembly near the point of entry; water supplies to this Eyewash/Emergency Shower Assembly shall be extended from the Potable Water System or the Tempered Potable Water System.

.4 Shower / Eye wash stations tied into hand sink faucet to ensure water always tempered.

.5 Consult with regulations, codes and University EH&S for design of safety station.

4 ANIMAL FACILITIES

.1 Water supplies to Lab Sinks, Lab Benches, Fume Hoods and Process Equipment shall be extended from the Non-Potable Water System

  .1 A Lab Faucet Vacuum Breaker shall be provided on each outlet.

    .1 Where there is potential risk, screw on type vacuum breaker is not acceptable.

    .2 A Hose Connection Vacuum Breaker shall be provided on each hose connection.

    .3 Fixtures/Equipment shall be clearly labeled as fed off a Non-Potable Water Supply.

.2 Each Lab shall be provided with at least one (1) hand-washing sink near the point of entry; water supplies to this sink shall be extended from the Potable Water System.

.3 Animal Drinking Water supplies shall be extended from a designated Protected Potable Water System.

5 SERVICE ROOMS

5.1 Mechanical Rooms

.1 One (1) hand-washing sink connected to the Potable Water System shall be provided in each Mechanical Room.

.2 One (1) deep bowl stainless steel chemical service sink, with a vacuum breaker where potential risk exists, connected to the Non-Potable Water System shall be provided in each Mechanical Room housing Heating & Cooling System or Closed Loop System Recirculation Pumps.

.3 At least one (1) hose connection, with a vacuum breaker where potential risk exists, connected to the Non-Potable Water System shall be provided in each Mechanical Room.

5.2 Service Rooms

.1 One (1) stainless steel slop sink connected to the Non-Potable Water System shall be provided in each Service Room.

5.3 Housekeeping Rooms & Closets

.1 One (1) stainless steel or fiberglass slop sink connected to the Non-Potable Water System shall be provided in each Housekeeping Closet.

.2 One (1) soap dispenser, complete with air gap, compliant with the University's Standard shall be provided within each Housekeeping Closet.

.3 No fittings, fixtures, or valves requiring maintenance shall be located above Housekeeping Room or Closets.

6 PRODUCTS

6.1 Installation Standards

.1 The requirements outlined in the following clauses are applicable to all Plumbing Systems.

.2 Piping Risers shall be routed through accessible pipe chases or accessible service shafts. In the case of the latter at least one light c/w manual light switch and one duplex receptacle shall be provided within the service shaft at each level.

.3 Access to pipe chases to be minimum 12"x12" for hand access, 18"x18" for arm access and 24"x24" for upper body.

.4 All Equipment and System Components shall be arranged and located to allow proper access for service and maintenance.

.5 Mechanical systems shall be installed to maximize the building's usable space while maintaining optimal service clearances for maintenance and repair.

.6 New systems shall not block access to existing systems.

.7 All equipment and materials shall be installed in a neat and orderly fashion. Refer to applicable ASHRAE guidelines for best practice guidelines.

.8 In finished areas, mechanical systems will be concealed. Exceptions are subject to the approval by the Manager, Mechanical Design, DEC during the schematic design stage.

.9 All equipment connections shall include unions, strainers and isolation valve as a minimum.

.10 CRN / CSA numbers required for all equipment.

.11 Automatic Air Vents c/w manual isolation valves shall be provided at all high points in water systems.

.12 Drain Valves (ball) with a garden hose connection c/w screwed cap shall be provided at all low points in water systems.

6.2 Plumbing Fixtures and Trim

.1 Plumbing fixtures shall be water conserving type. Maximum baseline requirements:

- .1 Water closets: 4.8 lpf
- .2 Urinals: 3.8 lpf
- .3 Showerheads: 5.7 lpm
- .4 Faucets: 3.8 lpf

.2 All plumbing trim shall be sourced from a single manufacturer (per washroom group). Identify the preferred manufacturer in consultation with the Manager, Mechanical Design, DEC before completion of the Design Development phase.

.3 A hose bibb connection shall be provided below the lavatory counter in all washrooms.

.4 Trim shall include ceramic disk cartridges, vandal resistance options in public areas and meet ADA requirements.

.5 All exposed valves, fittings, escutcheons, trim, etc. at each fixture shall be polished chrome plated brass. Exceptions are subject to the approval by the Manager, Mechanical Design, DEC.

.6 All electronic faucet mixing stations shall be installed as high as possible under the countertop while maintaining access.

.7 Water closets

- .1 All water closets shall be of the wall mounted type, elongated with automatic flush valves.
- .2 Seats for water closets shall be anti-microbial.
- .3 To include individual isolation valves with metal handle at fixture.

.8 Urinals

- .1 All urinals shall be of the wall mounted type with automatic flush valves.
- .2 Waterless urinals shall not be installed.
- .3 All drainage piping must be PVC.
- .4 To include individual isolation valves with metal handle at fixture.

6.3 Meters

6.3.1 General

.1 Reference “requirements for connecting WAGES Mechanical Meters to the EMS for system connection.

.2 All meters must be compatible with Schneider ION System.

.3 Provide upstream and downstream minimum distances or as specified by supplier.

.4 To make good on all surroundings after completion of installation of meter.

.5 Provide insulation to include meter body, surrounding flanges and unions.

6.3.2 Metering Requirements

.1 The University of Guelph requires metering of all building services only. This will enable us to monitor and track the campus energy usage and provide a clear understanding of each service demand.

.2 All service connections require meters that includes but are not limited to all:

- .1 Connections to a new or existing service;
- .2 Services include domestic services;
- .3 Where applicable, temporary service connections;
- .4 Connections that include an underground irrigation system.

.3 Meter shall provide a local readout display with an electronic 4-20mA signal for network connection.

.4 All hazardous area, CSA, and CRN where applicable, approvals must be met for all meters supplied.

.5 Supplied meter shall be compatible with services for all supplied.

.6 Meter shall be sized to meet present flow rates, provided by design engineer.

6.3.3 Metering Installation Requirements

.1 All meter location must be accessible and located in a position that allows ease of maintenance and removal without interfering with the meter accuracy or installation practices.

.2 Meter shall be installed with proper orientation, up and down stream distances and proper grounding as per manufacturer.

.3 Where required, install “Y” strainers immediately upstream of the meter using a flanged connection strainers shall be of the same size as the meter. Steam meter installations are the exception.

.4 Provide isolation valves upstream and downstream of the meter to allow removal of meter and strainer cases. Install one valve on bypasses. Provide a lock wing on the operating nut of bypass valves 50mm and smaller.

.5 For single source meter 3” in diameter and larger provide a by-pass. By-pass line should be sized for approximately 2/3 the line size.

.6 Meters, valves, and bypasses should be supported with appropriate adjustable pipe stands. Bricks, concrete or wood blocking are not acceptable means of support.

.7 Meter installations must be checked for leakage or contaminants at completion of the installation, the proper operation of the meter should be established.

.8 A by-pass is not required for dedicated irrigation meters.

.9 For meters 2 1/2” diameter and larger provide a mechanical flange adapter on the downstream side of the meter to provide flexibility for meter and strainer case removal.

.10 All flange connections must be supplied with an asbestos-free gasket material top meet temperature and pressure for service.

.11 All documentation and related work shall be provided for the flow rate specified, commissioning, calibration, verification, performance specification and warranty related to the metering device.

6.3.4 Domestic Water Meter

.1 Domestic Water Meter electrode shall be constructed of stainless steel construction.

.2 Units provided with a local digital display with meters cubed (M3) and digital 4-20mA output to tie into the University of Guelph building automation system and shall be compatible with Schneider ION System.

.3 Provide inline electronic magnetic meter, complete with proper grounding, display and warranty. Quantify alternate flow meter to meet accuracy, specification and range of flow rate specified.

.4 Quantify accuracy specification through the range of flow rate specified for approval.

.5 To use polyurethane sensor liner.

.6 The meter body shall include grounding and empty pipe electrodes of the same material as the measuring electrodes.

  .1 Meter must be H.A.R.T. / ION System compatible.

  .2 The magnetic flowmeter shall be microprocessor based with integral electronics.

  .3 LCD display shall enable the operator to monitor flow rate in clear text messages.

  .4 The meter shall have field replaceable sensors and coils.

  .5 The magnetic flowmeter shall provide an accuracy of +/- 0.5% of flow rate.

.7 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.

.8 Size meter to meet all present flow rates, provided by design engineer.

.9 Approved manufacturers:

  .1 Endress & Hauser

  .2 Emerson Rosemount

  .3 Spirax Sarco

.10 Meter to be NSF 61 approved.

.11 Design to include requirement for onsite commissioning of water meter by meter manufacturer or designated technician and submission of commissioning report.

.12 Design to include requirement for submitting shop test calibration certificate during procurement.

6.3.5 Raw Water Meter

.1 Raw water meter electrode shall be constructed of stainless steel construction.

.2 Units provided with a local digital display with meters cubed (M3) and digital 4-20mA output to tie into the University of Guelph building automation system and shall be compatible with the Schneider ION System.

.3 Provide inline electronic magnetic meter, complete with proper grounding, display and warranty. Quantify alternate flow meter to meet accuracy, specification and range of flow rate specified.

.4 Quantify accuracy specification through the range of flow rate specified for approval.

.5 To use polyurethane sensor liner.

.6 The meter body shall include grounding and empty pipe electrodes of the same material as the measuring electrodes.

.7 Meter must be H.A.R.T. / ION System compatible.

.8 The magnetic flowmeter shall be microprocessor based with integral electronics.

.9 LCD display shall enable the operator to monitor flow rate in clear text messages.

.10 The meter shall have field replaceable sensors and coils.

.11 The magnetic flowmeter shall provide an accuracy of +/- 0.5% of flow rate.

.12 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.

.13 Size meter to meet all present flow rates, provided by design engineer.

.14 Approved manufactures:

  .1 Endress & Hauser

  .2 Emerson Rosemount

  .3 Spirax Sarco

.15 Meter to be NSF 61 approved.

.16 Design to include requirement for onsite commissioning of water meter by meter manufacturer or designated technician and submission of commissioning report.

.17 Design to include requirement for submitting shop test calibration certificate during procurement.

6.3.6 Chilled Water Meter

.1 Chilled water meter electrode shall be constructed of stainless steel.

.2 Units provided with a local digital display with tonnes and digital 4-20mA output to tie into the University of Guelph building automation system and shall be compatible with the Schneider ION System.

.3 Provide inline electronic magnetic meter, complete with proper grounding, temperature sensors, metering flow computer with display, and warranty.

.4 To use polyurethane sensor liner.

.5 The temperature sensors must be supplied on both supply and return lines, supplying a 4-20mA output signal. Temperature sensors must be properly orientated and verified for accuracy. Output of temperature and meter must be combined to display units required.

.6 The meter body shall include grounding and empty pipe electrodes of the same material as the measuring electrodes.

.7 Meter must be H.A.R.T. / ION compatible.

.8 The magnetic flowmeter shall be microprocessor based with integral electronics.

.9 LCD display shall enable the operator to monitor flow rate in clear text messages.

.10 The meter shall have field replaceable sensors and coils.

.11 The magnetic flowmeter shall provide an accuracy of +/- 0.5% of flow rate over the range of expected flow rates.

.12 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.

.13 Size meter to meet all present flow rates, provided by design engineer.

.14 Approved manufactures:

.1 Endress & Hauser

.2 Emerson Rosemount

.3 Spirax Sarco

.15 Design to include requirement for onsite commissioning of BTU meter by meter manufacturer or designated technician and submission of commissioning report.

.16 Design to include requirement for submitting shop test calibration certificate during procurement.

.17 BTU/Thermal Energy meters are to include an energy computer directly connected to the paired flow and temperature sensors. All Energy calculations are to be done at the energy computer and not at the BAS.

6.3.7 Deionized (DI) Water Meter

.1 Deionized water meter body shall be constructed of non-conductive material.

.2 Units provided with a local digital display with meters cubed (M3) and digital two (2) wire 4-20mA output to tie into the University of Guelph building automation system and shall be compatible with the Schneider's ION System.

.3 Provide inline electronic meter to meet required turn-down, complete with proper grounding, display, and warranty.

.4 Meter must be H.A.R.T. / ION compatible.

.5 The meter body shall be bi-directional and non-intrusive

.6 LCD display shall enable the operator to monitor flow rate in clear text messages.

.7 The meter shall provide an accuracy of +/- 1% of flow rate.

.8 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.

.9 Size meter to meet all present flow rates, provided by design engineer.

.10 Approved manufactures:

.1 Endress & Hauser

.2 Emerson Rosemount

.3 Spirax Sarco

.11 Design to include requirement for onsite commissioning of water meter by meter manufacturer or designated technician and submission of commissioning report.

.12 Design to include requirement for submitting shop test calibration certificate during procurement.

6.3.8 Compressed Air Meter

.1 The compressed air service will only require metering if the expected service is larger than a 1" line size and/or has more than 50CFM requirements.

.2 Compressed air meter body shall be constructed of stainless steel.

.3 Units provided with a local digital display with standard cubic feet per minute (CFM) with full compensation for temperature and pressure complete with digital 4-20mA output to tie into the University of Guelph building automation system and shall be compatible with the Schneider's ION System.

.4 Provide inline meter, complete with proper grounding, display, and warranty.

.5 Meter must be H.A.R.T. compatible and shall be compatible with the Schneider's ION System.

.6 Do not reduce the line size. This will minimize the permanent pressure loss.

.7 The sensor shall be constructed of 316 L SS.

.8 Where specified, calibration data shall be supplied which verifies the meter accuracy to be ±1.0 percent of actual flow rate for gases and ±0.75% of flow rate for liquids.

.9 LCD display shall enable the operator to monitor flow rate in clear text messages.

.10 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.

.11 Size meter to meet all present flow rates, provided by design engineer.

.12 Approved manufactures:

- .1 Endress & Hauser
- .2 Emerson Rosemount
- .3 Spirax Sarco

.13 Design to include requirement for onsite commissioning of water meter by meter manufacturer or designated technician and submission of commissioning report.

.14 Design to include requirement for submitting shop test calibration certificate during procurement.

6.3.9 Steam Meter

.1 Steam meter body shall be constructed of stainless steel.

.2 Units provided with a local digital gauge with metric kilograms per hour (kg/hr) display with full compensation for temperature and pressure complete with digital 4-20mA output to tie into the University of Guelph building automation system (ION). (Pressure typically not required for steam flow compensation; temperature is sufficient for density compensation.)

.3 Supplier to indicate permanent pressure losses to quantify effect on the installation.

.4 Provide inline meter, complete with proper grounding, display, and warranty.

.5 Meter must be H.A.R.T. / ION compatible

.6 The sensor to count the vortices shall be capable of withstanding temperatures ranging from -40º to 500º F.

.7 The sensor shall be constructed of 316 L SS.

.8 Where specified, calibration data shall be supplied which verifies the meter accuracy to be ±1.0 percent of actual flow rate for gases and ±0.75% of flow rate for liquids.

.9 LCD Digital display shall enable the operator to monitor flow rate in clear text messages.

.10 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.

.11 Size meter to meet all present flow rates, provided by design engineer.

.12 Approved manufactures:

  .1 Endress & Hauser

  .2 Emerson Rosemount

  .3 Spirax Sarco

.13 Design to include requirement for onsite commissioning of water meter by meter manufacturer or designated technician and submission of commissioning report.

.14 Design to include requirement for submitting shop test calibration certificate during procurement.

.15 The steam meter shall have a stream flow computer either integral to the flow sensor or remotely mounted. The steam flow computer will collect relevant steam flow, temperature and pressure readings and provide totalized steam mass flow, based on required data. The steam flow computer will be equipped with suitable signal output to provide totalized steam consumption, volume flow rate, steam temperatures and pressure which are capable of integration into the University of Guelph building automation system (ION).

.16 The following steam data is to be trended and archived:

  .1 m^3/hour of steam consumed

  .2 Totalized Lb or kg of steam consumed

  .3 Temperature in °C

  .4 Pressure of steam in kPa or psi

6.3.10 Condensate Meter

.1 Domestic Water Meter electrode shall be constructed of stainless steel construction.

.2 Units provided with a local digital display with meters cubed (M3) and digital 4-20mA output to tie into the University of Guelph building automation system and shall be compatible with Schneider ION System.

.3 Provide inline electronic magnetic meter, complete with proper grounding, display and warranty. Quantify alternate flow meter to meet accuracy, specification and range of flow rate specified.

.4 Quantify accuracy specification through the range of flow rate specified for approval.

.5 To use polyurethane sensor liner.

.6 The meter body shall include grounding and empty pipe electrodes of the same material as the measuring electrodes.

  .1 Meter must be H.A.R.T. / ION System compatible.

  .2 The magnetic flowmeter shall be microprocessor based with integral electronics.

  .3 LCD display shall enable the operator to monitor flow rate in clear text messages.

  .4 The meter shall have field replaceable sensors and coils.

  .5 The magnetic flowmeter shall provide an accuracy of +/- 0.5% of flow rate.

.7 It should be possible to check the functionality and verify deviation of the flow meter without needing to dismantle the device by using an external device. This Verification of transmitter electronics should be traceable to NIST or equivalent standards.

.8 Size meter to meet all present flow rates, provided by design engineer.

.9 Approved manufacturers:

  .1 Endress & Hauser

  .2 Emerson Rosemount

  .3 Spirax Sarco

.10 Design to include requirement for onsite commissioning of water meter by meter manufacturer or designated technician and submission of commissioning report.

.11 Design to include requirement for submitting shop test calibration certificate during procurement.

6.4 Valves

6.4.1 General

.1 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.

.2 Isolation valves shall be provided on all Branch Piping and at individual fixtures and equipment connections.

.3 Wafer checks a minimum installation point of 8 to 10 pipe diameters downstream of pumps is recommended.

.4 Silent checks are not recommended for use with reciprocating pumps.

.5 Manufacturer

  .1 Provide valves of same manufacturer throughout, where possible.

  .2 Provide valves with manufacturer’s name and pressure rating clearly marked on body (per MSS-SP-25).

.3 Product shall carry valid CRN (Canadian Registration Number) issued by respective Provinces.

.4 University of Guelph will only accept original manufactured products.

.5 For equipment that is supplied as a package with valves built in, preference is that these valves meet the following valve standards.

6.4.2 General Design Specifications

.1 Valve Materials

.1 Bronze: to ASTM B62 (406F / 208C) or B61 (550F / 288C) as applicable

.2 Brass: to ASTM B283 C3770

.3 Cast Iron: to ASTM A126, Class B (353F / 178C) at 125 PSIG.

.4 Forge Steel: to ASTM A105N (800F / 427C)

.5 Cast Steel: to ASTM A216WCB (800F / 427C)

.2 Valve Markings

.1 All pressure ratings, manufacturers trademark and size to conform as per MSS SP-25.

.3 End Connections

.1 Threaded ends to: ASME B1.20.1

.2 Solder ends to: ASME B16.18

.3 Flanged ends to: ASME B16.1 (Class 125)

.4 Face to Face dimensions to: ASME B16.10

.5 Fanged ends to: ASME B16.5

.6 Butt Weld Ends to: ASME 16.25

.7 Socket Weld Ends to: ASME B.16.11

.4 Testing and Design

.1 MSS-SP-80 - Bronze, Gate & Check Valves.

.2 MSS-SP-110 - Ball Valves.

.3 MSS –SP-70, 85, 71 - Cast Iron Gate, Globe & Check Valve.

.4 MSS-SP-72 - American Valve

.5 MSS-SP-67 – Kitz, MAS, Butterfly Valves.

.6 API 602 – Forge Steel Valves (Design)

.7 API 598 – Cast Steel Valves, Forge Steel Valves (Testing)

.8 API 600 – Cast Steel Valves (Design)

6.4.3 Hot and Cold Domestic Potable Water Service up to 200PSIG - (Certified NSF 372 – Lead Free – Valves)

.1 Ball valves (Isolation) – Up to 50MM (2”)

.1 Class 150, 600 psi (4140 kPa) CWP, ASTM C46750 forged Lead Free brass/bronze, two piece body, stainless steel ball and stem, full port, virgin PTFE seats, Double O Ring design, blow-out proof stem, locking lever handle with memory balancing stops, stem extensions for insulated piping.

.1 Kitz 869AMLL (Soldered) (Stem Ext Kitz 69SE), Nibco S-585-70-66-LF-LL (EL)

.2 Kitz 868AMLL (Threaded) (Stem Ext Kitz 68SE), Nibco T-585-70-66-LF-LL (EL)

.2 Hose Bibbs/Drain Hose Connections c/w Cap and Chain

.1 Class 150, 600 psi (4140 kPa) CWP, ASTM C46750 forged Lead Free brass/bronze, two piece body, stainless steel ball and stem, full port, virgin PTFE seats, Double O Ring design, blow-out proof stem, locking lever handle. Lead free brass Cap & Chain fitting to be purchased and installed in the valve.

.1 Kitz 869AMLL (Soldered), Nibco S-585-70-66-LF-LL

.2 Kitz 868AMLL (Threaded), Nibco T-585-70-66-LF-LL

.3 Check Valves (Backflow Prevention) – Up to 50MM (2")

.1 860 KPA (125 psig), 200 WOG Rating, bronze body to ASTM C89530 (Lead Free Bronze), Y Pattern, swing, PTFE Seat.

.1 Kitz 823T (Soldered), Nibco S-413-Y-LF (PTFE Disc)

.2 Kitz 822T (Threaded), Nibco T-413-Y-LF (PTFE Disc)

.4 Strainers – Up to 50MM (2")

.1 860kpa (125PSIG) / 200wog Rating, Lead free Bronze Body, Screwed Cap, Y-Pattern, 316 S.S. 20 mesh Screen

.1 Mueller Steam Specialty LF 358S (Soldered)

.2 Mueller Steam Specialty LF351 (Threaded)

OR

.2 Class 600, 1480 PSI, Stainless Steel ASTM A351 CF8M Body, Screwed Cover, 316 S.S Screen with 1/16 Perforation.

.1 Mueller Steam Specialty 581-SS (Threaded)

.5 Recirculation Low Lead Balancing Valves – Up to 20MM (3/4")

.1 ASTM A351 CF8M Body Stainless steel construction. Valves to be order for required flow rate. All to be installed including ball isolation valve on upstream and downstream of flow valve

.1 Victaulic TS Series 76

.6 Ball Valves (Isolation) – 65MM (2 ½") & Over

.1 2 1/2" TO 10" Class 125, 200 WOG, LEAD FREE Flanged Full Port Ball Valves, Cast Iron ASTM A126, epoxy coated, 316 S.S.Stem, PTFE Fused Ball, RPTFE seats, EPDM O-Ring packing, Tapped & plugged boss, Class B Body, for venting or draining downstream side, lever operated or gear operated.

.1 American Valve 4000

Ball Valves (Isolation) – 65MM (2 ½”) & Over

.1 Class 150 Stainless Steel A351 CF8M Body, SS Ball & Stem, PTFE packing, Hypatite (PFA/PTFE) seats, locking lever operated (Use gear operated for 6”, 8” & 10”)

.1 Kitz 150UTDZM-N (Full Port), Nibco F-515-S6-F-66-FS

.2 Kitz 150UTAZM-N (Reduced Port), Nibco F-510-S6-F-66-FS

.7 Butterfly Valves (Isolation and Balancing) – 65MM (2 ½”) and Over

.1 1380 KPA / 200WOG Rating. Butterfly valves shall be lugged type, Ductile iron body, with 2” extended neck to allow for insulation, Aluminum/Bronze disc with EPDM molded or bonded seat, stainless steel stem with top and bottom bushings of dissimilar material. Valve shall have bubble tight shut-off to 200PSI when downstream flange is removed (Full dead-end service). Valves 150MM (6”) and smaller shall have locking lever operator, valves 200MM (8”) and larger shall have locking Manual Gear operator. NSF 372 Certified.

.1 Kitz 6122 EL and Kitz 6122 EG, Nibco LD-2000-3 (Lever) and Nibco LD-2000-5 (Gear)

.8 Check Valves (Backflow Prevention) - 65mm (2 ½ “) & Over

.1 Class 150, Stainless Steel A351 CF8M Body, Bolted Cover, Trim #12, Graphite Gasket, Flanged.

.1 Kitz 150 UOAMB-GRF-12, Powell 1561-FM2G-GXX (Flanged)

.9 Wafer Checks – 65MM (2 ½”) & Over

.1 Class 150, 316 Stainless Steel Body A351 CF8M, 316 SS A351 CF8M Disk, Viton Seat.

.1 Single Flapper: Moygro W15A-66V, Uni-Chek 15A233000

.2 At a minimum, installation point of 8 to 10 pipe diameters downstream of pumps is recommended.

.10 Double Door Check Valve – 65MM (2 ½”) & Over

.1 Class 150, 316 Stainless Steel Body A351 CF8M, 316 SS A351 CF8M Disk, Buna Seat.

.1 Mueller Steam Specialty 72HHH3H, Duo-Chek G15CVM-14

.11 Silent Check – 65MM (2 ½) & Over

.1 Class 150, 316 Stainless Steel Body A351 CF8M, 316 SS A351 CF8M disk & Seat, Spring Loaded Center Guided Disc.

.1 Mueller Steam Specialty 101MHT

.2 Mueller Steam Specialty 105MHT (Globe Style)

.12 Strainers – 65MM (2 ½) & Over

.1 Class 150, Stainless Steel Body, Bolted Cover, Y-Pattern, 316 S.S. Screen with 1/32 Perforation, Flanged.

.1 Mueller Steam Specialty 781-SS

6.4.4 Heating and Cooling Valves up to 150PSIG (Closed Loop Treated Water)

.1 Gate Valves (Isolation) – Up to 50mm (2")

.1 860KPA (125psig) / 200 WOG Rating, Bronze Body to ASTM – B62 Solid Wedge Disc, Bronze Trim, Rising Stem.

.1 Kitz 44, Nibco S-111 (Soldered)

.2 Kitz 24, Nibco T-111 (Threaded)

.2 Globe Valves (Throttling) – Up to 50MM (2") – Lock Shields Available

.1 860KPA (125psig) / 200WOG Rating, Bronze Body to ASTM B62, Rising Stem, Composition Disc (Teflon)

.1 Kitz 10, Nibco S-235-Y (Soldered)

.2 Kitz 03, Nibco T-235-Y (Threaded)

.3 Check Valves (Backflow Prevention) – Up to 50MM (2")

.1 860KPA (125psig) / 200 WOG Rating, Bronze Body to ASTM B62, Bronze Trim, and Y Pattern.

.1 Y – Pattern Swing

.1 Kitz 23, Nibco S-413-B (Soldered)

.2 Kitz 22, Nibco T-413-B (Threaded)

.2 Spring Loaded Checks

.1 Kitz 26, Nibco S-480 (Soldered)

.2 Kitz 36, Nibco T-480(Threaded)

.4 Ball Valves (Isolation) – Up to 50MM (2")

.1 Class 150, 600 psi (4140 kPa) CWP, Brass Body ASTM 283 C37700, two piece body, stainless steel ball and stem, full port, virgin PTFE seats, Double O Ring design, blow-out proof stem, locking lever handle with memory balancing stops, stem extensions for insulated piping.

.1 Kitz 69AMLL (Stem Ext Kitz 69SE), Nibco S-585-70-66 (Bronze body)(EL) (Soldered)

.2 Kitz 68AMLL (Stem Ext Kitz 68SE), Nibco T-585-70-66 (Bronze body)(EL) (Threaded)

.5 Hose Bibbs/Drain Hose Connections c/w Cap and Chain

.1 Class 150, 600 psi (4140 kPa) CWP, Brass Body ASTM 283 C37700, two piece body, stainless steel ball and stem, full port, virgin PTFE seats, Double O Ring design, blow-out proof stem, locking lever handle. Brass Cap & Chain fitting to be purchased and installed in the valve.

.1 Kitz 69AMLL, Nibco S-585-70-66 (Bronze body) (Soldered)

.2 Kitz 68AMLL, Nibco T-585-70-66 (Bronze body) (Threaded)

.6 Strainers – Up to 50MM (2")

.1 860KPA (125psig) / 200 WOG Rating, Bronze Body to ASTM B62, Screwed Cap, Y-Pattern, 316 S.S Screen with 20 mesh Perforation.
  .1 Mueller Steam Specialty 352 ½, Kitz 16 (Soldered)
  .2 Mueller Steam Specialty 351M, Kitz 15 (Threaded)
  OR
  .3 Class 250 / 400 WOG Rating, Cast Iron Body, Screwed Cap, Y Pattern, 316 S.S Screen with 20 mesh Perforation.
  .4 Mueller Steam Specialty 11M (Threaded)

.7 Gate Valves (Isolation) – 65MM (2 ½") & Over
  .1 860KPA (125psig) /200WOG Rating, Cast Iron Body to ASTM A126 Class B, Bronze Trim, OS &Y, Flanged.
    .1 Rising Stem Kitz 72, Nibco F-617-0

.8 Globes (Throttling) – 65MM (2 ½") & Over
  .1 860KPA (125psig) / 200WOG Rating, Cast Iron Body to ASTM A126 Class B, Bronze Trim, OS & Y, Flanged.
    .1 Kitz 76, Nibco F-718-B

.9 Checks (Backflow Prevention) – 65MM (2 ½") & Over
  .1 860KPA (125psig) /200WOG Rating, Cast Iron Body to ASTM A126 Class B, Bronze Trim, Bolted Bonnet, Flanged.
    .1 Kitz 78, Nibco F-918-B

.10 Wafer Checks – 65MM (2 ½") & Over
  .1 Class 150, 316 Stainless Steel Body A351 CF8M, 316 SS A351 CF8M Disk, Viton Seat.
    .1 Single Flapper: Moygro W15A-66V, Uni-Chek 15A233000

.11 Double Door Check Valve – 65MM (2 ½") & Over
  .1 Class 150, 316 Stainless Steel Body A351 CF8M, 316 SS A351 CF8M Disk, Buna Seat.
    .1 Mueller Steam Specialty 72HHH3H, Duo-Chek G15CVM-14

.12 Silent Check – 65MM (2 ½) & Over
  .1 Class 150, 316 Stainless Steel Body A351 CF8M, 316 SS A351 CF8M disk & Seat, Spring Loaded Center Guided Disc.
    .1 Mueller Steam Specialty 101MHT (Wafer),
    .2 Mueller Steam Specialty 105MHT (Globe Style)

.13 Butterfly Valves (Isolation) – 65MM (2 ½") & Over
  .1 1380 KPA / 200WOG Rating. Butterfly valves shall be lugged type, Ductile iron body, with 2" extended neck to allow for insulation, Aluminum/Bronze disc with EPDM molded or bonded seat, stainless steel stem with top and bottom bushings of dissimilar material. Valve shall have bubble tight shut-off to 200PSI when downstream flange is removed (Full dead-end

service). Valves 150MM (6”) and smaller shall have locking lever operator, valves 200MM (8”) and larger shall have locking Manual Gear operator.

.1 Kitz 6122 EL and Kitz 6122 EG, Nibco LD-2000-3 (Lever) and LD-2000-5 (Gear)

.14 Ball Valves in Lieu of Gate Valves, & Retrofits

.1 Requires prior approval by the Manager, Mechanical Design, DEC at the Schematic Design Stage when selecting Ball Valves in lieu of Gate Valves. 2 ½” to 10” Flanged, Ball valves 2 ½” to 10”, Can be used in lieu of gate valves, with Cast Iron ASTM A126 CLASS B Body, epoxy coated to NSF 61. Rated for Class 125, 200 WOG, 316 S.S. stem, Teflon Fused Ball, RPTFE seats, seals, and packing. Full port up to 6”, locking lever operated, or gear operated.

.1 American Valve #4000

.15 Strainers – 65MM (2 ½) & Over

.1 860KPA (125 psig) / 200 WOG Rating, Cast Iron Body to ASTM A126 Class B, Bolted Cover, Y-Pattern, 316 S.S. Screen with 1/32 Perforation, Flanged.

.1 Mueller Steam Specialty 758, Kitz 80

6.4.5 Steam and Condensate Service up to 50PSI / 307F / 153C

.1 Gate Valve, (Isolation) – Up to 50mm (2”)

.1 Class 800, Forge Steel A105N Body, OS & Y, Bolted Bonnet, ½ Stellite (Trim #8), Graphite Packing.

.1 Bonney Forge HL–11–T (Threaded), Bonney Forge HL–11-SW (Socket Weld)

.2 Beric 501-T-(X)-8-A-08 (Threaded), Beric 501-T-(X)-8-A-08 (Socket Weld)

.3 Powell GA08TA58GB (Threaded), Powell GA08SA58GB (Socket Weld)

.2 Globe Valves, (Throttling) – Up to 50mm (2”)

.1 Class 800, Forge Steel A105N Body, OS &Y, Bolted Bonnet, ½ Stellite (Trim #8), Graphite Packing.

.1 Bonney Forge HL–31–T (Threaded), Bonney Forge HL–31-SW (Socket Weld)

.2 Beric 502-T-(X)-8-A-08 (Threaded), Beric 502-S-(X)-8-A-08 (Socket Weld)

.3 Powell GL08TA58GB (Threaded), Powell GL08SA58GB (Socket Weld)

.3 Check Valves, (Backflow Protection) – Up To 50mm (2”)

.1 Class 800, Forge Steel A105N Body, Bolted Bonnet, ½ Stellite (Trim#8), and Graphite Gasket, Spring Loaded Piston Check for Vertical or horizontal use.

.1 Bonney Forge HL–41–T (Threaded), Bonney Forge HL–41–SW (Socket Weld)

.2 Beric 503-T-(X)-8-A-08 (Threaded), Beric 503-S-(X)-8-A-08 (Socket Weld)

.3 Powell PC08TA58GB (Threaded), Powell PC08SA58GB (Socket Weld)

.4 Strainers – Up to 50MM (2”)

.1 860KPA (125psig) / 200WOG Rating, Bronze body, 316 S.S Screen with 20 mesh Perforation.

.1 Mueller Steam Specialty 11M (Cast Iron Class 250/ # 400WOG) (Threaded)

.5 Gate Valves (Isolation) – 65mm (2 ½”) & Over

.1 Class 125 / 200WOG Rating, Cast Iron Body to ASTM A126 Class B, Bronze Trim, OS&Y, Flanged. Rising Stem ONLY.

.1 Kitz 72, Nibco F-617-0

.6 Globes (Throttling) – 65mm (2 ½”) & Over

.1 Class 125 / 200WOG Rating, Cast Iron Body to ASTM A126 Class B, Bronze Trim, Rising Stem, OS&Y, Flanged.

.1 Kitz 76, Nibco F-718-B

.7 Checks (Backflow Prevention) – 65mm (2 ½”) & Over

.1 860KPA (125psig) /200WOG Rating, Cast Iron Body to ASTM A126 Class B, Bronze Trim, Bolted Cover, Flanged.

.1 Kitz 78, Nibco F-918-B

.8 Strainers – 65mm (2 ½”) & Over

.1 860KPA (125 psig) / 200 WOG Rating, Cast Iron Body to ASTM A126 Class B, Bolted Cover, Y-Pattern, 316 S.S. Screen with 1/32 Perforation, Flanged.

.1 Mueller Steam Specialty 758, Kitz 80

6.4.6 Steam and Condensate Service up to 150PSI / 366F / 186C

.1 Gate Valve, (Isolation) – Up to 50mm (2”)

.1 Class 800, Forge Steel A105N Body, OS & Y, Bolted Bonnet, ½ Stellite (Trim #8), Graphite Packing.

.1 Bonney Forge HL–11–T (Threaded), Bonney Forge HL–11-SW (Socket Weld)

.2 Beric 501-T-(X)-8-A-08 (Threaded), Beric 501-T-(X)-8-A-08 (Socket Weld)

.3 Powell GA08TA58GB (Threaded), Powell GA08SA58GB (Socket Weld)

.2 Globe Valves, (Throttling) – Up to 50mm (2”)

.1 Class 800, Forge Steel A105N Body, OS &Y, Bolted Bonnet, ½ Stellite (Trim #8), Graphite Packing.

.1 Bonney Forge HL–31–T (Threaded), Bonney Forge HL–31-SW (Socket Weld)

.2 Beric 502-T-(X)-8-A-08 (Threaded), Beric 502-S-(X)-8-A-08 (Socket Weld)

.3 Powell GL08TA58GB (Threaded), Powell GL08SA58GB (Socket Weld)

.3 Check Valves, (Backflow Protection) – Up To 50mm (2”)

.1 Class 800, Forge Steel A105N Body, Bolted Bonnet, ½ Stellite (Trim#8), and Graphite Gasket, Spring Loaded Piston Check for Vertical or horizontal use.

.1 Bonney Forge HL–41–T (Threaded), Bonney Forge HL–41–SW (Socket Weld)

.2 Beric 503-T-(X)-8-A-08 (Threaded), Beric 503-S-(X)-8-A-08 (Socket Weld)

.3 Powell PC08TA58GB (Threaded), Powell PC08SA58GB (Socket Weld)

.4 Strainers – Up To 50mm (2”)

.1 Class 600, 1480 PSI, Cast Steel ASTM A216WCB Body, Screwed Cover, 316 S.S Screen with 20 mesh Perforation.

.1 Mueller Steam Specialty 581 (Thread Ends), Mueller Steam Specialty 582 (Socket Weld)

.5 Gate Valves (Isolation) – 65mm (2 ½”) &Over

.1 Class 150, Carbon Steel A216 WCB Body, Bolted Bonnet, OS&Y, ½ Stellite (Trim#8), Graphite Packing.

.1 Kitz 150SCLS (Flanged)

.2 Beric 101-RF-AA08-H (Flanged)

.3 Powell 1503-FC8G-GXX (Flanged)

.6 Globe Valves (Throttling) – 65mm (2 ½”) &Over

.1 Class 150, Carbon Steel A216 WCB Body, Bolted Bonnet, OS&Y, ½ Stellite (Trim #8), Graphite Packing.

.1 Kitz 150 SCJS (Flanged)

.2 Beric 201-RF-EAO8-H (Flanged)

.3 Powell 1531-FC8G-GXX (Flanged)

.7 Check Valves (Backflow Prevention) – 65mm (2 ½ “) & Over

.1 Class 150, Carbon Steel A216 WCB Body, Bolted Cover, ½ Stellite (Trim#8), Graphite Gasket.

.1 Kitz 150 SCOS (Flanged)

.2 Beric 301-RF-EAO8-X (Flanged)

.3 Powell 1561-FC8G-GXX (Flanged)

.8 Wafer Checks – 65mm (2 ½ “) & Over

.1 Class 150, Carbon Steel body ASTM A216WCB, 316 S.S (ASTM A351 CF8M), Disc & Trim.

.1 Moygro W15A – C66 (Single Flapper)

.9 Double Door Check Valves – 65mm (2 ½ “) & Over

.1 Class 150, Carbon Steel body ASTM A216 WCB, 316 S.S Disk, Inconel 600 Spring, 316L Overlay seat.

.1 Mueller Steam Specialty 72-DHHVX, Powell 1570YMOXXXX

.10 Strainers – 65mm (2 ½”) & Over

.1 Class 150, Carbon Steel ASTM A216WCB Body, Bolted Cover, and Y-Pattern, 316 S.S. Screen with 1/32 Perforation, Flanged.

.1 Mueller Steam Specialty 781 CS

6.4.7 Compressed Air

.1 Ball valves (Isolation) – Up to 50MM (2")

.1 Class 150, 600 psi (4140 kPa) CWP, Brass Body ASTM 283 C37700, two piece body, stainless steel ball and stem, full port, virgin PTFE seats, Double O Ring design, blow-out proof stem, locking lever handle with memory balancing stops, stem extensions for insulated piping.

.1 Kitz 68AMLL, Nibco T-585-70-66(Bronze body) (Threaded)

.2 Ball valves (Isolation) – 65MM (2 ½") & Over

.1 Flanged Ball Valves 2 ½" to 10", with Cast Iron Body, Epoxy Coated to NSF 61. Class 125 / 200 WOG, Teflon Fused Ball, RPTFE Seats, Seals and Packing. Full Port up to 6", Lever Handle, Flanged.

.1 American Valve #4000

OR

.2 Class 150, Carbon Steel A216WCB Body, S.S. Ball and Stem, RPTFE Packing and Gaskets, Lever Handle, Flanged.

.1 Kitz 150SCTDZM-N, Nibco F515-CS-R-66-FS (Full Port)

.2 Kitz 150SCTDM-N (Reduced Port), Nibco F-510-CS-R-66-FS (Reduced Port)

.3 Check Valves – Up to 50MM (2")

.1 1034KPA (150PSIG) / 300WOG, Bronze Body to ASTM B62, Spring Loaded

.1 Kitz 36, Nibco T-480 (Threaded)

OR

.2 860KPA (125PSIG) / 200WOG, Bronze Body to ASTM B62, PTFE seat, Y Pattern Swing type.

.1 Kitz 22T (Threaded), Nibco T413Y

6.4.8 CGA Ball Valves – Lab Gases

.1 Up to 50mm (2")

.1 Class 150, 600 psi (4140 kPa) CWP, Brass Body ASTM 283 C37700, two piece body, stainless steel ball and stem, full port, virgin PTFE seats, Double O Ring design, blow-out proof stem, locking lever handle with memory balancing stops, stem extensions for insulated piping.

.1 Kitz 68AMLL (Threaded)

.2 65mm (2 ½") & Over

.1 Class 150, Carbon Steel A216WCB Body, S.S. Ball and Stem, RPTFE Packing and Gaskets, Locking Lever and or Gear. Flanged.

.1 Kitz 150SCTDZM-N (Full Port), Kitz 150SCTAZM-N (Reduced Port)

6.5 Domestic Water Heat Systems – Requirements

6.5.1 General

.1 Provide two (2) semi-Instantaneous Type Steam to Hot Water Heaters, each sized to satisfy 75% of the Peak Demand.

.2 Instantaneous type water heaters are not permitted.

.3 A complete Water Heater Skid package, rated to heat of water from 40°F to 140°F, and control the domestic fixture outlet temperature to within +/- 4°F of the selected temperature when supplied with low pressure 15PSIG saturated steam before the control valve.

.4 Due to overhead clearance restrictions, each heater shall be capable of being disassembled in place, for maintenance and inspection purposes, without having to remove the shell from the domestic water piping. The heater's support shall provide ample clearance for tube bundle removal. A full diameter threaded tube sheet shall be provided to allow for inspection and maintenance while the shell remains under pressure.

.5 Each package shall consist of the following components, completely factory assembled ready for connection to services:

- .1 Water heater with vertical support
- .2 Visible metal plate stamped with CRN (Canadian Registration Number), model number and serial number.
- .3 Bronze ASME rated pressure and temperature relief valve set at 150 psig and 210°F.
- .4 Bronze circulator pump pre-wired with pilot lighted ON/OFF switch operating at 60/1/115V. The purpose of this pump is to prevent scale build-up in the unit shell. Recirc. System to be S.S. or bronze elbow.
- .5 Double solenoid temperature limit system.
- .6 Insulation in accordance with the current ASHRAE standards. Flexible foam insulation laminated to a durable, reinforced PVC jacket.
- .7 Mechanical actuated steam control valve. 150# cast steel body with stainless steel trim. Mounted with an air-to-pen pneumatic actuator and Siemens PS2 Sipart SMART electro-pneumatic valve positioner to accept 4-20 mA signal. Size determined by manufacturer based on the heating requirements.
- .8 Main control panel to be removed from skid as all sensors to be controlled from BAS.
- .9 RTD temperature sensor.
- .10 Domestic water thermometer direct mounted with separable S.S. thermowell
- .11 Steam pressure gauge with shut-off cock.
- .12 Float & thermostatic steam trap assembly c/w cast iron Y strainer and steam rated isolation ball valve. Size determined by manufacturer based on the heating requirements.
- .13 Bronze vacuum breaker.

6.5.2 Materials of Construction

.1 Shell – 90/10 Copper Nickel or stainless steel, ASME certified for 155 psig working pressure

.2 Tubes – 90/10 Copper-Nickel, double Wall

.3 Tubesheet – Solid Copper Allow

.4 Baffles – Teflon

.5 Shell Connections – Solid Copper Alloy

.6 Solenoid valves to be S.S. construction

.7 Integrated Recirc. System to be S.S.

6.5.3 Warranty

.1 The heater manufacturer shall warranty all components and workmanship for one year from date of start-up. The following components are to carry an extended, unconditional, non-prorated warranty, which shall be included as part of the submittal:

- .1 Tube Bundle – The entire tube bundle assembly, from the steam inlet to the condensate outlet, shall be guaranteed for 10 years against failure from thermal shock, mechanical failure or erosion.
- .2 Pressure Vessel – 20 year warranty against leakage.
- .3 Anticipator Temperature Control – 20 year warranty against any failure.

6.6 Grease Interceptors

6.6.1 General

.1 To be stainless steel or fiber reinforced plastic construction.

.2 To include vent and isolation valves on inlet and outlet.

.3 Must be accessible for cleaning at floor level.

6.7 Eyewash

6.7.1 General

.1 To be plastic or stainless bowl and single dispenser.

.2 Use combo unit shower / eye wash stations when a space requires both.

.3 Shower – Push lever or pull rod. Include lamacoid on wall reading “SAFETY STATION”)

6.8 Flash Tanks

6.8.1 General

.1 Subject to the approval by the Manager, Mechanical Design, DEC, higher pressure flash tanks to be connected to low pressure steam line to capture flashed steam whenever feasible.

6.9 Condensate Receiver

6.9.1 General

.1 Install in accessible location.

.2 Tank to be constructed with factory coated metal for corrosion resistance

.3 Must include BAS high level sensor connection.

.4 To include duel parallel pumps.

6.10 Drinking Fountains

6.10.1 General

.1 Shall be barrier free, and

.2 Of the "Refrigerated Type", and

.3 Equipped with Bottle-Filler c/w totalizers.

.4 Non-filtered combo bottle filling drinking fountain style.

.5 Ensure unit is accessible for ease of maintenance. Use of access panels acceptable.

.6 Elkay Model University Standard. Confirm on a project-by-project basis that the standard remains up to date.

6.11 Safety Relief Valves

6.11.1 General

.1 Install where easily accessible without removal of other equipment or components.

6.12 Preferred Vendors

Equipment/System	Proposed Vendor
Sinks & Lavatories	Novanni
	American Standard
	Kindred
	Kohler
	Franke
Water Closets, Urinals & Faucets	Delta Commercial
	Sloan
	Moen
Eyewash & Emergency Showers	HAWS
Backflow Preventers	Conbraco
	Zurn
Vacuum Breakers - Hose Connection	A.W. Cash Valve
	Watts
	Zurn
Vacuum Breakers - Lab Faucets	Conbraco

	Zurn
	Watts
Temperature Mixing Valves	Armstrong
	Bradley Navigator
Domestic Water System Valves	Nibco
	Kitz
Floor Drains	Zurn
	Jay R Smith
	Watts
	OS&B
	Mifab
Trap Seal Primers	Zurn
	Mifab
Incoming Water Meter	Endress + Hauser
	Emerson Rosemount
	Spirax Sarco
Pipe Hangers	Myatt
	Taylor
	Johns Manville

7 LABELLING

7.1 General

.1 Identification and labeling shall follow the University Standard.

.2 Equipment numbers are to be provided by the University's PM Scheduler.

.3 Equipment numbering strategy shall be presented for review / approval by the Manager, Mechanical Design, DEC and Manager, Maintenance & Energy Services prior to completion of Design Development.

.4 After completion of insulation and / or painting, all piping shall be identified to show the service and direction of flow as described below.

.5 Additional requirements may apply to pipe identification within the Central Utility Plant (building 55), Generator Building (building 56), and service tunnels.

.6 Lamacoid nameplates identifying non-potable water sources are required at each source unless the entire room is served by non-potable water in which case labels on both sides of the doors to the room is acceptable.

7.2 Applicable Codes and Standards

.1 CSA Standard B53 – Identification of Piping Systems

.2 CSA B149.1, Natural Gas and Propane Installation Code.

.3 Liquid Fuels Handling Code by Technical Standards and Safety Authority (TSSA)

.4 ANSI/ASME A13.1-2007 – Scheme Standards for the Identification of Piping Systems

.5 NFPA 99/CGA C-9 Standards for Medical Gas and Vacuum Systems.

.6 CAN/CSA Z305.1.92 – Standards for non-flammable medical gas piping systems and CGSB standard 1-GP-12 for colour coding

.7 Fire protection: Sprinklers in accordance with NFPA 13. Standpipes in accordance with NFPA 14

.8 CAN/CGSB-24.3-12 - Standard for Pipe Identification.

.9 R.R.O. 1990, Reg. 860 - Workplace Hazardous Materials Information System (WHMIS), under the Occupational Health and Safety Act.

.10 CSA C22.2 No. 130. Standards for heating cables and piping.

7.3 Label Placement

.1 The entire piping system is to be identified, including piping located in ceiling spaces, interstitial spaces, or within pipe chases.

.2 Pipe identification is required:

- .1 At every point of entry or exit to a space, on both sides of where the pipe penetrates a wall, floor, service column or enclosure, change in direction;
- .2 At every access door
- .3 Within 3 ft. (1 m) of pipe termination points
- .4 Within 3 ft. (1 m) of valve assemblies or individual valves
- .5 Within 3 ft. (1 m) of branching off (or connecting to) a distribution header
- .6 At least every 20 ft. (6 m) along pipe lengths.

.3 Pipe identification shall be visible from point of normal approach.

.4 Pipe identification shall be applied to clean, dry surfaces only and installed according to manufacturer's instructions.

7.4 Label Configuration

.1 Pipe identification shall consist of a label identifying the piping system contents, along with directional arrows indicating the flow direction and University of Guelph's standard system designations.

.2 Flow direction arrows shall be located at a minimum of one end of the pipe identification label.

.3 Pipe or duct label shall be properly orientated so wording of the pipe clear and free of interferences.

.4 Electrically traced piping shall have additional identification label indicating “Electric Traced” on the outside of the thermal insulation.

.5 Nylon cable ties shall be used to secure pipe identification labels at both ends

.6 Piping installed indoors shall be identified using labels/markers meeting either Option B, C, E or F requirements defined in Section 6 below. Option A to be used with the approval of the mechanical manager prior to the design or installation of any work.

.7 Piping installed outdoors (above grade) shall be identified using labels meeting Option B, C, D, E or F requirements defined in Section 6 below.

.8 Piping installed underground shall be identified with marking tape as outlined in Option C for locating buried services in addition to eliminating potential hazards of excavating in unmarked areas. For best detectability and protection during excavation, tape should be fully buried and installed as close to the surface as possible, no less than 3 feet above the service.

7.5 Label Size

.1 Pipe identification and flow direction markers shall be appropriately sized to match the outer diameter of the finished pipe installation.

.2 Label length and minimum text height shall be determined based on outside diameter of the finished pipe installation as follows:

Outside Pipe Diameter Including Covering	Minimum Length* of Label Field Colour	Minimum Text Height
3/4” – 1-1/4”	8”	1/2”
1-1/2” – 2”	8”	3/4”
2-1/2” – 6”	12”	1-1/4”
8” – 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

7.6 Materials

.1 Option A – adhesive type to be used with the approval of the mechanical manager prior to the design or installation of any work. Not preferred.

.2 Non-customized pressure sensitive adhesive label and banding tape:

- .1 minimum 6 mm thick vinyl or polyester with pressure sensitive acrylic adhesive backing; silk-screened with vinyl ink.
- .2 label printed with applicable abbreviation from Section 7 below.
- .3 label and text color as defined in Section 7 below.

.4 banding tape with directional flow arrows placed at a minimum one end of the pipe. Label and wrapped 360° around outside diameter. or include arrows directly on the label

.5 banding tape colors to match label color scheme.

.6 standard of acceptance:

.1 Brady

.2 Seton

.3 SMS Smillie McAdams Summerlin

.3 Option B – semi-rigid plastic vinyl. Preferred type of labelling by University.

.1 semi-rigid plastic vinyl label with ultraviolet ink surface printing, printed with applicable abbreviation from Section 7 below;

.2 label printed with applicable abbreviation from Section 7 below;

.3 label and text color as defined in Section 7 below;

.4 piping up to 6” OD: coiled vinyl wrapped to snap around pipe and provide 360° visibility;

.5 piping larger than 6” OD: flat vinyl tied down with 36” long nylon cable ties

.6 standard of acceptance:

.1 Brady

.2 Dura Label

.3 Seton

.4 SMS Smillie McAdams Summerlin

.4 Option C – Ductwork Stencil

.1 To be used on ductwork supply and return trunk mains.

.2 No less than one stencil per room or at least every 20’

.3 To be added to each main upon entering room.

.4 No less than 6” or greater than 1’ sized black lettering

.5 Option D – Underground Marking Tape

.1 Non-detectable 4mm thick low density polyethylene.

.2 Detectable has 35 gauge aluminum core encased by a protective plastic jacket.

.3 Organic pigmented lead free black ink.

.4 Install one (1) meter above underground pipe or service

.6 Option E – Medical Gas & Specialty Pipe Markers

.1 6mm thick (+/- 0.05mm soft vinyl

.2 Pressure sensitive acrylic adhesive

.3 Silk screened ¾” high lettering

.7 Option F –Valve Tags

.1 Exterior Valve Tag

.1 Material

.1 0.025” thick yellow brass

.2 Round: 1 1/2” diameter

.3 Hole for chain installation

.2 Lettering

.1 3/8” high

.2 Black filled

.3 Can include identifier on top line

.8 Interior Valve Tag

.1 Material

.1 1 ½” square, 1/16” thick lamacoid plastic hole for chain installation

.2 Lettering

.1 3/8” engraved lettering

.2 Two (2) contrasting letters, yellow with black lettering

.3 3/8” engraved lettering

.9 Ceiling Dot Labeling

.1 Applies to all ceiling panels. Place on ceiling support grid closest to equipment.

.1 Red Dot - Fire Damper

.2 Blue Dot - Heating & Cooling (coil, valves, etc)

.3 Yellow Dot - VAV

.4 Green Dot - Potable & Non-Potable Water

7.7 Label Legend

.1 Avoid the use of custom made labelling. Meet the requirements of the legend below or receive approval of the Mechanical Manager for any deviations.

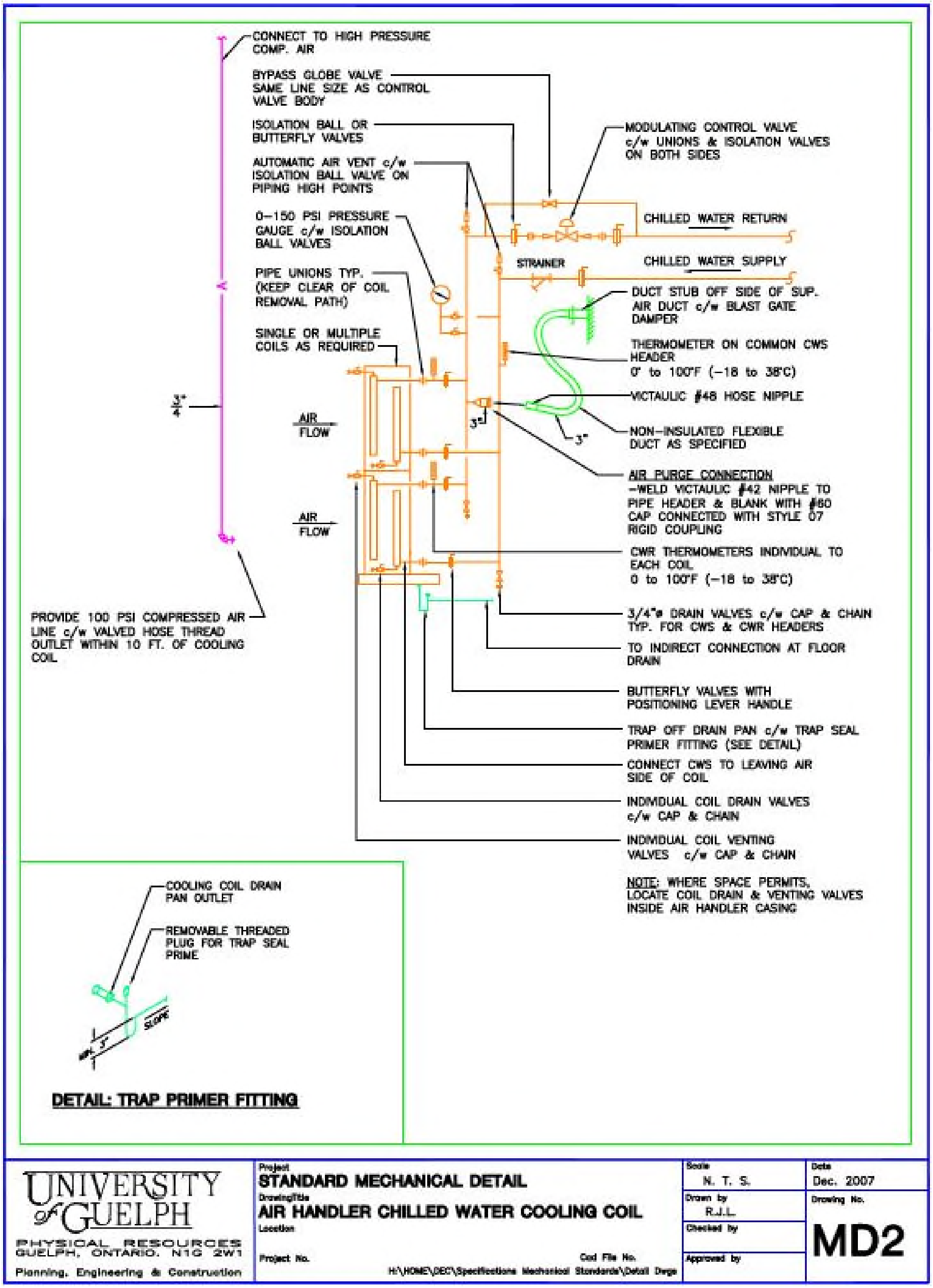
Label Abbreviation	System, Pipe Contents	Label Colors (Text - Background)
	PIPING	
ACETYLENE	ACETYLENE	Black - Yellow
ACID	ACID	Black - Yellow
BIOHAZARD VENT	BIOHAZARD VENT	Black - Yellow
BIOHAZARD WASTE	BIOHAZARD WASTE	Black - Yellow
BLOW-OFF	Blow-Off	Black - Yellow
BOILER BLOWDOWN	Boiler Blowdown	Black - Yellow
BOILER FEED WATER	Boiler Feed Water	Black - Yellow
CHEMICAL FEED	Chemical Feed	Black - Yellow
CHILLED WTR. RET.	Chilled Water return	White - Green
CHILLED WTR. SUP.	Chilled Water Supply	White - Green
COMPRESSED AIR	Compressed Air	Black - Yellow
COMPRESSOR VENT	Compressor Vent	White - Green
CONDENSATE	Condensate	Black – Yellow
COOLING TOWER RET.	Cooling Tower Return	White – Green

COOLING TOWER SUP.	Cooling Tower Supply	White – Green
DEIONIZED WATER	Deionized Water	White – Green
DISTILLED WATER	Distilled Water	White – Green
DIESEL FUEL RETURN	Diesel Fuel Return	Black - Yellow
DIESEL FUEL SUPPLY	Diesel Fuel Supply	Black - Yellow
DISTRICT HTG. RET.	District Heating Return	Black - Yellow
DISTRICT HTG. SUP.	District Heating Supply	Black - Yellow
DUAL TEMP. RET.	Dual Temperature Return	Black - Yellow
DUAL TEMP. SUP.	Dual Temperature Supply	Black - Yellow
EXHAUST / EXH.	Exhaust Air	Black - Yellow
FIRE PROT. WATER	Fire Protection Water	White - Red
FIRE STANDPIPE	Fire Standpipe	White - Red
FIRE	Fire Suppression Water	White - Red
FIRE (DRY)	Fire Suppression (Dry Pipe)	White - Red
FIRE (*insert gas/chemical type*)	Fire Suppression (Gas or Chemical)	White - Red
FUEL OIL RETURN / F.O.R.	Fuel Oil Return	Black - Yellow
FUEL OIL SUPPLY / F.O.S.	Fuel Oil Supply	Black - Yellow
FUEL OIL VENT / F.O.V.	Fuel Oil Vent	Black - Yellow
GAS VENT	Gas Vent	Black - Yellow
GLYCOL HTG. RET. / GLY.H.R.	Glycol Heating Return	Black - Yellow
GLYCOL HTG. SUP. / GLY.H.S.	Glycol Heating Supply	Black - Yellow
GLYCOL MAKE-UP / GLY.FILL.	Glycol Make-up (confirm)	Black - Yellow
HEAT RECLAIM RET.	Heat Reclaim Return	Black - Yellow
HEAT RECLAIM SUP.	Heat Reclaim Supply	Black - Yellow
HEATING WTR. RET.	Heating Water Return	Black - Yellow
HEATING WTR. SUP.	Heating Water Supply	Black - Yellow
HIGH PRESS. COND.	High Pressure Condensate	Black - Yellow
HIGH PRESS. STEAM	High Pressure Steam (≥125psi)	Black - Yellow
LOW PRESS. COND.	Low Pressure Condensate	Black - Yellow
LOW PRESS. STEAM	Low Pressure Steam (≤15psi)	Black - Yellow
LAB VACUUM	Lab Vacuum	White - Green
MED. PRESS. COND.	Medium Pressure Condensate	Black - Yellow
MED. PRESS. STEAM	Medium Pressure Steam	Black - Yellow
MAKE-UP WATER	Make-up Water	Black - Yellow
NATURAL GAS	Natural Gas (all piping painted yellow)	Black - Yellow
PUMPED CONDENSATE / P.COND.	Pumped Condensate	Black - Yellow
REFRIG. LIQUID / R.L.	Refrigerant Liquid	Black - Yellow
REFRIG. SUCTION / R.S.	Refrigerant Suction	Black - Yellow
REHEAT WATER RETURN	Reheat Water Return	Black - Yellow
REHEAT WATER SUPPLY	Reheat Water Supply	Black - Yellow
SPRINKLER WATER / SPR.W.	Sprinkler Water	White - Red
VACUUM	Vacuum	White - Blue
VENT	Vent (non-plumbing)	Black - Yellow
PLUMBING		
CAPTURED RAIN WATER	Captured Rain Water	White - Green
DOM. H.W. RECIRC./ D.H.W.R.	DOM. Hot Water Recirc.	White - Green
DOM. H.W. SUPPLY / D.H.W.S.	Domestic Hot Water Supply	White - Green
DOM. COLD WATER / D.C.W.	Domestic Cold Water	White - Green
DOM. HOT WATER / D.H.W.	Domestic Hot Water	White - Green
DRAIN	DRAIN	White - Green
GREY WATER	Grey water	White - Green
NON POT ANIMAL CW	Non Potable Animal Water	White - Green
NON POTABLE COLD WTR.	Non Potable Cold Water	White - Green
NON POT H.W. RECIR.	Non Potable Hot Water Recirculation	White - Green
NON POT HOT WTR.	Non Potable Hot Water	White - Green
POTABLE WATER	Potable Water	White - Green
POT CW	Potable Cold Water	White - Green

POT HW	Potable Hot Water	White - Green
POT HWR	Potable Hot Water Recirculation	White - Green
PROTECTED POT CW	Protected Potable Cold Water	White - Green
PROTECTED POT HW	Protected Potable Hot Water	White - Green
PROTECTED POT HWR	Protected Potable Hot Water	White - Green
R W L	Rain Water Leader	White - Green
RAW WATER	Raw Water	White - Green
SANITARY DRAIN / SAN.	Sanitary Drain	White - Green
STORM DRAIN / STM.	Storm Water Drain	White - Green
TEMPERED WATER	~~Potable~~ Tempered Dom. Water-Safety	White - Green
VACUUM	Vacuum	White – Green
VENT	Sanitary Vent	Black - Yellow
MEDICAL GAS		
ARGON	ARGON	Black - White
CARBON DIOXIDE	Carbon Dioxide	Black - Yellow
HELIUM	Helium	White - Brown
MEDICAL AIR	Medical Air	White - Black
MED VAC	Medical Vacuum	Black - Yellow
NITROGEN	Nitrogen	White - Black
NITRUOUS OXIDE	Nitrous Oxide	White - Blue
OXYGEN	Oxygen	White - Green

8 DETAILS

8.1 Air Handler Chilled Water Cooling Coil



9 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	15-09-2014	Entire Standard	Original Issue
1	09-04-2019	Entire Standard	Update of overall standards

1 GENERAL

1.1 After completion of insulation and/or painting, all piping shall be identified to show the service and direction of flow as described below.

1.2 Additional requirements may apply to pipe identification within the Central Utility Plant (building 55), Generator Building (building 56), and service tunnels.

2 APPLICABLE CODES AND STANDARDS

2.1 CSA Standard B53 – Identification of Piping Systems

2.2 ANSI/ASME A13.1-2007 – Scheme for the Identification of Piping Systems

2.3 NFPA 99/CGA C-9 Standards for Medical Gas and Vacuum Systems

3 LABEL PLACEMENT

3.1 The entire piping system is to be identified, including piping located in ceiling spaces, interstitial spaces, or within walls.

3.2 Pipe identification is required:

3.2.1 at every point of entry or exit to a space, where the pipe penetrates a wall, floor, service column or enclosure;

3.2.2 within 3 ft. (1 m) of and behind access doors;

3.2.3 within 3 ft. (1 m) of pipe termination point;

3.2.4 within 3 ft. (1 m) of branching off (or connecting to) a distribution header;

3.2.5 at least every 25 ft. (8 m) along straight pipe lengths.

3.3 Pipe identification shall be visible from point of normal approach.

3.4 Pipe identification shall be applied to clean, dry surfaces only and installed according to manufacturer’s instructions.

4 LABEL CONFIGURATION

4.1 Pipe identification shall consist of a label identifying the piping system contents, along with directional arrows indicating the flow direction.

4.2 Flow direction arrows shall be located at both ends of the pipe identification label.

4.3 Electrically traced piping shall have additional identification to show it is traced.

4.4 Nylon cable ties shall be used to secure pipe identification labels at both ends. Cable ties are in addition to the method of attachment provided by the pipe identification label itself.

4.5 Piping installed indoors shall be identified using labels meeting either Option A or Option B requirements defined in Section 6 below.

4.6 Piping installed outdoors (above grade) shall be identified using labels meeting Option B requirements defined in Section 6 below.

5 LABEL SIZE

5.1 Pipe identification and flow direction markers shall be appropriately sized to match the outer diameter of the finished pipe installation.

5.2 Label length and minimum text height shall be determined based on outside diameter of the finished pipe installation as follows:

Outside Pipe Diameter	Minimum Length* of Label	Minimum Text Height
1/2” – 1-1/4”	8”	½”
1-1/2” – 2”	8”	¾”
2-1/2” – 6”	12”	1-1/4”
8” – 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

*Note: not including flow direction arrows

6 MATERIALS

6.1 Option A – pressure sensitive adhesive label and banding tape:

- 6.1.1 minimum 6 mil thick vinyl or polyester with pressure sensitive backing;
- 6.1.2 chemical, UV light, heat, and water resistant;
- 6.1.3 label printed with applicable abbreviation from Section 7 below;
- 6.1.4 label and text color as defined in Section 7 below;
- 6.1.5 banding tape with directional flow arrows placed at both ends of label and wrapped 360° around outside diameter;
- 6.1.6 banding tape colors to match label color scheme;
- 6.1.7 standard of acceptance:
  - 6.1.7.1 Brady
  - 6.1.7.2 Seton
  - 6.1.7.3 SMS Smillie McAdams Summerlin
  - 6.1.7.4 Dura Label

6.2 Option B – semi-rigid plastic vinyl:

- 6.2.1 semi-rigid plastic vinyl label printed with applicable abbreviation from Section 7 below;
- 6.2.2 label shall include text and flow direction arrows;
- 6.2.3 label and text color as defined in Section 7 below;
- 6.2.4 chemical, UV light, and heat resistant, waterproof;
- 6.2.5 piping up to 6” OD: coil wrapped to snap around pipe and provide 360° visibility;
- 6.2.6 piping larger than 6” OD: saddle style
- 6.2.7 standard of acceptance:
  - 6.2.7.1 Brady: Snap-On and Strap-On
  - 6.2.7.2 Seton: Snap-Around
  - 6.2.7.3 SMS Smillie McAdams Summerlin: Coil Mark
  - 6.2.7.4 Dura Label: Pipe Grabber Sleeves

7 LABEL LEGEND

Label Abbreviation	System, Pipe Contents	Label Colors (Text - Background)
	PIPING	
CHWS	Chilled Water Supply	White - Green
CHWR	Chilled Water Return	White - Green
COMP AIR	Compressed Air	White - Blue
DI WATER	Deionized Water	White - Green
DUAL TEMP S	Dual Temperature Supply	White - Green
DUAL TEMP R	Dual Temperature Return	White - Green
FIRE	Fire Suppression Water	White - Red
FIRE (DRY)	Fire Suppression (Dry Pipe)	White - Red
FIRE (*insert gas/chem type*)	Fire Suppression (Gas or Chemical)	White - Red
F O S	Fuel Oil Supply	Black - Yellow
F O R	Fuel Oil Return	Black - Yellow
GLY R	Glycol Return	White - Green
GLY S	Glycol Supply	White - Green
HTG W R	Heating Water Return	White - Green
HTG W S	Heating Water Supply	White - Green
HIGH PRESS COND	High Pressure Condensate	Black - Yellow
HIGH PRESS STEAM	High Pressure Steam (≥125psi)	Black - Yellow
LOW PRESS COND	Low Pressure Condensate	Black - Yellow
LOW PRESS STEAM	Low Pressure Steam (≤15psi)	Black - Yellow
MED PRESS COND	Medium Pressure Condensate	Black - Yellow
MED PRESS STEAM	Medium Pressure Steam (>15psi,<125psi)	Black - Yellow
NAT GAS	Natural Gas (all piping painted yellow)	Black - Yellow
PUMPED COND	Pumped Condensate	Black - Yellow
RO WATER	Reverse Osmosis Water	White - Green
VAC	Vacuum	White - Blue
VENT	Vent (non-plumbing)	Black - Yellow
	PLUMBING	
CAPTURED RAIN WATER	Captured Rain Water	White - Green
GREY WATER	Grey water	White - Green
NON POT ANIMAL CW	Non Potable Animal Water	White - Green
NON POT CW	Non Potable Cold Water	White - Green
NON POT HW	Non Potable Hot Water	White - Green
NON POT HWR	Non Potable Hot Water Recirculation	White - Green
POT CW	Potable Cold Water	White - Green
POT HW	Potable Hot Water	White - Green
POT HWR	Potable Hot Water Recirculation	White - Green
PROTECTED POT CW	Protected Potable Cold Water	White - Green
PROTECTED POT HW	Protected Potable Hot Water	White - Green
PROTECTED POT HWR	Protected Potable Hot Water Recirculation	White - Green
TEMPERED	Potable Tempered Water – Safety Eqpt	White - Green
R W L	Rain Water Leader	White - Green
RAW WATER	Raw Water	White - Green
SAN VENT	Sanitary Vent	White - Green
SAN	Sanitary Waste	White - Green
STORM	Storm Water Drain	White - Green
	MEDICAL GAS	
CO2	Carbon Dioxide	White - Grey
He	Helium	White - Brown
MED AIR	Medical Air	Black - Yellow
MED VAC	Medical Vacuum	Black - White
N2	Nitrogen	White - Black
N2O	Nitrous Oxide	White - Blue
O2	Oxygen	White - Green

8 REVISION HISTORY

Revision	Date	Comment
0	Sept 28/12	- initial issue
1	Oct 1/12	- add Dual Temperature Supply/Return to legend - add Revision History to document

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSM-03

BUILDING AUTOMATION SYSTEMS

Version	Revision 1
Effective Date	June 3, 2021

TABLE OF CONTENTS

1 INTRODUCTION

1.1 General

.1 This Building Automation Systems (BAS) Design Standard has been developed to establish the University's minimum expectations and requirements for new BAS installations on campus.
.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.
.2 Full compliance is mandatory for new BAS installation within projects involving significant renovations.
.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing BAS infrastructure.
.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Mechanical Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.
.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Mechanical Design, DEC, together with proposed measures for addressing the conflict.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.
.2 All proposed Design Innovation shall be tabled for consideration by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

.1 Ontario Building Code
.2 Canadian Electrical Code
.3 ASHRAE Standard ANSI/ASHRAE 135 - BACnet
.4 ASHRAE Guideline 13, Specifying Direct Digital Control Systems.
.5 ANSI/TIA/EIA862 Building Automation Systems Cabling Standard for Commercial Buildings.
.6 Federal Communication Commission (FCC) Rules and Regulations, Part 15, Subpart J for computing devices
.7 Public Health Agency of Canada - Laboratory Biosafety Guidelines
.8 Canadian Council for Animal Care Guidelines
.9 LEED Guidelines
.10 Mechanical Plumbing Systems Standard DSM-02*
.11 Mechanical HVAC Systems Standard DSM-01*

.12 Electrical Power Systems Standard DSE-01*
.13 Architectural Space Planning & Finishes Standard DSA-01*

* A copy of these standards is available on University of Guelph Physical Resources web page

2 DESIGN STANDARDS

2.1 General

.1 The requirements outlined in the following clauses are applicable to all Building Automation System (BAS) installations. Application Specific requirements are outlined under clauses 2.2 – 2.17

.2 This document is not intended to describe the controls or sensors required for correct operation of the building systems or equipment. The Designer remains responsible for ensuring equipment and systems can be appropriately operated and maintained.

.3 Overarching Design Principles
- .1 All new BAS installations shall be designed as an integrated, open protocol, BACnet compliant system to ANSI/ASHRAE Standard 135.
- .2 All BAS installations in projects involving significant renovations shall be designed as an integrated, open protocol, BACnet compliant system to ANSI/ASHRAE Standard 135; any proposed deviations shall be presented to the Manager, Mechanical Design, DEC, for approval during the Schematic Design Phase.
- .3 All BAS installations in projects involving minor renovations to areas currently served by Legacy (KMD) systems shall comply with 2.1.2.2 above; any proposed deviations, including modifying existing Legacy (KMD) system, shall be presented to the Manager, Mechanical Design, DEC, for approval during the Schematic Design Phase.
- .4 Buildings shall not have multiple Control systems. Wherever possible, the Building Automation System shall directly control the equipment. Vendor provided control systems shall only be permissible with the approval of the Manger, Mechanical Design, DEC.

.4 Interfacing Standards:
- .1 Input/output devices to use ASCII (American Standard for Communication and Information Interchange) code and standard EIA (Electronic Industry Association) interfaces.
- .2 CSA T530: Building Facilities, Design Guidelines for Telecommunications (same as EIA/TIA 569).
- .3 IEEE 802.3 Ethernet 10Base-T LAN

.5 All Components and Equipment shall be designed and selected to provide the requisite level of function and performance when operating in following minimum ambient condition ranges:
- .1 Temperature: 0°to 40°C (32° to 104°F) for Indoor Installation / -30°to 40°C (-22° to 104°F) for Outdoor Installation.
- .2 Relative Humidity: 10% to 90% non-condensing
- .3 Withstand VHF, UHF, FM, AM or background RFI as generated by commercial or private, portable or fixed transmitters that meet regulatory codes
- .4 For retrofit work the existing conditions may differ from those stated above. The designer must confirm that all newly specified equipment is rated for the conditions experienced within the retrofitted space.

.6 All equipment, components& devices shall be designed to operate on an electrical power service rated at 120 VAC +/- 10%, 60 Hz nominal.

- .1 Components installed within Motor Control Devices to be designed to operate with transient electrical fields occurring within these devices

.7 Licenses and Ownership

- .1 Ownership of, and licenses for, all hardware and software originally installed or required for ongoing system operation, maintenance and modification to be registered, without restrictions, in Owner's name.
- .2 Licensing to permit an unlimited number of users to access system without additional fees.
- .3 As of last month of the warranty period, software is to be upgraded to current version or release at no cost to the Owner.

.8 Accessibility

- .1 All equipment must be installed such that access can be easily provided for maintenance.

2.2 BAS Architecture – Individual Buildings

.1 BAS Network Architecture

- .1 Dedicated LAN for BAS:
- .2 BAS communication architecture to consist of at least two tiers with each tier using local area networks.
  - .1 Tier 1: Building Controller network;
    - High level network providing communication between Building Control Unit's (BCU's) and workstations
    - Ethernet communications (ISO 8802-3/IEEE 802-3), using high speed local area network communications. TCP/IP to be used as communication protocol on first tier network.
    - Shall be designed with an expansion capacity of at least 10 additional BCU/Routers over and above those required to complete the original installation.
  - .2 Tier 2: Equipment Controller network;
    - Lower level network providing communications between Equipment Control Units (ECU's) and BCU's.
    - Open, peer-to-peer control networks to interconnect BAS controllers (Building Control Units, BCU's, and/or Equipment Control Units, ECU's) on ring or star topology bus.
    - Peer-to-peer configuration means units exist and speak equally on same bus.
    - Controllers in peer-to-peer configuration can share data without assistance from Operator Interface.
    - Refer to Appendix A, BACNET ADVANCED APPLICATION CONTROLLERS (DXR), for further information.
- .3 System architecture to be modular, permitting stepped expansion of application software, system peripherals, and field hardware
- .4 Use of non-networked stand-alone control devices is not permitted.

.2 Control System:

- .1 High-speed, peer-to-peer network comprising microprocessor based Direct Digital Control (DDC) controllers with a web-based operator interface,
- .2 Each system controlled or monitored through the BAS, building floor plan, and control device to be displayed through point-and-click graphics,

.3 Web server with network interface card to gather data from this system and generate web pages that can be accessed through conventional web browser on any PC connected to network,
.4 Operators to access this system through web browser, and browser interface to perform normal operator functions.
.5 OEM Controller integration
  .1 BAS to incorporate hardware and software to allow bi-directional data communications between BAS and 3rd party manufacturers' control panels.

2.3 BAS Functional Requirements

.1 Functional requirements shall be defined through the use of Control Sequences & Schematics and Points List used in combination.
  .1 Control sequences shall be developed based on overarching criteria defined under Clause 2.10.
.2 Controllers
  .1 Designed to operate with local closed loop programming, independent from server, if peer-to-peer communication is interrupted.
.3 Central BAS Web Server
  .1 Designed to perform global application programs and data consolidation including:
    .1 communications with controllers,
    .2 host software routines for:
      - BAS Server operation,
      - Database creation and data storage,
      - Web based Graphical User Interface (GUI) with graphics generation and display,
      - Reporting

2.4 BAS Server – Individual Buildings

.1 A dedicated BAS Server is not required; rather the BAS software shall be installed on a designated Campus Server residing on a Tier I network.
  .1 Minimum performance levels for the server shall be estimated before completion of the Design Development Phase and submitted to the Manager, Mechanical Design, DEC.
  .2 Performance levels for the server shall be validated by the chosen BAS vendor and finalized within 60 days of commencement of the Construction Phase

2.5 Main Operator Workstation – Individual Buildings

.1 A dedicated Main Operator Workstation (OWS) is not required.
.2 However, each Mechanical Room / Equipment Room shall have at least one (1) designated connection point to allow access to the BAS Graphics using a portable device.

2.6 Internet Appliances

.1 BAS architecture and software to incorporate thin client design software to allow use of web appliances such as Tablets and web-enabled cellular telephones

2.7 Fibre Optic Cable

.1 Duplex 900 mm tight-buffer construction designed for intra-building environments
.3 UL listed sheath OFNP meeting requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.

.4 field terminations made using ST type connectors with ceramic ferrules and metal bayonet latching bodies.

2.8 Routers and Bridges

.1 Selected as Industry standard hardware
  .1 Central system to use an Ethernet Local Area Network (LAN) for communication.
  .2 Communication between central server and controllers to be IP.
  .3 Router to bridge IP and data link (ARCNET, BACnet, MS/TP, LON) to be used between controllers if required.
  .4 Router to use FLASH memory and allow firmware updates to be performed from remote work station.

2.9 BAS Software

.1 System software to support alternate operating systems, such as Red Hat Linux, or Sun Solaris.
.2 Software to be completely web based without need for interface/translation devices or need to load software individually on each computer.
.3 System and software to permit remote access, for multiple users, through internet connections.
.4 Graphic files to be created with use of graphics generation package furnished with system.
.5 Software to support concurrent operation of multiple standard and non-standard protocols including but not limited to:
  - BACnet

.6 Operator Interface designed to operate through standard desk top or lap top personal computers without requiring purchase of special software from BAS manufacturer.
  .1 Interface on these personal computers to be standard Web Browser by Microsoft, Chrome or Firefox.
.7 System software to support automatic paging

2.10 Control Sequences - Overarching Criteria

.1 Control sequences shall be developed with consideration to the overarching criteria listed below. Where criteria have not been defined, develop control sequences based on guidelines published in the ASHRAE Handbook and/or following Industry Best Practices.
.2 Control sequence descriptions, and list of control and alarm points, shall be submitted for review/approval by the Manager, Mechanical Design, DEC and Manager, Maintenance & Energy Services prior to the completion of Design Development.
.3 Minimum Requirements
  .1 Occupied/Unoccupied mode schedule for terminal unit set-back controls
  .2 Occupied/Unoccupied mode schedule and Occupancy sensors to control AHU(s) dedicated to an individual classroom
  .3 Standalone local washroom exhaust fan interfaced with the light switch and an Off-Timer
  .4 Control Valve sequences shall incorporate a feedback loop to detect leakage past valve when in “Closed Position”
  .5 Pressure is to be monitored across all individual filter racks (analog value)
  .6 Supply air humidity sensors are to be located downstream of air handlers in the ductwork to promote full mixing and accurate readings.
  .7 Leak sensors to be installed in flood-prone areas including mechanical rooms and elevator machine rooms and connected to the BAS.

.8 Space temperature to be monitored by the BAS in mechanical rooms and vestibules and any other areas where a freezing potential exists.

.4 Scheduling

.1 Scheduling is to include the capability of including multiple adjustable modes of operation including: School In, School Out, Run Day (unoccupied, but runs equipment for 30 minutes during the day), and Run Night (unoccupied, but runs equipment for 30 minutes overnight) . Specific operation of systems during these modes is to be defined in the sequence of operations.

.2 Scheduling application must include the ability to override schedules to turn systems on or off for Holidays and special events.

.3 Systems that can be shut down will do so based on the schedule

.5 Sequences and Schematics for Typical Systems

.1 Refer to the "Standard Sequences and Schematics" document attached to this design standard.

.6 Exhaust Fans

.1 Exhaust fans provided for ventilation will typically operate based on a predefined Occupancy Schedule. Occupancy sensors can be considered for control if applicable

.2 Exhaust fans provided for temperature control must include a temperature setpoint that is adjustable from the BAS graphics.

.3 For special circumstances such as equipment specific exhaust, local control of exhaust fans may be utilized. Consult with the University of Guelph Mechanical Manager at the time of design.

.7 Condensate Pump Systems

.1 BAS to monitor alarms from packaged duplex pumping system.

.8 Global Commands

.1 Chilled Water Clamp.

- ability to clamp all chilled water control valves to a fixed position (excluding critical systems)
- this will allow the chilled water valves to be limited to a maximum position for extreme hot days as well as any CUP production limitations

.2 Heating setpoint Offset

- ability to offset the setpoint for all heating systems (excluding critical systems)
- this will allow temperature setbacks for Holidays, and will limit steam requirements due to any CUP production limitations

.3 Maximum Outdoor Air Damper Position (all Mixed Air units)

- ability to adjust maximum damper position
- this will allow maximum damper position to be limited based on outdoor temperature and humidity

.4 SAT setpoint Offset

- ability to put an offset on all fan units.
- this will allow a temperature offset to be introduced for extreme temperature days to allow for reduction of chilled water use as well as steam use

.5 Perimeter Heating Disable
- ability to disable perimeter heating for all buildings.
- this will allow buildings, on days with cool mornings and warmer days, to not use perimeter heat in the morning and chilled water later on.

.6 VFD Maximum Clamp
- ability to set the VFD speed for critical global adjustment days (excluding critical areas)
- Want to know what was the last speed the unit was running
- More thought required for this section – SN

.9 Global Command Page
.1 a Global Command Page shall be created on each BAS system to allow operator to monitor status of global command points and have the ability to set the values and override automatically calculated values.
.2 this page will include:
- Current Schedule running
- Chilled Water Maximum clamp value
- Heating setpoint offset value
- Damper Maximum Position value
- SAT offset value
- Perimeter Heating enable status
- VFD Maximum clamp value
- Chilled water pressures and temperatures in various locations

.3 this page is also to display the status of chilled water cooling systems that have domestic water backup

.10 Emergency Services Only
- Ability to disable all systems on campus with the exception of those providing emergency services as defined by the University.

2.11 BAS Graphics

.1 At a minimum BAS graphics shall display the following:
.1 Facility Site Graphic
.2 Individual Graphics for each System
.3 Terminal Unit & Equipment Floor Plan
- Room Number and Area designation for each Terminal Unit & piece of Equipment

.4 A Main Page in Tabular Format displaying, as applicable, the following information for each piece of equipment/system
- Command Status
- State Status
- Current Setpoints
- Current Speed
- Current Temperatures
- Alarm Condition, if any, displayed in a different color.
  - Alarms to be assigned a Priority Ranking and include Descriptor identifying relevant equipment and its location. (eg. E1 BLDG 040 P4 Condensate Pump failed to start <Room 008>)

- Area served by Equipment/System with a link to the individual graphic for the said Equipment/System

.2 Graphics shall be developed using a standard library of image files and industry standard symbols.

.3 Graphics shall have the capability to be modified and edited by University of Guelph personnel. This functionality shall allow the University to accomplish the following:
  .1 Relocate and customize information provided within the graphics
  .2 Create links to external relevant information and reports including Testing and Balancing reports or Operation and Maintenance manuals
  .3 Rename equipment and other graphic labels as required.

2.12 BAS Alarms

.1 The BAS system shall be complete with all alarming required for proper operation of the equipment and systems.

.2 All time delays and alarm thresholds shall be adjustable via the software, not via the BAS graphics.

.3 Alarms shall include any specific alarms required for specialized applications.

.4 Critical alarms requiring email or text notification are to be confirmed during the design and commissioning of the project.

.5 At a minimum the following alarms are to be provided:

  .1 Priority 1 alarms (P1):
  - HVAC system motor fails to start (pumps, fans, etc.). BAS shall include the capability of detecting a broken belt as part of this alarm through a properly calibrated current sensing relay.
  - Critical fan system supply air temperature deviates from setpoint by 5°C for more than 10 minutes
  - Perimeter heat pump fails to start and temperature is not at set point
  - Critical exhaust fan motors fail to start
  - Critical static pressure deviates from setpoint by an adjustable amount for 10 minutes.
  - High-high level for all condensate tanks, sump pits, or any other application where a flood will occur if the high-high level is surpassed
  - Low temperature alarm in vestibules or other freeze-prone areas
  - Overall building maximum or minimum space temperature exceeds threshold (adjustable).
  - Alarms from leak sensors where installed.

  .2 Priority 2 Alarms (P2):
  - Non-critical fan system supply air temperature deviates from setpoint by 5°C for more than 10 minutes
  - Terminal heat pump fails to start and temperature is not at set point.
  - Non-critical exhaust fan motor fails to start

  .3 Maintenance Alarms (Maint):
  - System not in Auto Mode
  - Filter pressure drop is out of range (low or high)

- Control valves leaking (Temperature difference across all heating or cooling coils greater than 5°C after a 5 minute delay following control valve closing).
- Dampers fail to open
- Dampers fail to close
- Supply air temperatures cycling
- Converter temperatures more than 10°C from setpoint for more than 10 minutes
- CO_2 sensor readings are out of range
- Broken belt alarm (to be setup and configured through the variable frequency drive).

.4 High CO_2 level (when CO_2 sensor(s) are utilized)
.5 Differential pressure across filter bank exceeds 250pa
.6 High supply humidity level in supply air duct
.7 High duct pressure
.8 High duct temperature
.9 Low plenum air temperature after 3 resets of Freezestat. Refer to the sequences attached for the approved freezestat sequence strategy.
.10 Temperature difference across all heating or cooling coils greater than 5°C after a 5 minute delay following control valve closing
.11 Supply air temperatures that deviate more than 5°C from setpoint for more than 10 minutes
.12 Converter temperatures that deviate more than 10°C from setpoint for more than 10 minutes
.13 Outdoor air, mixed air, exhaust air damper positions that do not match the command. Logic must be implemented to exercise dampers fully open and closed every 24 hours. Alarms for leaking or incorrect damper positions must be based on physical monitoring of damper position or temperature calculations.
.14 Leaking steam valves: For all steam-to-water heat exchangers, alarms must be provided if the steam valves are closed and the heat exchanger or supply water temperature sensor detects high temperature in the system (initially set at 50°C)

2.13 Power Supplies and Line Filtering

.1 Power Supplies:
.1 where Essential Power is available in a building, all Tier I devices shall be fed off an Essential Power source.
.2 power supplies to all BCU's and all ECU's/Control Elements associated with equipment fed off an Essential Power source shall be extended from an Essential Power source, preferably the same Essential Power source feeding the equipment in question.
- an On-Board UPS Power source with a minimum 12 hour backup shall be provided within each BCU & ECU with the prior approval of the Mechanical Design manager. Include written approval in the close out documentation.
- Capacitor UPS systems shall be preferred over battery technology due to reduced maintenance requirements.

.3 control transformers shall be UL listed,
.4 line voltage units shall be CSA listed,
.5 provided with over-current protection in primary and secondary circuits,
.6 sized to limit connected loads to 80% of rated capacity.
.7 equipped with

.2 DC power supplies:
  .1 output to match equipment current and voltage requirements,
  .2 units to be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation to be 1.0% line and load combined, with 100-microsecond response time for 50% load changes,
  .3 units shall have built-in over-voltage and over-current protection and to be able to withstand 150% current overload for at least three seconds without trip-out or failure,
  .4 units shall be capable of operation between 0°C and 50°C (32°F and 120°F). EM/RF to meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.

.3 Power Line Filtering:
  .1 shall be provided to afford internal or external transient voltage and surge suppression for workstations and control modules,
  .2 surge protection:
    - dielectric strength of 1000 V minimum,
    - response time of 10 nanoseconds or less,
    - transverse mode noise attenuation of 65 dB or greater,
    - common mode noise attenuation of 150 dB or greater at 40-100 Hz.

2.14 Automatic Control Valves

.1 Performance:
  .1 General:
    - Straight through water valves shall be single seated type with equal percentage flow characteristics and minimum resolution of 40:1 or greater.
    - designed to close at a differential pressure of 280 kPa (40 psi), with an inlet pressure of 1035 kPa (150 psi).
    - three-way mixing water valves: linear for each port giving constant total flow.
    - modulating steam valves: modified linear flow characteristics.
  .2 Steam Valves, Pressure Drop,.
    - modulating, 100 kPa (15 psig) or less steam supply pressure: maximum 80% of inlet gauge pressure.
    - two position, 100 kPa (15 psig) or less steam supply pressure: maximum 15 kPa (2 psig).
    - modulating, greater than 100 kPa (15 psig) steam supply pressure: 42% of the inlet absolute pressure.
  .3 Water Valves, Pressure Drop
    - two position: maximum 10% of system pump head.
    - modulating, two-way: maximum of 36 kPa (12 ft) pressure drop.
    - modulating, three-way: maximum of 60 kPa (20 ft) pressure drop.

.2 Proportional valves - Globe:
  .1 Body:
    - carbon steel, bolted body.
    - maximum allowable water pressure: 860 kPa (150 psi)
    - maximum working temperature: 216°C (260°F).
  .2 Trim:
    - stem guided plug,
    - V-port cage, equal percentage,

- T316 stainless steel
- threaded seat ring, T316 stainless steel.
- disc, seals, and other valve components suitable for clean water.

.3 ANSI Class IV leakage.
.4 Refer to Appendix B, PRESSURE INDEPENDENT CONTROL VALVES, for further information.

.3 Actuators:
.1 electric or electronic action
.2 electronic interface control board, solid state drive, reversible motor, oil immersed gear train
.3 spring return mechanism to return valve to “normal” position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),
.4 manual override for valves over NPS 2½.
.5 valve positioners:

- microprocessor based digital valve controllers,
- HART communications protocol,
- two independent adjustable travel position switches and wiring to BAS for indication of valve position.
- to be provided on automatic valves NPS 2½ and larger.

.6 general purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,

2.15 Automatic Dampers

.1 Multi-leaf Dampers for general service
.1 shall be parallel blade type for two-position OPEN/CLOSED service
.2 shall be parallel blade or opposed blade type for modulating service
.3 Performance:

- leakage in closed position: maximum 2% of rated air flow at 500Pa (2 in wg) differential across assembly,
- pressure drop in open position: maximum 50 Pa (0.2 in wg) differential at 5 m/s (1000 fpm).

.4 Frame & Blade Construction :

- insulated or non-insulated depending upon service. Thermal breaks in insulated frame construction.
- extruded aluminum for general applications; formed stainless steel for corrosive environments.
- extruded aluminum, thermally broken,
- seals: extruded vinyl seals, and spring stainless steel side seals,
- maximum blade width: 125 mm (5 in),
- maximum blade length: 1200 mm (4 ft).
- self-lubricated bronze bearings.
- blade linkage with steel tie rods, brass pivots and steel brackets.

.5 Damper Actuator (Operator)

- Electric or electronic action
- electronic interface control board, solid state drive, reversible motor, oil immersed gear train

- spring return mechanism to return valve to "normal" position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),
- manual override.
- Damper positioners: microprocessor based digital damper controllers c/w
- HART communications protocol two independent adjustable travel limit switches with wiring to BAS for indication of damper position and alarm annunciation in the event position is not positively verified.
- general purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,

.2 Isolation / Control Valves Type for Isolation Service:

.1 Single blade type for modulating and two position, OPEN/CLOSED, service..

.2 Performance:

- leakage in closed position: maximum 0.01% of rated air flow at 7 kPa (28 in wg) differential across assembly,
- linear characteristic with 20:1 turndown,
- sized using Cv numbers in 65% open position for pressure drop of less than 150 Pa (0.6 in wg) differential at 5 m/s (1000 fpm),

.3 Construction:

- 316L stainless steel construction for Body, Trim, Shaft and all elements exposed to the air stream
- teflon packing glands
- seat: elastomer seat compatible with paraformaldehyde and ethylene gas
- flanged gasketed connections for 7 kPa (28 in wg) service

.4 Damper Actuator (Operator)

- Electric or electronic action
- electronic interface control board, solid state drive, reversible motor, oil immersed gear train
- spring return mechanism to return valve to "normal" position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),
- manual override.
- Damper positioners: microprocessor based digital damper controllers c/w
- HART communications protocol two independent adjustable travel limit switches with wiring to BAS for indication of damper position.
- general purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,

2.16 Cleanroom and Laboratory (incl. Animal Labs) Pressure Monitor

.1 Space pressure measurement, referenced to adjacent space, designed, tested, and packaged by a single manufacturer.

.1 Standard of Acceptance – packaged by BAS provider. If not Siemens requires prior approval from University Mechanical manager.

- Siemens

.2 Monitor unit construction:

.1 industrial grade metal case mounted on an electrical junction box,

.2 local digital display control unit;

- Range: -50 to + 50 Pa (-0.19999 to +0.19999 in.wg.)

- Resolution: 5% of reading,
- Display updated every second,
- Spill-proof membrane keypad for programming,
- Local calibration protected by pass-code.

.3 Indicating lights:
- Low pressure alarm
- Normal
- High pressure alarm
- Audible Mute
- Vivarium standards may differ – ensure vivarium standards are met.

.4 Audible alarm annunciates when pressure in monitored room is in alarm condition.
- Adjustable time-delay on alarm initiation for door opening,

.5 Remote alarm annunciation:
- High pressure alarm contact - contacts normally open.
- Low pressure alarm contact - contacts normally open

.3 Pressure Sensor:

.1 two velocity sensing elements mounted in-line to each other, with temperature compensating element;
- Pressure measurement accuracy: -50 to + 50 Pa (-0.19999 to +0.19999 in.wg.)
- Temperature compensation range: 12.7 to 35 °C (55 to 95 °F)

.2 Alarm setpoints:
- Adjustable to any point over sensing range. Must be set to meet project requirements.

2.17 Building Pressure Control

.1 A dynamic Building Pressure Control System shall be provided to maintain the building pressurized relative to the outside.

.1 Building reference pressure shall be measured on the 2nd Floor

.2 Outdoor pressure reference shall utilize a properly designed outdoor air static pressure pickup port to eliminate the influence of wind pressure.

2.18 Sensors and Instrumentation

.1 All field sensors and instrumentation shall have a measurement range suitable to the application.

.2 All field sensors, instrumentation, and control loops shall meet the minimum performance requirements tabulated below.

Parameter	***Variable***	***Reporting Accuracy***	***Control Accuracy***	***Remarks***
Temperature	• space • ducted air • liquids • outside air • differential • dew point • low limit (Freezestat)	±0.25°C (±0.50°F) ±0.5°C (±1.0°F) ±0.15°C (±0.25°F) ±1.0°C (±2.0°F)	±1.0°C (±2.0°F)	RTD type • 3 attempts at Automatic Reset before lockout

Parameter	*Variable*	*Reporting Accuracy*	*Control Accuracy*	*Remarks*
				• range:1.7°C to 7.2°C (35°F to 45°F) • field adjustable
Humidity	• relative humidity	± 3%	± 5%	Electronic type Range: 10-100% RH
Pressure	Air • ducts / space • static / differential	± 1%	± 5Pa (±0.02"w.g)	Electronic type • for compressed air see Liquids requirements
	Liquids • absolute / static / differential	± 1%	± 1.5 psi	
Flow	Air • proving switch	± 1% full scale -	± 10% full scale	Multiple-head Pitot Tube Type or Thermal Anemometer Probe Type • differential pressure activated diaphragm type
	Liquids • flow switch	± 2% full scale -		• differential pressure activated paddle type
Gas Detection	• CO • CO_2	± 3% ± 5 ppm		Zone-level CO_2 sensors to be installed on wall adjacent o thermostats. System-level CO_2 sensors to be installed in return air ductwork.
	• Laboratory gases			Project specific requirements
Occupancy Sensors	• Occupancy			Can be used for triggering occupancy mode in terminal equipment. Consideration can be provided for hard-wired interface with lighting control system. Occupancy status from lighting control system through network communication shall not be utilized.

3 INSTALLATION STANDARDS

3.1 General

.1 The requirements outlined in the following clauses are applicable to all BAS Installation. Application Specific requirements are outlined under clauses 3.2 – 3.13

.2 All campus network drops required to complete the BAS installation shall be provided by the BAS Contractor.

.1 Extend network a connection(s) from the nearest IT/Communications Closet; coordinate this activity with the Electrical/Communications contractor.

3.2 BAS Panels & Cabinets

.1 Install Building Control Units, Equipment Control Units, and Field Panels in cabinets.
  .1 cabinets shall be mounted on a painted non-combustible backboard which is rigidly mounted to a wall or on a galvanized steel, floor mounted support frame.
    - installation on ductwork, equipment, and locations subject to vibration is not acceptable
    - cabinets for Terminal Equipment Controllers may be installed on the terminal equipment provided there is no vibration that could affect controller operation or calibration of control device(s).
  .2 cabinets to be sized to accommodate 20% future I/O points.
  .3 cabinet locations are to be coordinated with other trades and the general contractor.
.2 No panels (except Terminal Equipment Controllers) shall be installed in the ceiling space or at an elevation inaccessible for normal & ready access from the finished floor.

3.3 BAS Wiring

.1 Wiring:
  .1 wiring shall be installed in conduit, raceways and enclosures separated from other wiring.
  .2 wiring may be installed without conduit in the interstitial space above finished ceilings provided the following conditions are met:
    - wiring has a minimum rating of FT6;
    - interstitial ceiling space is within the room where final termination of wire will be made;
    - wiring is neatly installed parallel to walls.
    - Approval in advance by mechanical and electrical manager.
  .3 each run of communication wiring to be continuous length without splices
  .4 wiring within BCU's, ECU's and Field Panels (Cabinets) shall be installed in a plastic tray with a removable cover
    - wiring shall be terminated at field-removable, modular terminal strips
  .5 connections within cabinets and panels shall be done using terminals
    - wire nuts and Marr connections are not acceptable
  .6 wiring to field sensors shall not be daisy-chained
  .7 should it become necessary to splice field wiring it shall be soldered and a 500mm (20in.) loop length is to be provided
    - wire nuts and Marr connections are not acceptable
    - if soldering is not possible approved B-type crimp connectors are an acceptable alternative
.2 Conduit:
  .1 thin wall (EMT) conduit up to and including 32mm (1¼") size for exposed wiring up to 3 m (10 ft) above floor level
  .2 rigid galvanized steel conduit in locations accessible to public, subject to mechanical injury, or outdoors; and for conduit 40mm (1½") size and larger
  .3 conduit to be parallel with, or at right angles to, building walls
  .4 concealed within finished shafts, ceilings, and walls where possible
  .5 route all conduit to clear beams, plates, footings, and structural members
  .6 watertight compression fittings in exterior locations
  .7 provide watertight seals at penetrations through outside walls

.8 conduits leaving a building to the outside shall be sealed internally to prevent moist air from being pulled through the conduits, condensing, and then the water freezing inside the conduit
.9 empty or unused conduit openings and stubs to be plugged or capped with compatible fittings
- plugs or caps on conduit openings are to be maintained during construction

.10 conduits travelling between separate pressure regime areas shall be sealed internally to prevent migration of air and odors
.11 conduit to field sensors shall not be daisy chained

.3 Flexible conduit:
.1 shall be provided for the final conduit run to vibrating or rotating equipment so that vibration and equipment noise is not transmitted to the rigid conduit
- minimum 450mm (18in.) / maximum 900mm (36in.)

.2 shall be provided for the last 450mm (18 in.) of conduit runs to field sensors
- a junction box / enclosure shall be provided for terminations

.3 waterproof flexible conduit to be provided where exposed to weather or in damp or wet locations

.4 Lightning arrester shall be provided according to manufacturer's recommendations between the communication cable and ground wherever cable enters or exits building. Doug Doel to provide feedback on this note.
.5 Fire stopping to be included as required.

3.4 Air Handling Units

.1 At a minimum instrumentation shall be provided at each Air Handling Unit to monitor the following:
.1 Outside Air Temperature (may be common to a building)
.2 Return Air Temperature
.3 Mixed Air Temperature
.4 Filter Pressure Drop across each individual rack of filters
.5 Air Temperature Upstream & Downstream of all Coils
.6 Supply Air Relative Humidity
.7 Supply Air Static Pressure
.8 Supply Air Flow
.9 Supply Fan Speed (where fan is equipped with a Variable Frequency Drive)
.10 Return Air Relative Humidity
.11 Return Fan Speed (where fan is equipped with a Variable Frequency Drive)
.12 Return Air CO2 sensor (where required)
.13 Supply and Return Fan Status
.14 Control valve command and feedback
.15 Return air pressure (where required)

3.5 Heating & Cooling Coils

.1 A water temperature sensor shall be provided on the inlet and outlet of each coil installed within an air handling unit.
.2 An air temperature sensor shall be provided upstream and downstream of each coil installed within an air handling unit.

3.6 Reheat Coils & VAV Boxes

.1 An air temperature sensor shall be provided downstream of each reheat coil.
.2 Air temperature sensors shall be provided such that the discharge temperature of each VAV can be measured.

3.7 Terminal Units

.1 Terminal units shall be equipped with an Air-flow Monitoring device interfaced with the BAS.

3.8 Heat Exchangers

.1 Temperature sensors shall be provided on the inlet and outlet of each heat exchanger.
.2 Where a dual (or triple) heat exchanger system is used temperature sensors shall be provided on the outlet of each exchanger plus a common sensor for the mixed outlet.
.3 Control valve command and feedback

3.9 Steam

.1 A pressure sensor shall be provided downstream of every PRV station.
.2 A pressure sensor shall be provided on the building's incoming high pressure steam line.

3.10 Compressed Air

.1 A pressure sensor shall be provided on the building's incoming compressed air line (if present).

3.11 Water

.1 A pressure sensor shall be provided on the building's incoming domestic water line.
.2 A pressure sensor shall be provided on the building's incoming deionized water line (if present).
.3 Pressure and temperature sensors shall be provided on the building's incoming chilled water supply and chilled water return lines.

3.12 Identification

.1 Point Object Numbering systems shall include the Building Number as a prefix to all object identifiers. (eg. <99.AC1.SAT> is Building 99 Air Handling Unit 1 Supply Air Temperature).
.2 All Equipment shall be identified in accordance with the University's Identification Standards and numbering convention. Equipment numbers are to be provided by the University's PM Scheduler.
.3 Equipment numbering strategy shall be presented for review/approval by the Manager, Mechanical Design, DEC and Manager, Maintenance & Energy Services prior to completion of Design Development.
.4 Wiring
    .1 All wires shall be tagged at both ends. The tagging shall identify the device a wire is connected to. Use of the point object name is an acceptable means of device identification.
    .2 All junction boxes shall be tagged "BAS" with a sequential number suffix.
.5 Control Devices shall be labelled using a Blue Flag Tie-Marker, such as Nelco PT#N-9L (or equivalent). Labels shall be white or yellow with large black text.
.6 All local alarm devices (lights, strobes, horns, etc.) shall be clearly labelled as to their purpose with an appropriately sized lamacoid plastic plate that is securely affixed so as to be visible and legible from the direction of normal approach.
    .1 Prior to fabrication, proposed alarm device labels (wording, size, colors) shall be presented for review/approval by the Manager, Mechanical Design, DEC and Manager, Maintenance & Energy Services.

3.13 Redundant or Obsolete Pneumatic, Electric, Electronic, and DDC Devices

.1 Existing BAS control equipment rendered redundant or obsolete by the installation of a new BAS system or component shall be removed to the greatest extent possible.
  .1 control drawings and graphics shall be updated accordingly.

.2 Removal shall include the clean-up, removal, and proper termination of all existing pneumatic equipment (tubing, piping, panels, actuators, sensors, etc.), existing electronics (wiring, conduit, actuators, sensors) or existing DDC system (controllers, cabinets, sensors, relays, transformers, power supplies, etc.) no longer used by the BAS.
  .1 ductwork or walls affected shall be patched and sealed or covered with a suitable wall plate
  .2 removal may require the re-piping or rewiring of existing BAS control equipment that is to remain
  .3 pneumatic tubing or piping that cannot be removed shall be suitably plugged to prevent air leakage. Crimping or folding of tubing/piping is not acceptable.
  .4 wiring remaining shall be suitably terminated

.3 Removal shall occur immediately after commissioning of the new control system in the building is complete.

4 Version Control Summary

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	15-09-2014	Entire Standard	Original Issue
1	03/06/2021	Entire Standard	

5 Appendices

5.1 Appendix A - BACNET Advanced Application Controllers (DXR)

BACNET ADVANCED APPLICATION CONTROLLERS (DXR)

A. Each Advanced Application Controller shall operate as a stand-alone controller capable of performing its user selectable control routines independently of any other controller in the system. Each Advanced Application Controller shall provide standard applications and programmability to provide both reliability and flexibility. Each advanced application controller shall be a microprocessor-based, multi-tasking, digital control processor.

B. Basis of design is the programmable Siemens DXR controller.

C. Configurable control applications. Each Advanced Application Controller model must have a set of pre-loaded, selectable and field-adjustable control applications appropriate for the secondary HVAC equipment that the controller model is intended to control. Specific applications must be configurable to meet the user's control strategy requirements, allowing for additional system flexibility.

D. Programmability: Advanced Application Controllers shall be programmable. Program language shall be graphical.

E. The Advanced Application Controller shall include all point inputs and outputs necessary to perform the specified HVAC control sequences. The controller shall accept input and provide output signals that comply with industry standards. Controllers only utilizing proprietary control output signals shall not be acceptable. Controllers shall provide outputs utilized either for two-state, modulating floating, or proportional control, allowing for additional system flexibility.

1. Analog inputs shall be software configurable to accept sensors using 0-10v (such as RH or CO2 sensors), NTC3k, NTC10k, NTC100k, Ni1000, PT1K 385, PT1K 375, and resistance sensors of 1000Ω, 2500 Ω, 10K Ω, and 100k Ω. 24vDC or 24vAC power to drive active sensors shall be an option available from the controller.
2. Differential Pressure sensor (on selected controllers) 0-500 Pa (0-2.0 inwc)
3. Digital input
4. Analog Outputs shall support 0-10v HVAC control signals.
5. Digital outputs shall be AC 24V high-side switching triacs, able to switch loads of 250 mA / 6 VA per output.
6. Every installed Advanced Application Controller shall be prepared for the addition of occupancy, CO2 and humidity sensors
7. Additional sensors and output modules for occupancy, lighting and shade control within the same space as the HVAC control shall be connected as needed via a sub-network connection on each Advanced Application Controller
8. The Advanced Application Controller shall be compatible with a Siemens Room Unit which combines a display with CO2, temperature and humidity sensing in 1 wall device.
9. The Advanced Application Controller shall be compatible with a Siemens Room Unit which combines a display with temperature sensing and configurable switches for lighting, shade and scene control in 1 wall device.

F. Each Advanced Application Controller model must have a set of pre-loaded, selectable and field-adjustable control applications for lighting equipment control, independent from or in conjunction with the HVAC control applications, which can be enabled if the appropriate lighting control devices are connected.

G. Each Advanced Application Controller model must have a set of pre-loaded, selectable and field-adjustable control applications for shading equipment control, independent from or in conjunction with the HVAC control applications, which can be enabled if the appropriate shading control devices are connected.

H. Advanced Application Controller communication

1. Communication over floor level network shall be BACnet over MS/TP or BACnet IP over Ethernet.
2. A maximum of 96 controllers may be configured on individual BACnet MS/TP networks.
3. Each controller that uses BACnet IP shall provide at least two Ethernet ports allowing the controllers to be wired in a daisy-chain configuration of up to at least 20 controllers per chain, utilizing standard Ethernet cables of up to 300ft in length between each controller.

I. The Advanced Application Controller shall have the BTL listing and meet the BACnet device profile of an Advanced Application Controller (B-AAC) as specified in ANSI/ASHRAE 135-2012. The controller shall support the following BACnet BIBBs:

1. Data Sharing
   a. DS-RP-A: Data Sharing – Read Property-A
   b. DS-RP-B: Data Sharing – Read Property-B
   c. DS-RPM-A: Data Sharing – Read Property Multiple-A
   d. DS-RPM-B: Data Sharing – Read Property Multiple-B
   e. DS-WP-A: Data Sharing – Write Property-A
   f. DS-WP-B: Data Sharing – Write Property-B
   g. DS-WPM-A: Data Sharing – Write Property Multiple-A
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6. Advanced Application Controller shall support the following Data Link Layers: a. BACnet MS/TP Master (Clause 9)
   b. BACnet IP, Foreign Device

J. The Advanced Application Controller shall provide for control of each piece of equipment, including, but not limited to the following:

1. Variable Air volume (VAV)

2. Constant Air volume (CAV)
3. Fan Powered Boxes (FPB)
4. Fan Coil Units (FCU) Unit Conditioners
5. Fan Coil Units (FCU) Unit Ventilators
6. Heat Pump Units (HPU): Single, multiple or variable speed compressors
7. Water source HPU. Ground source or loop source water Heat Pump units
8. Terminal Fans (single-speed, multi-speed and variable-speed control)
9. Hot water and electric reheat coils
10. Heating/Cooling coils (2-Pipe and 4-Pipe)
11. DX cooling and chilled water coils
12. Baseboard radiator hot water and electric
13. Chilled, heated or Chilled/heated radiant ceiling panels
14. Chilled beams: Passive and Active

K. Applications for VAV and FPB terminals:

1. The following VAV terminal box equipment and VAV Fan Powered Box configurations must be supported with pre-loaded, pre-tested applications that can be selected and configured during commissioning:
    a. VAV w/cooling only
    b. VAV w/hot or cool primary air,
    c. VAV w/ HW or electric reheat
    d. VAV w/ chilled water or heating/cooling coils
    e. VAV w/ Series or Parallel fan and HW or electric reheat
    f. VAV w/ Series or Parallel fan and chilled water or heating/cooling coils.
2. All VAV applications must support the following options (where appropriate):
    a. Minimum ventilation control and flow set points configurable for each application operating mode
    b. Demand Control Ventilation using IAQ or CO2 measurement for each application operating mode
    c. Separate heating and cooling room temperature setpoints for each occupancy mode of operation.
    d. User input for room temperature shift for both heating and cooling setpoints e. Separate minimum and maximum flow set points for heating, cooling and ventilation
    f. Supply temperature cascade control with minimum and maximum reset range.
    g. Configuration for Constant Volume control
    h. Supply VAV and Exhaust VAV tracking control
    i. Two or more controllers coordinated by a master temperature and ventilation controller independent of central commands.
    j. Dedicated Outdoor Air Systems (DOAS) Ventilation only or demand control ventilation only
    k. Chilled/heated ceiling and Chilled beam
    l. 2-pipe or 4-pipe HW/CHW coil valve control
    m. Variable speed fan control
    n. Single or Multi-speed fan control
    o. Auxiliary/Base-board/Radiator heating, valve, two position or modulating and electric.
    p. Analog or 3-point floating control valve/damper actuation, including 6-way heating/cooling valve via standard BACnet Analog Output objects.
    q. Fault Detection for automatic change to pressure dependent control.
    r. Built in air balancing support.
    s. User initiated rapid ventilation to assist in purging the space for a configurable time with a separate flow set point
    t. Occupancy sensor

u. User initiated temporary occupancy control

L. Applications for Fan Coil terminals:

1. The following Fan Coil terminal unit equipment configurations must be supported with pre-loaded, pre-tested applications that can be selected and configured during commissioning.
2. Heating sources
   a. 2-pipe HW coil
   b. 2-pipe HW/CHW coil, 4-Pipe HW/CHW coil
   c. Electric analog or staged reheat
3. Cooling sources
   a. 2-pipe CHW coil
   b. Single and multiple DX Cooling
4. All Fan Coil applications must support the following options (where appropriate):
   a. Heating/cooling control with no fan
   b. Chilled/heated Ceiling and chilled beam
   c. Dehumidification control
   d. Single, multi-speed or variable speed fan control
   e. Auxiliary/Base-board radiator heating, valve modulating or two position and analog or staged electric
   f. Analog or 3-point floating control valve actuation, including 6-way heating/cooling valve via standard BACnet Analog Output objects.
   g. Occupancy sensor
   h. User initiated temporary occupancy control

M. Applications for Unit Ventilator terminals:

1. The following Unit Ventilator terminal box equipment configurations must be supported with pre-loaded, pre-tested applications that can be selected and configured during commissioning.
   a. Heating and/or Cooling with Outdoor air damper control
2. All Unit Ventilator applications must support the following options (where appropriate):
   a. DX or CHW cooling
   b. Electric or HW heating
   c. 2-pipe HW/CHW coil,
   d. 4-pipe HW/CWH coil
   e. Discharge temperature control
   f. Dehumidification Control Ventilation or/and Demand Control Ventilation for each application operating mode
   g. Single or multi-speed or Variable speed fan control
   h. Auxiliary/Base-board heating,, valve modulating or two position and electric i. Analog control or floating control valve/damper actuation, including 6-way heating/cooling valve via standard BACnet Analog Output objects.
   j. Cooling via economizer control of outside air damper.
   k. Occupancy sensor
   l. User initiated temporary occupancy control

N. Applications for Chilled Beam terminals

1. The following Chilled Beam terminal unit equipment configurations must be supported with pre-loaded, pre-tested applications that can be selected and configured during commissioning.
   a. Chilled Beam Passive Heating and Cooling
   b. Chilled Beam Active Heating & Cooling with VAV, FPB, FCU or HP
2. All Chilled Beam applications must support the following options (where appropriate):

a. Electric or HW heating
b. 2-pipe HW/CHW coil,
c. Discharge temperature control
d. Dehumidification Control (FCU or HP)
e. Ventilation and/or Demand Control Ventilation for each application operating mode
f. Auxiliary/Base-board heating,, valve modulating or two position and electric
g. Analog control or floating control valve/damper actuation, including 6-way heating/cooling valve via standard BACnet Analog Output objects.
h. Occupancy sensor
i. User initiated temporary occupancy control

O. Applications for Heat Pump terminal units

1. The following Heat Pump Unit terminal box equipment configurations must be supported with pre-loaded, pre-tested applications that can be selected and configured during commissioning.
   a. Heat Pump Single speed, multiple speed or Variable Speed compressor
   b. Heat Pump hot gas Reheat control for dehumidification.
   c. Single speed, multiple speed or variable speed terminal fan.
   d. Water source Heat pump for ground source or loop source water supply and control.
   e. Heat Pump with outside air damper with ventilation, economizer and mixed air temperature control.
   f. Heat Pump with reversing valve or direct heating and cooling compressor control.
2. All Heat Pump applications must support the following options (where appropriate):
   a. Single, multi-speed or variable speed Heat Pump with reversing valve control
   b. Water Source control (for water source heat pumps)
   c. Electric staged or analog heating
   d. Hot water modulation heating
   e. Dehumidification Control
   f. Ventilation and/or Demand Control Ventilation for each application operating mode
   g. Auxiliary/Base-board radiator hot water valve or modulating or two position electric
   h. Analog control or floating control valve/damper actuation, including 6-way heating/cooling valve via standard BACnet Analog Output objects.
   i. Cooling via economizer control of outside air damper.
   j. Occupancy sensor
   k. User initiated temporary occupancy control

P. Applications for Light Control

1. Each Advanced Application Controller shall provide a set of pre-loaded, selectable and field-adjustable control applications for lighting equipment control, independent from or in conjunction with the HVAC control applications, which can be optionally enabled if the appropriate lighting control devices are connected.
2. The following Lighting control equipment must be supported with pre-loaded, pre- tested applications that can be selected and configured during commissioning:
   a. ON/OFF Lighting
   b. Line voltage Dimmed Lighting
   c. 0-10V Dimmed Lighting
3. All Lighting control applications must support the following options (where appropriate):
   a. Manual Switching / Dimming
   b. Occupancy / Vacancy control
   c. Automatic Light Level control
   d. Accept floor or building wide commands from the BMS such as scheduled control

Q. Applications for Motorized Shade Control

1. Each Advanced Application Controller shall provide a set of pre-loaded, selectable and field-adjustable control applications for shading equipment control, independent from or in conjunction with the HVAC control applications, which can be optionally enabled if the appropriate shading control devices are connected.
2. The following Shade control equipment must be supported with pre-loaded, pre- tested applications that can be selected and configured during commissioning
   a. Indoor or outdoor motorized shades, with or without tilting slats, supporting a 2-relay interface for positioning the shades
3. All Shade control applications must support the following options (where appropriate):
   a. Manual Shade control
   b. Occupancy / Vacancy control
   c. Accept floor or facade level commands from the BMS such as solar glare protection

R. Provide centralized control functions for secondary HVAC control, Lighting, and Shading

1. Functions for coordinating control across a grouping of rooms, a floor area, entire floor, façade, mechanical or electrical supply chains, or different combinations thereof shall be provided.
2. Support commanding of all group members to a common position or state.
3. Support consolidation of common information from group members for calculation or optimization purposes
4. Central functions shall reside in an Advanced Application Controller dedicated to the central control functions specified herein.
5. Members of the groups used by the central functions specified herein shall be assigned and be changeable through standard BACnet services.

S. Central functions for Secondary HVAC – Primary Supply Air: Utilize the HVAC control status and conditions in a large number of Advanced Application Controllers in order to support optimization of primary Supply Air HVAC plants.

1. Central Supply Air function collects air demand data from rooms (Advanced Application Controller flow control loops) to support demand-based run/stop decisions for air handler. Rooms indicate need for primary heating, cooling and ventilation.
2. Central Supply Air function collects data from rooms (Advanced Application Controller flow loops) to minimize duct pressure. Advanced Application Controllers provide multiple signals to support duct pressure reset, including damper command, damper saturation signal and air flow deviation signal. All are available for collection by Central Air application.
3. Central Supply Air function collects data from rooms (Advanced Application Controller control loops) to support dynamically optimizing the primary supply air temperature. Data available from the Advanced Application Controller includes cooling demand and demand in the room for reheat.
4. Central Supply Air function collects data from rooms (Advanced Application Controller control loops) to support dynamically optimizing the outside air intake. Data available from the Advanced Application Controller includes ventilation demand and CO_2 levels.

T. Central functions for Secondary HVAC –Hot Water Supply: Utilize the HVAC control status and conditions in a large number of Advanced Application Controllers in order to support optimization of primary Hot Water HVAC plants.

1. Central Hot Water Supply function collects hot water demand data from rooms to support demand-based run/stop decisions for central hot water systems. Rooms indicate demand for hot water for heating.
2. Central Supply Hot Water function collects data from rooms to support dynamically optimizing the hot water supply temperature to rooms. Data

available from the Advanced Application Controller includes heating demand in the room for reheat.

3. Central Supply Hot Water function supports temporary override of group member valve positions to support hydraulic balancing and testing during commissioning of hot water supply loops.
4. Central Supply Hot Water function supports temporary command “Valve Kick” to prevent hot water heating valves from sticking, during off-season (e.g., cooling season). Valve Kick global commanding shall provide adjustable settings for: Kick cycle (e.g., 500 hrs), Kick time (e.g., 2 mins) and Kick value (e.g., 50%)

U. Central functions for Secondary HVAC – Chilled Water Supply: Utilize the HVAC control status and conditions in a large number of Advanced Application Controllers in order to support optimization of primary Chilled Water HVAC plants.

1. Central Chilled Water Supply function collects chilled water demand data from rooms to support demand-based run/stop decisions for central chilled water systems. Rooms indicate demand for chilled water for cooling.
2. Central Supply Chilled Water function collects data from rooms to support dynamically optimizing the chilled water supply temperature to rooms. Data available from the Advanced Application Controller includes cooling demand in the room.
3. Central Supply Chilled Water function supports temporary override of group member valve positions to support hydraulic balancing and testing during commissioning of chilled water supply loops.
4. Central Supply Chilled Water function supports temporary command “Valve Kick” to prevent hot water heating valves from sticking, during off-season (e.g., heating season). Valve Kick global commanding shall provide adjustable settings for: Kick cycle (e.g., 500 hrs), Kick time (e.g., 2 mins) and Kick value (e.g., 50%)

V. Central functions for Secondary HVAC – Water source Heat pumps: Utilize the HVAC control status and conditions in a large number of Advanced Application Controllers in order to support optimization of water source Heat pumps.

1. Central Heat Pump Source function collects heat pump demand data from rooms to support demand-based run/stop decisions for water source systems. Rooms indicate demand for heat pump source water.
2. Central Heat Pump function supports temporary override of group member valve positions to support hydraulic balancing and testing during commissioning of water source heat pump supply loops.

W. Coordination between Advanced Application Controllers. In situations where more than one controller is serving a common space, it must be possible through configuration only (not reprogramming) to subordinate one or more Advanced Application Controllers to another Advanced Application Controller allowing multiple controllers to coordinate HVAC control in a large space.

X. Application Operating Modes - All of the following operating modes shall be supported, with configurable operation of each controlled device during each mode.

1. Comfort, Standby (Pre-comfort), Economy, and Building Protection modes
   a. Comfort: Space is occupied
   b. Standby: Space has been or will be unoccupied for a short time
   c. Economy: Space has been or will be unoccupied for a longer time
   d. Building Protection: Space has been or will be unoccupied for a more than a day
2. Configurable set points and limits for each mode.
   a. The operating mode can be changed by system schedule or command or by conditions in the space such as by presence detection.
   b. All controlled devices shall respond to changes in operating mode in a configurable way such as set point resets after a configurable time to optimize energy consumption.

Y. Room Units / HMIs shall provide an intuitive user alert to indicate energy-efficient operation or when there is unnecessary energy consumption, and provide occupants with a one-touch release to return to efficient, comfortable control. Energy efficient operation shall be determined by configurable and programmable algorithms provided by the Advanced Application Controller and shall include (but not be limited to) the following conditions:

1. Temperature set point is set outside customer-specified limits
2. Fan Speed is overridden to a higher speed than is required for automated temperature control.
3. The energy efficiency status for each Advanced Application Controller and space shall also be available as BACnet object at the BMS for operating and monitoring.
4. Manual override of brightness control, lights using more energy than needed to light the space
5. Shades are overridden to position that allows too much solar radiation into the room during cooling modes, wasting HVAC energy

Z. Scene control. The Advanced Application Controller shall provide a set of configurable and field-adjustable presets of HVAC, lighting and shading levels that can be activated by pressing assigned buttons on the Room Unit / HMI.

AA. Advanced Application Controller Configuration and Commissioning Tool

1. Provide industry standard, commercially available laptop to host the Advanced Application Controller Configuration and Commissioning Tool. The tool shall plug directly into all controllers as described below:
2. Functionality of the Configuration and Commissioning Tool connected to any Advanced Application Controller shall include:
   a. Provide connection capability at either the controller, a related room unit, through a BACnet router or through a Siemens Field Panel controller to access controller information.
      1) When connected via a related room unit to a controller, the tool shall be able to access information of the controller the room unit is connected to and all controllers connected to the same MS/TP or IP network.
      2) Connection of the Tool to a controller shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted or preclude centrally-initiated commands and system modification.
      3) Tool access to controller shall be password-controlled. Password protection shall be configurable for each operator based on function, points (designating areas of the facility), and edit/view capability.
   b. Provide device discovery, configuration and setup for addressing and network management of multiple devices from one connection point (location) in parallel.
   c. Select, view, command, change, and enable/disable features and functionality of the control application.
   d. Load pre-designed templates of configuration settings and allow copying of templates to other controllers in order to speed the commissioning process.
   e. Provide status, setup, balancing and control reports to support commissioning and troubleshooting activities.
   f. Backup and restore of application configurations
   g. Air flow balancing.
      1) For every air flow sensing channel in the Advanced Application Controller control application, the Tool shall offer an interface and menu specifically designed to support the Test, Adjust, and Balance functions. Through the balancing menu, the controller enables the following operations:
         a) Select the operating point for the test from a list of named operating points, including maximum and minimum cooling, maximum and

minimum ventilation and maximum and minimum heating.
b) Accept the balancer's flow measurement as a manually entered value.
c) Automatically calculate and display the revised flow calibration factor.
d) Apply the new calibration factor on command.

2) The Advanced Application Controller shall maintain a BACnet object reflecting the TAB state of the controller as: Initial, Balancing, Balanced. The Advanced Application Controller records data representing the TAB process, and stores for later retrieval. The controller delivers the data when called for producing reports. Stored data includes:
a) Air balancer's air flow measurement.
b) Controller's air flow measurement after correction.
c) Named test point (max cooling, etc.).
d) Initial calibration factor.
e) Applied selected calibration factor

h. The tool should allow configuring, loading and balancing multiple controllers from one connection point (location) in parallel

i. The Ethernet / IP Advanced Application Controller models shall provide web pages for troubleshooting and operation and monitoring which can be accessed via a standard web browser

BB. Each Advanced Application Controller shall, at a minimum, be provided with:
1. Appropriate NEMA rated enclosure
2. Power supplies as required for all associated modules, sensors, actuators, etc.
3. Each controller measuring air volume shall include a differential pressure transducer
4. Approvals and standards: UL916 PAZX; UL864 UUKL; CUL; FCC
5. Plenum rated per UL94-5VB flammability rating, UL1995

CC. Each Advanced Application Controller shall continuously perform self-diagnostics on all hardware and secondary network communications. The Advanced Application Controller shall provide both local and remote annunciation of any detected component failures or repeated failure to establish communication to the system.

DD. Power Supply. The Advanced Application controller shall be powered from a 24 VAC, 50/60 Hz source and shall function normally under an operating range of -15% / +20%.

EE. All controller configuration settings and programs shall be stored in non-volatile memory. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.

FF. Environment. The controllers shall function normally under ambient conditions of 23 to 122°F (-5 to 50°C) and 5% to 95% RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the circuit board assembly

5.2 Appendix B - Pressure Independent Control Valves

PRESSURE INDEPENDENT CONTROL VALVES (PICV)

A. General

1. All control valves shall be sized by the control vendor. All control valve bodies shall be suitable for the static and dynamic pressures of the system. Control valve operators shall be sized to close against a differential pressure equal to the design pump head plus 10 percent.

   a. Body pressure rating and connection type construction shall conform to fitting and valve schedules. Design body pressure shall be determined by the adding the static pressure due to the height of the system plus the compression tank charge plus the maximum head of the system pump at cut off. Provide 10% design factor.

2. The valve seat differential pressure rating shall exceed the pump dynamic head design pressure.

2. All automatic control valves controlled by the BAS shall be furnished by the controls contractor unless otherwise noted in these documents.

3. All automatic control valves shall be installed by the mechanical trade.

4. The controls contractor shall provide wiring as follows:

   a. All line voltage power for electric valve actuators shall be wired by the controls contractor from the nearest available power panel. Coordinate with electrical trade.

   b. All low voltage wiring between the controller and the valve actuator shall be wired by the controls contractor.

   c. All wiring between safeties and the valve actuator shall be wired by the controls contractor.

   d. All wiring shall comply with code requirements. Segregate high and low voltage wiring and circuits and segregate the Fire Alarm (FACS) and BAS controls wiring.

B. Manufacturer

1. Siemens 599 series valves bodies, SSD, SAY, SAX, SAV and SQV Actuators, Series 230, 231, 232, 233, 238, 239, 334, 335, 371, 373, 378 and 379 assemblies

C. Where to use PICVs

1. Provide PICVs where called for in the specifications, sequences of operations, or on the drawings.

2. If it is not stated elsewhere, PICV valves should be provided to meet the following guidelines:

   a. Provide in direct return, constant speed pumping systems.

   b. Provide in direct return, variable flow water systems where with the system at full flow the pressure differential between the supply connection and the return connection is more than double the pressure drop of the circuit or loop at design flow (including piping, fittings, devices, control valve and coil).

   c. Provide in reverse return, constant speed pumping systems where the circuits and loop pressure drops differ by more than 50%.

d. Provide in reverse return, variable speed pumping systems where the differential pressure between the systems will vary more than the pressure drop of the circuit or loop.

e. Provide in systems that have direct return headers and reverse return branch lines where with the system at full flow the pressure differential between the supply connection and the return connection is more than double the pressure drop of the branch at design flow (including piping, fittings, devices, control valve and coil).

D. Piping for circuits with PICVs

1. Systems installed with PICVs shall not require balancing valves.

2. Calibrated balancing valves shall not be required in branches or loops where PICV are installed.

3. Automatic flow control valves are strictly prohibited in branches or loops where PICVs are installed.

4. Circuit setters may be required for coils with multiple sections. Follow the piping details.

5. Install pressure ports on either side of the coil for the balancer to test the flow across the coil at different system flows.

E. Sizing Criteria (Pressure Independent):

1. Two-way modulating service:

a. Determine the design GPM of the actual coil that is selected be used (may be different than the coil and GPM on the design coil schedule).

b. Select the PICV valve with a GPM rating higher than the GPM required.

c. If more than one valve fits the GPM rating, then pick the valve that matches or is closest to the line size of the circuit piping.

d. If the maximum GPM of the valve exceeds the design GPM required, then adjust the Flow Limiter setting on the valve to the GPM required.

e. Traditional flow coefficient and pressure drop sizing is not applicable to PICV valves.

F. Flanged Valves, line size 2 ½” and larger

1. Controlled Media Specific Items

a. The control valve shall be suitable for chilled water to a minimum of 34°F (1°C) and hot water to a maximum temperature of 248°F (120°C).

b. The control valve shall be suitable for up to 50% ethylene or propylene glycol solutions, chilled glycol/water solutions to a minimum of 34°F (1°C) and hot glycol/water solutions to a maximum temperature of 248°F (120°C).

2. General Construction Materials/Applicable

a. Control valve bodies shall be constructed of cast iron and shall meet requirements of ANSI 125 or ANSI 250 pressure classes.

b. Inlets and outlets shall be clearly marked on the valve bodies.

c. Valves shall be constructed with a single chamber and multiple seats to provide flow limiting, pressure compensation and flow control.

d. Valves shall contain a mechanical, spring-loaded pressure independent regulator to maintain a consistent differential pressure across the control port of the valve.

e. Valves shall contain an actuated flow control portion that responds to the modulating signal from the controller. This control valve portion shall have a linear flow characteristic.

f. Valves shall contain a field adjustable flow limiter. The flow limiter shall be easily adjustable in the field without the use of special tools. The adjustment dial shall be set for and indicate maximum flow. It shall be possible to manually limit the flow to the required value with the flow limiter and then modulate the flow with the control valve and actuator.

   1) A table shall be attached to each valve indicating GPM corresponding to each setting on the dial.

   2) No mechanical devices besides the valve and actuator shall be permitted to adjust the maximum flow setting. Flow limiting port shall be integrated into the valve body.

   3) The valve shall always maintain full nominal stroke regardless of the maximum flow setting of the flow limiter.

   4) The flow limiter shall be lockable and tamper resistant when the actuator is installed correctly.

g. At any given actuator setting the flow accuracy across the entire pressure independent operating range of the automatic differential pressure regulator shall be ±10% or less.

h. Pressure ports shall be standard in the body of the valve for all flanged valves. Pressure ports shall provide a means for a balancer to test the differential pressure across the valve control port to ensure the PICV is operating within the pressure independent range.

i. Valves 2-1/2 inch and larger shall be provided with ANSI 125 or ANSI 250 flanged connections.

j. Valves 2-1/2 inch and larger line size shall meet or exceed ANSI Class IV (0 to 0.01% of nominal maximum) leakage rating at 100 psi close off.

k. The differential pressure range for effective pressure independent operation shall be 3.6 – 90 psi or 8 – 90 psi for 2-½ and 3 inch flanged valves and 5 – 90 psi or ≤ 10 – 90 psi for 4 to 6 inch flanged valves, depending on the maximum gpm flow range of the valve.

l. Valve materials shall meet or exceed the following:

   1) Valve body: Cast iron

   2) Stem, spring: Stainless steel

   3) Seat: Stainless steel

   4) Plug: Brass and EPDM

5) Seals: EPDM (peroxide cured)

G. Threaded Valves, line size ½” to 2”

1. Controlled Media Specific Items

a. The control valve shall be suitable for chilled water to a minimum of 35°F (2°C) and hot water to a maximum temperature of 250°F (121°C).

b. The control valve shall be suitable for up to 50% ethylene or propylene glycol solutions, chilled glycol/water solutions to a minimum of 35°F (2°C) and hot glycol/water solutions to a maximum temperature of 250°F (121°C).

2. General Construction Materials/Applicable Standards

a. Control valve bodies shall be constructed of forged DZR brass or ductile iron and shall meet requirements of ANSI 250 pressure class.

b. Inlets and outlets shall be clearly marked on the valve bodies.

c. Valves shall be constructed with a single chamber and multiple seats to provide flow limiting, pressure compensation and flow control.

d. Valves shall contain a mechanical, spring-loaded pressure independent regulator to maintain a consistent differential pressure across the control port of the valve.

e. Valves shall contain an actuated flow control portion that responds to the modulating signal from the controller. This control valve portion shall have a linear flow characteristic.

f. Valves shall contain a field adjustable flow limiter. The flow limiter shall be easily adjustable in the field without the use of special tools. The adjustment dial shall be set for and indicate maximum flow. It shall be possible to manually limit the flow to the required value with the flow limiter and then modulate the flow with the control valve and actuator.

1) The dial shall show settings in GPM.

2) No mechanical devices besides the valve and actuator shall be permitted to adjust the maximum flow setting. Flow limiting port shall be integrated into the valve body.

3) The valve shall always maintain full nominal stroke regardless of the maximum flow setting of the flow limiter.

4) The flow limiter shall be lockable and tamper resistant when the actuator is installed correctly.

g. At any given actuator setting the flow accuracy across the entire pressure independent operating range of the automatic differential pressure regulator shall be +/- 5% from 5 to 58psi and $\leq$-10% from Δp min. to 5 psi.

h. Pressure ports shall be an optional accessory that can be added to threaded valves. Pressure ports shall provide a means for a balancer to test the differential pressure across the valve control port to ensure the PICV is operating within the pressure independent range.

i. Valves 2 inch and smaller shall be provided female NPT piping connections.

j. Close-off and leakage

1) Normally open valves 1-1/4 inch and smaller line size shall meet or exceed ANSI Class IV (0 to 0.01% of nominal maximum) leakage rating at 200 psi close off.

2) Normally closed valves 1-1/4 inch and smaller line size shall meet or exceed ANSI Class IV (0 to 0.01% of nominal maximum) leakage rating at 45 psi close off.

3) Valves 1-1/2 and 2 inch line sizes shall meet or exceed ANSI Class IV (0 to 0.01% of nominal maximum) leakage rating at 100 psi close off.Differential pressure ranges:

4) The start-up differential pressure of the automatic differential pressure regulator shall be between 2.3 and 5 psi, depending on valve size and flow rate for ½ to 2 inch valves.

5) The maximum operating differential pressure of the automatic differential pressure regulator shall be 58 psi for ½ to 2 inch valves.

6) In no instance shall the minimum effective pressure differential for effective pressure independent operation exceed 5 psi for valves less than or equal to 2 inch line size.

k. Valve materials shall meet or exceed the following:

1) Valve body: DZR brass or ductile iron

2) Stem, spring: Stainless steel

3) Seat: brass

4) Plug: Brass and EPDM

5) Seals: EPDM (peroxide cured)

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSM-04

FIRE PROTECTION SYSTEMS

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1 INTRODUCTION

1.1 General

.1 This Fire Protection Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Fire Protection Systems (Sprinklers and Fire Standpipe) installed on campus.

.2 The University's minimum expectations and requirements for new Plumbing Systems installed on campus are covered under Standard DSM-02.

.3 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new Fire Protection installation within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing Fire Protection infrastructure

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Mechanical Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Mechanical Design, DEC, together with proposed measures for addressing the conflict.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovation shall be tabled for consideration by the Manager, Mechanical Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

.1 Ontario Building Code
.2 Ontario Fire Code
.3 Mechanical Plumbing Systems Standard DSM-02*
.4 Electrical Power Systems Standard DSE-01*
.5 Electrical Fire Alarm Systems Standard DSE-03*
.6 Campus Domestic Water System Schematic
.7 City of Guelph Cross Connection Bylaw (Backflow Bylaw)
.8 NFPA Standards
.9 University's Identification Standard*
.10 Underwriters Laboratories Canada (ULC)
.11 Insurers' Advisory Organization (IAO) Risk Management Services (RMS)

* A copy of these standards is available on University of Guelph Physical Resources web page

2 DESIGN STANDARDS

2.1 General

.1 The requirements outlined in the following clauses are applicable to all Fire Protection Systems; Application Specific requirements are outlined under clauses 2.2 – 2.9

.2 Space Hazard Classification for Protection:

- .1 Space Hazard classification for the purposes of establishing the minimum level of fire protection shall be as defined under NFPA 13.

.3 Fire Protection Systems shall encompass the following:

- .1 Standpipe & Hose Systems
- .2 Sprinkler System – Dry Sprinklers, Wet Sprinklers & Pre-action Sprinklers
- .3 Gas Fire Suppression Systems
- .4 Kitchen Hood Suppression Systems

2.2 Incoming Fire Water Service

.1 Incoming water service shall be extended from the University's Premise Protected Campus Water Distribution Main.

- .1 Incoming water service shall be common with the water service extended to serve the building plumbing systems.
- .2 Branch off the fire water service line upstream of any water meter and/or cross-connection protection device.
- .3 Provide a Double Check Detector Assembly (DCDA) in the fire water service main.

2.3 General Requirements – Fire Protection System

.1 Renovation Projects – Minor Renovations

- .1 Modify existing Fire Protection Systems, as applicable, to suit new Work. Maintain the design criteria followed for the existing installation.

.2 Renovation Projects – Major Renovations

- .1 Modify existing Fire Protection Systems, as applicable, to suit new Work. Maintain the design criteria followed for the existing installation.
- .2 Where an existing building does not have a functioning Sprinkler System, develop a conceptual design solution with an accompanying Class C Cost Estimate to provide the area of work and the building a new Sprinkler System following the criteria outlined under Clause 2.3.3. Also, in collaboration with the Architect develop a Cost-Benefit Analysis addressing a new sprinkler installation versus other Compensating Construction to comply with Codes. This Conceptual Design Solution and Cost-Benefit Analysis shall be tabled as a part of the Schematic Design submission.

.3 New Construction Projects

- .1 All new buildings shall be fully sprinklered
  - .1 Arrange sprinkler zones in accordance with NFPA 13.
  - .2 Where practical and feasible without increasing the number of sprinkler zones, arrange sprinkler zones to overlap with architectural fire separations forming a part of an all-encompassing Fire Compartment for the purposes of establishing an Area of Refuge.

.3 Where sprinklers are being used in lieu of detectors, coordinate sprinkler zoning with the Fire Alarm System design.

- Sprinklers serving Chemical Storage Rooms and other Special Areas (to be identified through consultation with the architect during the Schematic Design Phase) shall be zoned independent of other zones.

.4 Where building is equipped with a fire alarm system, zoning of sprinkler systems shall match the boundaries of the fire alarm zones. More than one fire alarm zone may be contained within each sprinkler zone.

.5 If a sprinkler system is not required by Code then option to omit sprinkler system, together with an accompanying cost-benefit analysis, shall be presented for the approval of the Manager, Mechanical Design, DEC before completion of the Schematic Design.

.2 All new buildings shall be provided with a fire standpipe system

.1 If a standpipe system is not required by Code then option to omit standpipe system, together with an accompanying cost-benefit analysis, shall be presented for the approval of the Manager, Mechanical Design, DEC before completion of the Schematic Design.

2.4 Fire Pump

.1 A Fire Pump Assembly (Fire Pump + Jockey Pump) shall be provided, as necessary, to support the facility Standpipe and Sprinkler Water Demand; Jockey Pump Start/Stop shall be automated.

.2 The need for a fire pump assembly shall be identified at the Schematic Design stage and supported with a Hydrant Flow Test and Preliminary Hydraulic Calculations.

.1 Consideration shall be given to increasing the size of the sprinkler and standpipe system piping to satisfy the system hydraulic demand before opting to use a fire pump.

.2 Where provided, a fire pump installation shall comply with NFPA 20

- Fire Pump Assembly must be on the Essential Power system.
- Coordinate Essential Power supplies to the Fire Pump Assembly with the electrical designer and the Electrical Power Systems Standard DSE-01.
- Coordinate Fire Alarm interface to the Fire Pump Assembly with the electrical designer and the Electrical Fire Alarm Systems Standard DSE-03.
- Provide a ULC/FM listed Bypass Flow Meter across the Fire Pump.

2.5 Sprinkler Systems

.1 Sprinkler Systems shall be hydraulically designed.

.2 Sprinkler Systems shall be the “Wet-Pipe Type”; exceptions include:

.1 Dry-Pipe System shall be considered for Loading Docks, Unheated or Partially Heated Soffits and other areas that could be exposed to freezing conditions.

.2 A Single-Interlock or Double-Interlock Pre-action System shall be considered for a Transformer Room, Main Electrical & Switchgear Room. Critical Equipment Rooms, Computer Rooms and LAN Rooms

- Selection of a Pre-action System as the sprinkler system of choice shall be presented for the approval of the Manager, Mechanical Design, DEC before the completion of Schematic Design.
- Where provided, a Pre-action System shall be configured around the use of a Packaged Pre-action System Cabinet such as the TotalPac Pre-action System or equivalent.

.3 Sprinkler Piping
  .1 Wet-Pipe Systems
    - Piping shall be Schedule 20 Black Steel with flanged, screwed or grooved connection; use of a lower pipe schedule is not permitted without the prior approval of the Manager, Mechanical Design, DEC.
    - Use of Pressfit piping is not permitted.
  .2 Dry-Pipe Systems
    - Piping shall be Schedule 20 Galvanized Black Steel with flanged, screwed or grooved connection; use of a lower pipe schedule is not permitted without the prior approval of the Manager, Mechanical Design, DEC.
    - Use of Pressfit piping is not permitted.
    - A Blow-out connection with a Schrader Valve shall be provided on all Dry-Pipe Systems
  .3 Pre-action Systems
    - Piping shall be Schedule 20 Galvanized Black Steel with flanged, screwed or grooved connection; use of a lower pipe schedule is not permitted without the prior approval of the Manager, Mechanical Design, DEC.
    - Use of Pressfit piping is not permitted.
    - A Blow-out connection with a Schrader Valve shall be provided on all Dry-Pipe Systems.
  .4 Use of "Prefabricated Flexible Piping" with an integral sprinkler head is permitted only with the prior approval of the Manager, Mechanical Design, DEC. Such requests shall be tabled for consideration at the Schematic Design Phase.

.4 Sprinkler Heads
  .1 Sprinkler heads for Wet-Pipe Systems and Pre-action Systems in areas with a finished ceiling shall be of the Semi-Recessed type. Exceptions include:
    - Use of Concealed type sprinkler heads may be considered only in Board Rooms, Large Meeting Rooms and other similar areas where "Form & Aesthetics" are deemed as important as "Function". However, use of Concealed type sprinkler heads is not permitted without the prior approval of the Manager, Mechanical Design, DEC.
  .2 Sprinkler heads for Wet-Pipe Systems, Dry-pipe and Pre-action Systems in areas without a finished ceiling shall be of the Upright type.
  .3 Sprinkler Heads in Mechanical Rooms, Gymnasiums, or other similar areas where mechanical damage is a possibility, shall be provided with "cages".
  .4 Sprinkler heads in Generator Rooms and other areas with expected high ambient temperature shall be selected as High Temperature Heads suitable for the intended location.

.5 Valves
  .1 Refer clause 2.8

2.6 Standpipe System

.1 Standpipe systems shall be hydraulically designed.

.2 Standpipe Cabinets
  .1 Cabinets shall be Recessed type in all "Finished" areas
  .2 Cabinets shall be Semi-recessed or Surface mounted type in all other areas.
  .3 Cabinets shall be sized to accommodate one 9 kg (20 lb.) ABC fire extinguisher.
  .4 Door shall be Flush, with a full Lexan face, hinged, positive latch device as required.

- Use of Glass or Wired Glass is permitted only with the prior approval of the Manager, Mechanical Design, DEC. Such requests shall be tabled for consideration at the Schematic Design Phase.

.5 Cabinet finish shall be suitable for the application and location; all internal components shall be polished and chrome plated. As a rule cabinets shall be painted Visible Red or left as polished Stainless Steel.

.6 Hose lengths shall be 30m (100 ft.)

.3 Standpipe Piping

.1 Piping shall be Schedule 40 Black Steel with flanged, screwed or grooved connection; use of a lower pipe schedule is not permitted without the prior approval of the Manager, Mechanical Design, DEC.

.2 Use of Pressfit piping is not permitted.

.4 Use of Pressure Reducing Devices shall be avoided to the extent possible. Where provided, a dedicated and appropriately sized drain riser shall be provided adjacent to the Pressure Reducing Device to facilitate annual testing.

.5 Valves

.1 Refer clause 2.8

2.7 Gas Fire Suppression System

.1 Selection of a Gas Fire Suppression System as the sprinkler system of choice for a specific area shall be presented for the approval of the Manager, Mechanical Design, DEC before the completion of Schematic Design.

.2 Where provided, a Gas Fire Suppression System shall be configured around the use of a Novec 1230 as the suppression agent of choice.

.3 Valves

.1 Refer clause 2.8

2.8 Fire Protection System Valves

.1 All valves shall be supervised

.1 Supervisory devices shall be hard-wired; use of plug-in cord type supervisory devices is not permitted.

.2 Shut off valves shall

.1 be located in restricted use corridors or service rooms and not within occupied spaces.

.2 be accessible by personnel standing on the floor without ladders or other aids.

2.9 Fire Extinguishers

.1 A Fire Extinguisher shall be provided in every Fire Hose Cabinet, Mechanical Room, Electrical Room.

.1 In addition provide a fire extinguisher in all other areas as called for in the Room Data Sheets or identified though the Functional Planning and Programming.

.2 Fire Extinguishers not included with a Fire Hose Cabinet shall be installed in Mounting Cabinet.

.3 Standard of Acceptance: Amerex

3 PRODUCT & INSTALLATION STANDARDS

3.1 General

.1 The requirements outlined in the following clauses are applicable to all Fire Protection Systems; Application Specific requirements are outlined under clauses 3.2 and 3.3.

3.2 Equipment

.1 Fire Pumps
- .1 Fire Pumps shall be installed on a 6” (150 mm) housekeeping pad.
- .2 Fire Pumps shall be installed with an upstream strainer and upstream and downstream supervised isolation valves.
- .3 Fire Pumps shall be installed in a dedicated Service Room or a Mechanical Room. This room may be shared with the Incoming Water Meter Room as called for under the Plumbing Systems Standard DSM-02.

.2 Incoming Fire Water Service Cross-Connection Protection Device
- .1 Cross-Connection Protection Device on the incoming fire water service shall be installed between upstream & downstream isolation valves. These isolation valves may be shared with the Fire Pump.
- .2 Cross-Connection Protection Device shall be installed in the same Service Room or Mechanical Room as the Fire Pump.

3.3 Identification and Labeling

.1 All fire water piping should be painted “Fire Red” and labelled as to its service – Sprinkler Pipe, Dry-Sprinkler, Pre-Action Sprinkler, Standpipe.

.2 All Equipment and Piping Systems shall be identified in accordance with the University’s Identification Standards and numbering convention. Equipment numbers are to be provided by the University’s PM Scheduler.

.3 Equipment numbering strategy shall be presented for review/approval by the Manager, Mechanical Design, DEC and Manager, Maintenance & Energy Services prior to completion of Design Development.

4 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	15-09-2014	Entire Standard	Original Issue

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSE-01

ELECTRICAL POWER SYSTEMS

Version	Revision 0	
Effective Date	08-29-14	
Approved By		
	Manager, Electrical Design, DEC	
Reviewed By	Dec 1 - 14	
	Director, MES	

TABLE OF CONTENTS

1 INTRODUCTION

1.1 General

.1 This Electrical Power Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Electrical Power Systems installed on campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new Electrical Power System installation within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing Electrical Power System infrastructure

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Electrical Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Electrical Design, DEC, together with proposed measures for addressing the conflict.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovation shall be tabled for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

.1 Ontario Building Code

.2 Canadian Electrical Code

.3 Electrical Lighting Standard DSE-02*

.4 Electrical Fire Alarm System Standard DSE-03*

.5 Security, IT & Communications Standard DSE-04*

.6 Mechanical HVAC Standard DSM-01*

.7 Campus Power Distribution System Single Line Diagram

* A copy of these standards is available on University of Guelph Physical Resources web page

2 DESIGN STANDARDS

2.1 General

The University of Guelph is supplied primary electrical power at 13.8kV grounded from the Guelph Hydro Distribution System. There are a total of 6(six) Incoming Lines supplying the main campus through 3(three) locations. (reference drawings # 209Reference – E3, …-E3A, …-E3B). The power is distributed throughout campus to over 30 substations using cables run in tunnels and ductbank/manhole systems. The majority of substations are loop fed to provide security of supply. Substations utilize high voltage switches for the loop feeds including one “tie switch” and fused switches for each transformer. The loops are operated with one open point. Where primary power is required for a project, early consultation is required with the Manager, Electrical Design, DEC to establish service entrance points and other related requirements.

.1 The requirements outlined in the following clauses are applicable to all Electrical Power Systems; Application Specific requirements are outlined under clauses 2.2 – 2.13.

.2 Primary Power Supply (13.8kV)

.1 Major substations (re: Science Buildings) shall be supplied as a loop configuration and are to be doubled ended switchgear design c/w dual tie breakers to facilitate safer maintenance.

.2 Radially fed substations can be considered on a case by case basis.

.3 Secondary Power Supply (600 V, 3 phase, 3 wire).

.4 Secondary Metering

.1 Metering shall be installed on the 600 V side of the main transformer(s) using Schneider Power Logic ION 7650 c/w communication card.

.2 Sub-metering is to be installed on all circuits coming from the main switchboard(s) using Schneider Power Logic PM850 daisy chained to the ION 7650.

.3 All meters are to be connected into the central metering system using the communication card and via the ethernet and be fully programmed c/w additions/corrections to the system graphics by a qualified Schneider technician.

.5 Transformers

.1 13.8 kV/600-347 V Dry Type

.2 Each transformer sized to support a maximum of 150 % of the Connected Load; any deviations shall be submitted for consideration by the Manager, Electrical Design, DEC for approval before finalization of the Schematic Design.

.1 Sizing supported by Connected Load and Demand Load Calculations.

.6 Substation, Switchgear & Switchboards

.1 Double-Ended Substation configuration with dual Tie-Breakers.

.7 Generators

.1 Generator shall be 600/347 V, 0.8 Power Factor, Prime Rated, designed for operation using Diesel Fuel.

.1 A Cost-Benefit Analysis for the use of Natural Gas and Dual Fuel Generators shall be shall be submitted for consideration by the Manager, Electrical Design, DEC as a part of the Schematic Design submission.

.2 Sized to support Defined Emergency Power Loads and Life Safety Loads.

.1 Sizing supported by Connected Load and Demand Load Calculations.

.3 A minimum of two (2) Generators, each sized to support 100% of the Emergency Power needs.

.1 A Single Generator sized to support 125% of the Emergency Power needs will be deemed adequate in the case of a Building designated exclusively for an Administrative or Classroom Type Use.

.8 A computer generated colour Short Circuit Calculation / Coordination Study / Arc Flash Study shall be undertaken for the entire Electrical Distribution System for all New Construction Projects.

.1 Measures shall be implemented in the design to limit Arc Flash Hazard Category to a Level 3 or lower for all equipment installed within Transformer Rooms, Switchgear Rooms, Main Electrical Rooms and Generator Rooms.

.2 Measures shall be implemented in the design to limit Arc Flash Hazard Category to a Level 2 or lower for all equipment installed within Electrical Closets, Mechanical Rooms and Service Rooms.

2.2 General Requirements – Electrical Normal (Utility) Power System

.1 Renovation Projects

.1 Modify existing Normal (Utility) Power System to suit new Work. Maintain the design criteria followed for the existing installation.

.2 New Construction Projects

.1 Power distribution within the building to follow a “Radial” design philosophy

.2 Power distribution shall be designed to separate General Power Load, Lighting Load and Mechanical Load, and permit the use of check metering.
.3 Distribution Panels, Wiring Devices and Power Connections in accordance with clause 2.5.
.4 Equipment Identification in accordance with clause 2.6

2.3 General Requirements – Electrical Emergency Power System

.1 Renovation Projects
.1 Modify existing Emergency Power System to suit new Work. Maintain the design criteria followed for the existing installation. Power Supplies to designated Life Safety Loads shall be separated from other Emergency Power Loads.
.2 New Construction Projects
.1 Power distribution within the building to follow a “Radial” design philosophy
.2 Power distribution shall be designed to separate General Power Load, Lighting Load and Mechanical Load, and permit the use of check metering.
.3 Distribution Panels, Wiring Devices and Power Connections in accordance with clause 2.5.
.4 Equipment Identification in accordance with clause 2.6

2.4 General Requirements – Uninterruptible Power Supply (UPS) System

.1 Renovation Projects
.1 Modify existing UPS Systems to suit new Work. Maintain the design criteria followed for the existing installation.
.2 New Construction Projects
.1 UPS Systems shall be designed around the provision of decentralized point-of use UPS Systems.
.2 Centralized UPS Equipment, if installed shall be designed with an Alarm Output for Remote Monitoring

2.5 General Requirements – Distribution Panels, Wiring Devices and Power Connections

.1 Renovation Projects
.1 Maintain the design criteria followed for the existing installation.
.2 New Construction Projects
.1 Distribution Panels
.1 Designed with a Copper Bus
.2 48 Circuits per Panel
.3 Number of Distribution Panels to maintain a minimum of 25% Spare Circuits at the time of initial installation.
.4 Panels shall be lockable with flush doors and provisions for scanning.
.2 Power Outlets
.1 At a minimum Power Outlets shall be provided in accordance with the applicable Codes and Standards. Additional Outlets shall be provided as noted under clauses 2.5.2.2.2 & 2.5.2.2.3 below.
.2 Arranged to suit needs identified to support Functional Program and as identified in Room Data Sheets.
.3 Supplementary Outlets shall be provided as follows:
- A Quad Receptacle shall be provided adjacent to each group of Voice/Data Outlets.
- A minimum of one (1) Duplex Receptacle shall be provided on each side of a wall space in all Office & Administrative Areas including Storage Rooms.
- 120 V/20A Convenience Outlets every 15 feet along each wall of a Mechanical or Electrical Room.

.2 Wiring
.1 Wire Size in accordance with the Canadian Electrical Code but no smaller than # 12 Stranded Copper wire RW 90
.2 BX cabling only permitted for lighting fixture drops to a maximum allowable length of 10 feet.

.3 All wiring to be installed in EMT conduit with Steel Set-Screw connectors; exceptions include;

- Rigid conduit shall be used in areas exposed to potential physical damage

2.6 General Requirements – Equipment Identification

.1 Renovation Projects

.1 Maintain the design criteria followed for the existing installation.

.2 New Construction Projects

.1 Equipment Identification Nameplates

.1 Minimum Size: To be finalized in consultation with Manager, Electrical Design, DEC

.2 Color: Black Background with Engraved White lettering for Normal Power System

.3 Color: Orange Background with Engraved White lettering for Essential Power System.

.2 Labels for Distribution Equipment and Power Outlets

.1 Color Coded to allow ready identification of Distribution Equipment and Power Outlets fed from different Main Head-End Equipment.

2.7 Special Requirements – Meeting Rooms, Classrooms, and Service Spaces

.1 Meeting Rooms:

.1 Provide a Duplex Outlet for every 6'-0" of Wall Space..

.2 Classrooms:

.1 Provide a Quad Outlet directly behind the Lectern

.2 Provide a Duplex Floor Outlet (Monument) every 20'-0" along each wall of a Classroom. Floor Monuments shall be provided only with the prior approval of the Manager, Electrical Design and Manager, Architectural Design; an intent to provision the same shall be tabled for consideration before completion of the Design Development phase.

2.8 Special Requirements – Laboratories

.1 All power outlets over Lab Benches to be GFI Type.

.2 In addition to requirements identified in Room Data Sheets, provide a Duplex Outlet every 10'-0".

2.9 Special Requirements – Animal Facilities

.1 All power outlets to be GFI Type with In-Use Water-Proof Covers.

2.10 Special Requirements - Electrical Rooms

.1 Provide at least one Duplex Type convenience outlet each on Normal Power and Essential Power along each wall.

.2 Provide at least one (1) designated Duplex Outlet on Essential Power to service a Battery Pack.

2.11 Special Requirements – IT/COMM Rooms

.1 Provide power supplies for IT/COMM Equipment to suit equipment specific requirements.

.2 Provide at least two Duplex Type convenience outlets, both on Normal Power and Essential Power; location to suit layout of the room.

2.12 Special Requirements – Equipment/Elevator Machine Rooms

.1 Provide power supplies for Elevator Equipment to suit equipment specific requirements.

.2 Provide at least one Duplex Type convenience outlet.

2.13 Special Requirements – Kitchenettes

.1 Provide a duplex power outlet spaced on 6'-0" center all along all kitchen counters.

.1 All power outlets to be 20 amp T-slot GFCI Class A Type.

.2 Outlets assigned for a Dishwasher and Microwave(s) shall be assigned separate and dedicated circuits.

3 INSTALLATION STANDARDS

3.1 General

.1 The requirements outlined in the following clauses are applicable to all Electrical Power Systems; Application Specific requirements are outlined under clauses 3.2 – 3.4

3.2 Equipment

.1 All floor mounted equipment shall be installed on 150 mm (6”) high housekeeping pads

.2 All suspended equipment shall be installed using Spring Hangers.

3.3 Transformers, Switchgear & Switchboards

.1 Under Development

3.4 Distribution Panels

.1 Under Development

4 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	08-29-14	Entire Standard	Original Issue

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSE-02
ELECTRICAL LIGHTING SYSTEMS

Version	Revision 0
Effective Date	08-29-14
Approved By	Manager, Electrical Design, DEC
Reviewed By	Dec 1-14 Director, MES

TABLE OF CONTENTS

1 INTRODUCTION

1.1 General

- .1 This Electrical Lighting Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Lighting Systems installed on campus.
- .2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

- .1 Full compliance is mandatory on projects involving new construction.
- .2 Full compliance is mandatory for new Electrical Lighting System installation within projects involving significant renovations.
- .3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing Electrical Lighting System infrastructure
- .4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Electrical Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

- .1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.
- .2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Electrical Design, DEC, together with proposed measures for addressing the conflict.

1.4 Design Innovation

- .1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.
- .2 All proposed Design Innovation shall be tabled for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

- .1 Ontario Building Code
- .2 Canadian Electrical Code
- .3 IESNA Lighting Handbook
- .4 LEED & ASHRAE Standards
- .5 Electrical Power Systems Standard DSE-01*

* A copy of these standards is available on University of Guelph Physical Resources web page

2 DESIGN STANDARDS

2.1 General

- .1 The requirements outlined in the following clauses are applicable to all Electrical Lighting Systems; Application Specific requirements are outlined under clauses 2.2 – 2.x.
- .2 Lighting systems shall be designed to
  - .1 Provide a quality visual environment and to meet functional criteria of each specific area.
  - .2 Ensure that illumination is primarily directed to the desired location, with minimal direct glare or reflection.
- .3 Design general ambient illumination to minimum of one third of the luminance required for the specific task.
- .4 Valance Lighting complete with local switch shall be provided under upper cabinets where installed.

.5 Emergency lighting shall be provided in all areas as required by the Ontario Building Code. In addition, at least one (1) Battery Pack plugged into an Essential Power Outlet shall be provided in each Electrical Sub-station, Mechanical Room and Workshops/Equipment Rooms with Rotating Equipment

.6 Design Illumination Levels

Space / Application	*Average Illumination Level*
Corridors and Circulation Areas (Finished)	250 lux
Corridors and Circulation Areas (Unfinished)	200 lux
Office, Administrative & Support Areas	400 lux
Electronic Labs	650 - 800 lux*
Food Labs	550 - 650 lux*
Chemistry Labs	550 - 650 lux*
Biology Labs	550 - 650 lux*
Bio-containment Labs	650 - 700 lux*
Utility Room, Service Rooms, Mechanical & Electrical Rooms	300 lux
Washrooms & Showers	150-200 lux
Locker Rooms	200 lux
Specialized Program Areas	To suit functional needs as defined in the Room Data Sheets
Night Lighting – Principal Routes to Exits & Areas requiring Security Camera Coverage	Illumination sufficient for chosen Security Cameras and compliant with the minimum illumination for emergency lighting as required in the OBC
*Provide Task Lighting as necessary to support Functional Needs.	

2.2 General Requirements – Lamps & Luminaires

.1 All luminaires shall be commercial standard. Custom design luminaires shall be avoided.

.2 Luminaires shall be suitable for the area in which they are installed.

.3 LED or Fluorescent Luminaires shall be used for indoor applications. LED luminaires are preferred. Provide a Cost-Benefit Analysis (incl. Maintenance costs) for use of Fluorescent Luminaires for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design

.4 LED Luminaires with cut-off distribution to minimize light trespass and uplight pollution shall be used for outdoor applications. Fixtures shall satisfy LEED SSc8 Light Pollution Reduction requirements. Provide a Cost-Benefit Analysis (incl. Maintenance costs) for use of an alternate luminaires for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

.5 Provide complete photometric calculations for each building area and outdoor areas.

2.3 Special Requirements – Lamps

.1 Renovation Projects

  .1 Modify existing Lighting System to suit new Work.

    .1 Minor Renovations: Maintain the design criteria followed for the existing installation.

    .2 Major Renovations: Comply with this Standard

.2 New Construction Projects

  .1 All lamps shall be energy efficient type. Lamp types within a project shall be kept to a minimum.

  .2 Where different types of lamps are installed in the same area, lamp color temperature shall be properly coordinated.

.3 Energy efficient T8 or T5 fluorescent lamps with a CRI of 82 shall be used for all general fluorescent luminaires. Color temperature shall be 4100K for lab and research areas and 3500K for other areas.
.4 LED lamps shall have a color temperature of 3500 K, with high CRI values to satisfy user requirements.
.5 LED lamps used for outdoor applications shall have a color temperature of 5000K.

2.4 General Requirements – Ballast

.1 Renovation Projects
.1 Provide electronic ballast for all new work.
.2 New Construction Projects
.1 Electronic ballasts for fluorescent fixture shall have a class 'A" sound rating and total harmonic distortion (THD) factor no greater than 10%.
.2 Fluorescent luminaires controlled by occupancy sensors shall be equipped with program start ballasts
.3 All other fluorescent luminaires shall be equipped with rapid start type ballasts.

2.5 General Requirements – Lighting Panels and Wiring Devices

.1 Renovation Projects
.1 Maintain the design criteria followed for the existing installation.
.2 New Construction Projects
.1 Lighting Panels
.1 Designed with a Copper Bus
.2 Minimum 42 Circuits in Public Areas
.3 Number of Lighting Panels to maintain a minimum of 25% Spare Circuits in each panel at the time of initial installation.
.4 Panels shall be flush mounted, lockable c/w "Door in Door" construction to facilitate Infrared (IR) Scanning.
.2 Wiring
.1 Wire Size in accordance with the Canadian Electrical Code but no smaller than # 12 Stranded Copper Wire RW 90.
.2 Maximum allowable length of BX Cabling: 6'-0".
.3 All wiring to be installed in EMT conduit with steel set-screw connections; exceptions include;
- Rigid conduit shall be used in areas exposed to potential physical damage
.4 Exposed conduit shall be painted to match adjacent surface.

2.6 General Requirements – Lighting Controls

.1 Renovation Projects
.1 Maintain the design criteria followed for the existing installation; exceptions include:
- Occupancy Sensors with Manual Override shall be provided within all single occupancy Offices, Utility Rooms, Service Rooms, Lockers and Washrooms
.2 New Construction Projects
.1 A Stand-Alone Programmable Lighting Control System shall be provided
- Lighting Control System shall be designed with a BACNet interface to allow the System to be interfaced with the Building Automation System
- In addition, Occupancy Sensors with Manual Override shall be provided within all spaces.
.2 Local Switching shall be provided for all valance lighting

2.7 Special Requirements – Meeting Rooms, Classrooms, and Service Spaces

.1 Meeting Rooms:
.1 Light Fixtures shall be dimmable decorative luminaires with LED Lamps or fluorescent.
.2 Light Fixtures shall be circuited to allow selective switching, arranged to support the use of Audio-visual equipment.

.2 Classrooms:

.1 Lighting Fixtures shall be arranged to suit architectural layouts and ceiling plans.

.3 Service Spaces and Stairwells

.1 Surface Mounted or Chain Hung LED or Fluorescent Luminaires shall be used. Wall mounted fixtures preferred in stairwells. Fixtures shall be accessible from a six foot step ladder. LED luminaires are preferred. Where used, fluorescent strip fixtures shall be provided with wire guard. Provide a Cost-Benefit Analysis (incl. Maintenance costs) for use of Fluorescent Luminaires for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

2.8 Special Requirements – Chemistry Laboratories / Wet Labs

.1 Light Fixtures & Light Switches in Chemistry Labs shall be gasketted and sealed and water-proof.

2.9 Special Requirements – Animal Facilities / Clean Room / Wet Labs / Surgery / Research Facilities

.1 Light Fixtures & Light Switches shall be gasketted, sealed and water-tight.

2.10 Special Requirements - Electrical Rooms

.1 Surface Mounted or Chain Hung LED or Fluorescent Luminaires shall be used. LED luminaires are preferred. Where used, fluorescent strip fixtures shall be provided with wire guard. Provide a Cost-Benefit Analysis (incl. Maintenance costs) for use of Fluorescent Luminaires for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

.2 At least one (1) Battery Pack plugged into an Essential Power Outlet shall be provided in each Sub-Station and Main Electrical Room.

2.11 Special Requirements – IT/COMM Rooms

.1 Light fixtures shall be surface mounted fluorescent wrap around fixture for installation within a drywall ceiling or recessed fluorescent luminaire with K12 lens for installation within a T-bar ceiling system.

2.12 Special Requirements – Equipment/Elevator Machine Rooms

.1 Light fixtures shall be surface mounted or chain hung fluorescent strip fixtures with wire guard.

3 INSTALLATION STANDARDS

3.1 General

.1 The requirements outlined in the following clauses are applicable to all Electrical Lighting Systems; Application Specific requirements are outlined under clauses 3.2 – 3.x

.2 Locate recessed fixtures in acoustic ceilings to permit relocation by one tile/panel in each direction, without disconnecting the fixture from its power circuit.

.3 For recessed fixtures, provide narrow profile trim ring for installation in acoustic tile ceilings and trimless plaster rims for installation in drywall ceilings.

.4 Provide independent supports for all lighting fixtures located in or on suspended ceilings. Each fixture shall be supported by minimum two (2) tensor chains.

3.2 Distribution Panels

.1 Under Development

4 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	08-29-2014	Entire Standard	Original Issue

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSE-03

FIRE ALARM SYSTEMS

Version	Revision 0
Effective Date	08-29-14
Approved By	
	Manager, Electrical Design, DEC
Reviewed By	Dec 1-14
	Director, MES

TABLE OF CONTENTS

1 INTRODUCTION

1.1 General

.1 This Electrical Fire Alarm Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Fire Alarm Systems installed on campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new Fire Alarm System installation within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing Fire Alarm System infrastructure

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Electrical Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Electrical Design, DEC, together with proposed measures for addressing the conflict.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovation shall be tabled for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

.1 Ontario Building Code
.2 Ontario Fire Code
.3 Canadian Electrical Code
.4 CAN/ULC-S524-06, Standard for the Installation of Fire Alarm Systems
.5 CAN/ULC-S536-04, Inspection and Testing of Fire Alarm Systems.
.6 CAN/ULC-S537-04, Verification of Fire Alarm Systems.
.7 CAN/ULC-S561-03, Installation and Services fir Fire Signal Receiving Centres and Systems
.8 ULC-S533, Egress Door Securing and Releasing Devices
.9 CAN/ULC-S527-99 Control Units for Fire Alarm Systems
.10 Electrical Power Systems Standard DSE-01*
* A copy of these standards is available on University of Guelph Physical Resources web page

2 DESIGN STANDARDS

2.1 General

.1 The requirements outlined in the following clauses are applicable to all Electrical Fire Alarm Systems; Application Specific requirements are outlined under clauses 2.2 – 2.x.

.2 Fire Alarm Systems shall be designed to
  .1 System Survivability and Post Disaster Building Performance
  .2 Clear and Concise System Reporting and Monitoring

.3 Cost Effective and Code Compliant System Maintainability

2.2 Fire Alarm System Configuration

.1 The fire alarm system shall be an automatic, single-stage, addressable, networked with peer-to-peer emergency voice communication system.

.2 The fire alarm system shall be provided with an integrated emergency voice communication system for broadcasting emergency voice messages, alert and alarm tones simultaneously to separate areas via the fire alarm system speakers.

.3 The fire alarm system shall include but not be limited to the following:

.1 Display and Control Centre (DCC) Annunciator in a secure location

.2 Transponders connected to the DCC in a DCL-C performance and topology.

.3 LCD annunciator in the building main entrance vestibule with a LED Lamp Annunciator for Zone Indication

.4 A Common “Trouble” and “Alarm” LCD annunciator in the Campus Security Office

.5 Manual and automatic initiating devices

.6 Addressable monitor modules and addressable relays

.7 Audible and visual signaling devices

.8 End-of-line resistors serving conventional Notification Appliance Circuits such as speakers and visual strobe devices

.4 System transponders shall be modular design type to allow minimum 25% future expansion. Each initiating and notification signaling circuit shall not be loaded at more than 80% of its capacity.

.5 The transponders and DCC Annunciator equipment shall support communication wiring to comply with "DCL-C" performance as identified in Table 1 of CAN/ULC-S524-06

.6 All surface mounted control and display equipment enclosures shall be provided with rain guard shields.

.7 System operating architecture must allow any input to be programmed to any or all outputs of the system.

.8 System shall have the transponders located in one hour separated electrical utility rooms and Display and Control Centre Annunciator located at the Central Alarm Control Facility.

.9 The fire alarm system shall be continuously monitored as per the requirements defined in CAN/ULC-S561-03, Installation and Services for Fire Signal Receiving Centres and Systems.

2.3 Fire Alarm System Initiating Devices

.1 Pull Stations shall be provided at all Exit Doors / Exit Paths and as mandated by the Ontario Building Code.

.1 Pull Stations shall be the dual action type / manual single-stage type with vandal-proof ULC listed manual station cover accessories, pull-type covers and local piezo audible signal to prevent false alarms.

.2 Heat and Smoke Detectors as stipulated elsewhere in this Standard.

.3 Cross Zoned Heat and Smoke Detectors to support a Double Interlocked Cross-Zoned Pre-action Sprinkler System?

2.4 Fire Alarm Notification Appliances

.1 Fire alarm audible signal devices shall be provided throughout the facility as required by Code.

.1 Audible devices shall be supplemented by visual signal devices in all public corridors and in areas with high ambient noise level such as but not limited to Mechanical Rooms and Generator Rooms.

2.5 Power Supply to Fire Alarm System

.1 Each fire alarm transponder and DCC to be serviced with two sources of power.

.1 Primary source of power supply shall be derived from the building’s essential (emergency) power source.

.2 Power supplies shall automatically transfer to the emergency internal batteries upon failure of the primary 120 Volt AC source.

.2 Temporary AC power interruptions (30 seconds or less) shall not be indicated or treated as a trouble condition. If the AC failure lasts longer than 30 seconds, operate trouble signals and indicate power failure condition showing "System on Battery".

.3 Failure of any over current device on the primary source shall not cause the trouble signals to become inoperative.

.4 A separate 24 Volt DC 2 amp, fused output for ancillary devices control shall be provided at each transponder.

2.6 Interface with Other Building Systems

.1 HVAC Systems

.1 Ancillary HVAC Air Handling System shutdown shall be controlled by the fire alarm system via the transponder serving the area.

.2 Sprinkler Systems

.1 Sprinkler system, pre-action system and other types of fire suppression system installed within in the facility shall be monitored by the associated transponders and annunciated at the DCC Annunciator.

2.7 Special Requirements – Classrooms, Service Spaces & Stairwells

.1 Classrooms:

.1 Provide Heat Detectors – Rate of Rise & Fixed (135F) in combination.

.2 Service Spaces

.1 Provide Heat Detectors – Rate of Rise & Fixed (135F) in combination

.3 Stairwells

.1 Provide smoke detectors in each Stairwell.

2.8 Special Requirements - Electrical Rooms

.1 Provide Heat and Smoke Detectors in each Electrical Room.

2.9 Special Requirements – IT/COMM Rooms and Raised Floor Areas

.1 Very Early Warning Smoke Detection shall be provided under all Raised Floors.

.2 Provide Heat and Smoke Detectors in all IT/COMM Rooms.

2.10 Special Requirements – Equipment/Elevator Machine Rooms

.1 Provide a Heat and Smoke Detector at top and bottom of Pit and in front of door on every floor.

2.11 Special Requirements – Generator Room

.1 Provide a High Temperature Heat Detector in the Generator Room.

2.12 Special Requirements – Central Utility Plant

.1 Provide Linear Heat Detection Cable within the Central Utility Plant.

2.13 Special Requirements – Atriums and High Bay Areas

.1 Provide Beam Type Detector(s) within Atriums and High Bay Areas

2.14 Special Requirements – Residences

.1 Provide Combination Heat/Smoke Detectors in all Dorm Rooms.

.2 Hardwire Power supplies to each detector.

3 INSTALLATION STANDARDS

3.1 General

.1 The requirements outlined in the following clauses are applicable to all Electrical Fire Alarm Systems; Application Specific requirements are outlined under clauses 3.2 – 3.3.

3.2 Initiating Devices

.1 Under Development

3.3 Notification Appliances

.1 Under Development

3.4 Graphics

.1 Under Development

4 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
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UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSE-04

IT & COMMUNICATION SYSTEMS

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Approved By	
	Manager, Electrical Design, DEC
Reviewed By	
	Computing and Communications Services (CCS)

TABLE OF CONTENTS

1 INTRODUCTION

1.1 General

.1 This Electrical IT & Communication Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new IT & Communication Systems installed on campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new IT & Communication System installation within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing IT & Communication Systems infrastructure

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Electrical Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Electrical Design, DEC, together with proposed measures for addressing the conflict before the finalization of the Schematic Design.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovation shall be tabled for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

.1 Ontario Building Code

.2 Canadian Electrical Code

.3 CAN/CSA C22.2 No. 232-M Optical Fibre Cables

.4 CAN/CSA C22.2 No. 214 Communications Cables

.5 TSB-67, Transmission Performance Specifications for Field-Testing of UTP Cabling

.6 TSB-72, Centralized Optical Fibre Cabling Guidelines.

.7 TSB-75, Open Office Cabling.

.8 ANSI/EIA/TIA-455, Test Procedures for Optical Fibres, Cables and Transistors

.9 ANSI/EIA/TIA568A (or CAN/CSA T529-M), Commercial Building Telecommunications wiring standard and all the Communications Bulletin Boards (TSBs')

.10 ANSI/EIA/TIA-569 (or CAN/CSA T530-M), Commercial Building standard for Communications pathways and spaces.
.11 ANSI/EIA/TIA-598, Colour Coding Of Optical Cables.
.12 ANSI/EIA/TIA-604-3, FOCIS 3 Fibre Optic Connector Intermateability Standard.
.13 ANSI/EIA/TIA-606 (or CAN/CSA T528-M), Administration standard for Communications infrastructure of commercial buildings.
.14 ANSI/EIA/TIA-607 (or CAN/CSA T527), Commercial Building Grounding and Bonding requirements for communications.
.15 ANSI/ICEA S-83-596, Fibre Optic Premises Distribution Cable.
.16 ANSI/ICEA S-83-640, Fibre Optic Outside Plant Communications Cable.
.17 ANSI Z136.2, American Standards For The Safe Operation Of Optical Fibre Communication Systems Utilizing Laser Diode And LED Sources
.18 Building Industry Consulting Service International (BICSI) TDM Manual
.19 Electrical Power Systems Standard DSE-01*

* A copy of these standards is available on University of Guelph Physical Resources web page

2 DESIGN STANDARDS

2.1 General

.1 The requirements outlined in the following clauses are applicable to all Electrical IT & Communication Systems; Application Specific requirements are outlined under clauses 2.2 – 2.11.
.2 IT & Communication System shall be designed to
  .1 Assure System Survivability and Post Disaster Building Performance
  .2 Integrate Security Systems including, as applicable, a Video Surveillance System and an Access Control System
  .3 Assure Cost Effective System Maintainability

2.2 IT & Communication System – General Requirements

.1 The IT & Communication System shall include
  .1 A Building Entry Room
  .2 Communications Equipment Rooms
  .3 Backbone Cabling
  .4 Horizontal Cabling
  .5 Voice / Data Outlets

2.3 Building Entry Room (BER)

.1 A dedicated BER shall be provided in all new construction and major renovations with the exception that a BER may be consolidated with the Communications Equipment Room with the prior approval of the Manager, Electrical, DEC; requests for approval shall be tabled for consideration before finalization of the Schematic Design.
  .1 BER shall be capable of supporting fibre optic ‘backbone’ cable, splice enclosures and service loops as well as copper backbone cabling, lightning protectors, terminations and cross-connects.

.2 All of the cables, enclosures and devices shall be mounted on a ¾" fire-rated plywood backboard; the plywood backboard shall be painted once the fire rating labels (stamps) are verified by the Engineer but before any devices or equipment is mounted.

.2 A 7m (25 ft.) fibre service loop shall be provided in the BER to accommodate incoming Fibre Optic Cable.

.3 A minimum of two (2) 6-strand fibre cables (for redundancy) shall be pulled through the BER into the Communication Equipment Room (CER).

.4 Copper backbone cables shall be pulled through the BER into the CER's or terminated and cross-connected to smaller cables in the BER.

2.4 Communications Equipment Room (CER)

.1 At least one (1) dedicated CER shall be provided on every floor; exceptions shall be tabled for consideration by the Manager, Electrical Design, DEC, before finalization of the Schematic Design.

.1 Communication Equipment is to be terminated to the Horizontal Distribution Cable and interconnected to the Backbone within the CER.

.1 One Workstation and one CER Patch Cord shall be provided for each Horizontal Cable.

.2 Workstation Patch Cords shall be 3.0m (10ft.) in length.

.3 CER Patch Cords shall be 2.2m (7ft) in length.

.2 The Voice Intra-building backbone cable shall be terminated on BIX 1A connectors (Nordx).

.1 All traditional voice cables shall be labelled using Nordx Designation Strips; identification labels must follow the colour scheme tabulated below

Application	***Colour***
Central Office Terminations	Green
Network	Orange
Switching and Data Equipment Terminations	Red, White or Silver
MDF to IDF Cabling Terminations	Purple
IDF to TC Cabling Terminations	Grey
Horizontal Cabling Terminations	Blue
Auxiliary, Maintenance Alarm, and Security	Yellow
Key Telephone Systems	Red

.3 Data termination shall be completed using CAT 6 Patch Cords, length sized to limit the quantity of Patch Panels.

.4 Fibre termination / splice panels shall be utilized for all CER fibre terminations; minimum requirements are as tabulated below.

Description	***Part Number***	***Quantity***
ADC Krone Termination/Splice Panel	FL2-24TS525	1
ADC Krone Splice Wheel	FST-DRS12-HS	1
ADC Krone Fibre Clamp	FL2-ACC007	1
ADC S/M fibre pigtail and adapter	FL2-6P7SC603W	2

.5 Copper patch panels shall be used for all copper backbone terminations (using the appropriate number of RJ21 25 pair Category 3 cables); minimum requirements are as tabulated below

Description	***Part Number***	***Quantity***
AMP NetConnect Category 3 Patch Panel, RJ21 (CHAMP Wiring), 24-Port, RJ45 T568A (4-Pair) Wiring (Active Pins 1 - 8), 3U (5.25 in) x 19 in, Four RJ21	556180-1	1 (small CER with ≤ 50 pr. copper backbone)
AMP NetConnect Category 3 Patch Panel, RJ21 (CHAMP Wiring), 48-Port, RJ45 T568A (4-Pair) Wiring (Active Pins 1 - 8), 3U (5.25 in) x 19 in, Eight RJ21	556641-1	1 (large CER with > 50 pr. copper backbone)

.2 In CER's utilizing multiple racks and vertical cable managers, each rack shall be bolted to its cable manager and each cable manager bolted to the next rack to form a single unified unit (assembly).

2.5 Communication Racks

.1 Communication Racks shall be "R F Mote" floor mounted, 19" communication Free Standing Relay Racks.

.1 R F Mote racks shall incorporate a vertical cable manager on the both sides.

.2 Cable management panels shall be reserved for patch cords, pigtails and jumper wire; minimum requirements are as tabulated below

Manufacturer	***Part Number***	***Description***
R.F. Mote	RFM-1944-RB	19", 44u Relay Rack
R.F. Mote	RFM-FMS-12	12" Vertical cable manager

2.6 Communications Cabling & Wiring

.1 Communications cabling & wiring shall satisfy the minimum requirements outlined below:

.1 The Backbone shall be provided by a single mode fibre based communications system.

.2 The basic workstation communications shall be provided utilizing unshielded twisted pair cabling.

.2 Fibre Backbone/Riser Cable

.1 Fibre Backbone/Riser Cable shall be

.1 9/125µm Single Mode Optical Fibre Cables, with a loss of not more than 0.40 dB/km at 1310 nm and 0.35 dB/km at 1550 nm.
.2 Loose tube construction. 6 & 12 strand fibre cable shall be of single tube construction; 24 strand or greater fibre cable shall have 12 fibres per tube
.3 Suitable for indoor/outdoor with FT- 4 rating. 7m loop
.2 Standard of Acceptance: Cable constructed with Corning Glass

.3 Copper Backbone and Riser Cable
.1 Copper Backbone / Riser Cable shall meet the following minimum requirements
.1 Backbone/Riser shall be constructed using Multipair Copper Cables, PIC (Plastic Insulated Conductor) in 25 pair multiples
.2 Building Backbone feeder cable shall be of a ALPETH construction
.3 Riser cable shall be FT-4 rated

.4 Horizontal Cabling
.1 Maximum lengths of individual cable runs shall be 90m (…..ft.); a pull box shall be provided every 27m (90 ft).
.2 Maximum 180deg bends between pull-box.
.3 Cabling shall be completed utilizing CAT 6, 4-pr UTP, 24 AWG cables.
.4 Cable shall be sweep tested and characterized to 350 MHZ
.5 The cables shall be CMR (FT4) rated or CMP (FT6) depending on the applications and local fire code.
.6 Use of Splicing or intermediate termination of UTP cable is not permitted.
.7 Cabling shall be installed in conduit; conduit sweep (bend) radius shall be at least 10 times the conduit diameter.
.7 Cable shall meet the following minimum requirements:

Part Number	***Description***
10032455	BERK-TEK, LanMark 1000 FT-4 (blue)
10032094	BERK-TEK, LanMark 1000 FT-6 (blue)
65N4+	COMMSCOPE, Media 6 FT-4 (blue)
65O4+	COMMSCOPE, Media 6 FT-6 (blue)
7133800	GENERAL GenSpeed Cat6 FT-4 (blue)
7131800	GENERAL GenSpeed Cat6 FT-6 (blue)
C6RRB	HUBBELL Nextspeed Cat6 FT-4 (blue)
C6RPB	HUBBELL Nextspeed Cat6 FT-6 (blue)
M58292	MOHAWK/CDT, 6 LAN FT-4 (blue)
M58281	MOHAWK/CDT, 6 LAN FT-4 (blue)
66-240-2A	SUPERIOR ESSEX, DataGain FT-4 (blue)
66-240-2B	SUPERIOR ESSEX, DataGain FT-6 (blue)
1071	SYSTIMAX, GigaSpeed FT-4 (blue)

Part Number	Description
2071	SYSTIMAX, GigaSpeed FT-6 (blue)

.5 Communications cabling & wiring shall be physically separated from power sources; minimum separation shall be as tabulated below

Power Source	Minimum Separation (Clearance)
Fluorescent ballasts	150mm (6”)
Conduit and cables used for electrical distribution less than 1kV	300mm (12”)
Conduit and cables used for electrical distribution greater than 1kV	1000mm (36”)
Motor	1200mm (48”)
Transformer	1200mm (48”)

2.7 Communications Outlet

.1 Communications Outlets shall be provided throughout the facility to satisfy the functional needs and intended use of the facility.

.1 At a minimum one Communications Outlet shall be provided in the following areas. Final outlet count shall be as outlined in the Functional Program and/or Room Data Sheets.

.1 Every Workstation
.2 Each Office
.3 Training, Meeting & Board Rooms
.4 Security Rooms
.5 Electrical Rooms
.6 Dorm Room
.7 Equipment Rooms
.8 Mechanical Rooms
.9 Labs and Teaching Spaces
.10 Other areas as defined in the Room Data Sheets

.2 Communication Outlet – Wall faceplates

.1 All outlets shall be 2-port (minimum) face plates.
.2 Minimum requirements shall be as tabulated below

Wall Faceplates and Surface Boxes	
Part Number	Manufacturer and Description
M10L-246	SYSTIMAX, Modular faceplate, 1 port, Ivory**
M12L-246	SYSTIMAX, Modular faceplate, 2 port, Ivory**
M14L-246	SYSTIMAX, Modular faceplate, 4 port, Ivory**
M16L-246	SYSTIMAX, Modular faceplate, 6 port, Ivory**

Wall Faceplates and Surface Boxes	
Part Number	***Manufacturer and Description***
M102SMB-246	SYSTIMAX, Surface mounted box, 2 port, Ivory**
M104SMB-246	SYSTIMAX, Surface mounted box, 4 port, Ivory**
M106SMB-246	SYSTIMAX, Surface mounted box, 6 port, Ivory**
M112SMB-246	SYSTIMAX, Surface mounted box, 12 port, Ivory**
IFP11EI	HUBBELL, Modular faceplate, 1 port, Ivory**
IFP12EI	HUBBELL, Modular faceplate, 2 port, Ivory**
IFP14EI	HUBBELL, Modular faceplate, 4 port, Ivory**
IFP16EI	HUBBELL, Modular faceplate, 6 port, Ivory**
ISM2EI	HUBBELL, Surface Housing, 2 port, Ivory**
ISM4EI	HUBBELL, Surface Housing, 4 port, Ivory**
ISM6EI	HUBBELL, Surface Housing, 6 port, Ivory**
ISM12EI	HUBBELL, Surface Housing, 12 port, Ivory**

.3 Modular Outlets – 8-position Data

.1 Minimum requirements shall be as tabulated below

Modular Jacks	
Part Number	***Manufacturer and Description***
MGS-400-318	SYSTIMAX, CAT6 Modular Jack (blue)
HXJ6B	HUBBELL, CAT6 Modular Jack (blue)

.2 White module to be used for traditional voice applications (such as fax lines).

.3 Pin-out Termination Sequence shall be to T568A.

.4 Patch Panels – 8-position Data

.1 Minimum requirements shall be as tabulated below

Patch Panels	
Part Number	***Manufacturer and Description***
PM-GS3-24	SYSTIMAX, Cat6 24 port patch panel
PM-GS3-24	SYSTIMAX, Cat6 48 port patch panel
P624U	HUBBELL, Cat6 24 port patch panel
P648U	HUBBELL, Cat6 48 port patch panel

.2 Pin-out Termination Sequence to T568A.

2.8 Equipment Cable Assemblies

.1 UTP Patch Cables
 .1 Stranded patch cables with characteristics of 100Ω CAT 6 cables
 .2 Rated for performance at 20°C.

.2 Single Mode Fibre Optic Patch Cords
 .1 Dual strand, 9/125µm single mode cable, connectors to suit end equipment.
 .2 Standard of Acceptance: Cable constructed with Corning Glass.

2.9 Fibre Splice Panels

.1 Fire Splice Panels shall meet the following minimum requirements:

Manufacturer	***Part Number***	***Description***
Tyco Electronics	FOSC-400-A4-24-1-NGV	Fibre Optic Splice Closure (buildings with ≤ 2 C.E.R.'S)
Tyco Electronics	F-CB24-4AAAA-00000-0	Fibre Optic Splice Closure (buildings with > 2 C.E.R.'S)

2.10 Copper Lightning Protectors.

.1 Copper Lightning Protectors shall meet the following minimum requirements

Manufacturer	***Part Number***	***Description***
Circa	2100B-25	25 pair lightning protector
Circa	2100B-100	100 pair lightning protector
Circa	4B1S-300	Solid State Module

2.11 Special Requirements – Animal Facilities

.1 All Outlets within wet areas or areas that may be washed down to be equipped with water-tight covers.

3 INSTALLATION STANDARDS

3.1 General

.1 The requirements outlined in the following clauses are applicable to all Electrical IT & Communication Systems; Application Specific requirements are outlined under clauses 3.2 – 3.x

.2 Communications wiring shall be installed within a conduit sized at no less than ¾" diameter; a conduit shall be no more than 50% full at time of initial installation.

.3 All Patch Panels shall be sized with 25% spare capacity at the time of the original installation.

.4 Comm Rooms shall be commissioned well in advance of substantial / networking installation.

3.2 Wi-FI System

.1 A Wi-Fi Router will be provided by the University. Comm Outlet(s) to support Router(s) shall be provided in consultation with the Manager, Electrical Design, DEC.

3.3 Emergency Phones

.1 Emergency Phones (Code Blue Phones) shall be provided Indoors and Outdoors.

.2 Emergency Phones are to be wired over the “Copper” network.

3.4 Alarms

.1 High Security Alarms shall be hard-wired and interfaced with the Campus ONYX Works system.

4 VERSION CONTROL SUMMARY

Revision No.	**Effective Date**	**Section / Page**	**Brief Description of Revision**
0	2014-10-23	Entire Standard	Original Issue

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSE-04

IT & COMMUNICATION SYSTEMS

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Reviewed By	
	Computing and Communications Services (CCS)

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1 INTRODUCTION

1.1 General

.1 This Electrical IT & Communication Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new IT & Communication Systems installed on campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new IT & Communication System installation within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing IT & Communication Systems infrastructure

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager, Electrical Design, DEC before the completion of Schematic Design.

1.3 Responsibility of the Designer

.1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager, Electrical Design, DEC, together with proposed measures for addressing the conflict before the finalization of the Schematic Design.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovation shall be tabled for consideration by the Manager, Electrical Design, DEC, before the completion of Schematic Design.

1.5 Reference Documents

.1 Ontario Building Code

.2 Canadian Electrical Code

.3 CAN/CSA C22.2 No. 232-M Optical Fibre Cables

.4 CAN/CSA C22.2 No. 214 Communications Cables

.5 TSB-67, Transmission Performance Specifications for Field-Testing of UTP Cabling

.6 TSB-72, Centralized Optical Fibre Cabling Guidelines.

.7 TSB-75, Open Office Cabling.

.8 ANSI/EIA/TIA-455, Test Procedures for Optical Fibres, Cables and Transistors

.9 ANSI/EIA/TIA568A (or CAN/CSA T529-M), Commercial Building Telecommunications wiring standard and all the Communications Bulletin Boards (TSBs')
.10 ANSI/EIA/TIA-569 (or CAN/CSA T530-M), Commercial Building standard for Communications pathways and spaces.
.11 ANSI/EIA/TIA-598, Colour Coding Of Optical Cables.
.12 ANSI/EIA/TIA-604-3, FOCIS 3 Fibre Optic Connector Intermateability Standard.
.13 ANSI/EIA/TIA-606 (or CAN/CSA T528-M), Administration standard for Communications infrastructure of commercial buildings.
.14 ANSI/EIA/TIA-607 (or CAN/CSA T527), Commercial Building Grounding and Bonding requirements for communications.
.15 ANSI/ICEA S-83-596, Fibre Optic Premises Distribution Cable.
.16 ANSI/ICEA S-83-640, Fibre Optic Outside Plant Communications Cable.
.17 ANSI Z136.2, American Standards For The Safe Operation Of Optical Fibre Communication Systems Utilizing Laser Diode And LED Sources
.18 Building Industry Consulting Service International (BICSI) TDM Manual
.19 Electrical Power Systems Standard DSE-01*

* A copy of these standards is available on University of Guelph Physical Resources web page

2 DESIGN STANDARDS

2.1 General

.1 The requirements outlined in the following clauses are applicable to all Electrical IT & Communication Systems; Application Specific requirements are outlined under clauses 2.2 – 2.11.
.2 IT & Communication System shall be designed to
  .1 Assure System Survivability and Post Disaster Building Performance
  .2 Integrate Security Systems including, as applicable, a Video Surveillance System and an Access Control System
  .3 Assure Cost Effective System Maintainability

2.2 IT & Communication System – General Requirements

.1 The IT & Communication System shall include
  .1 A Building Entry Room
  .2 Communications Equipment Rooms
  .3 Backbone Cabling
  .4 Horizontal Cabling
  .5 Voice / Data Outlets

2.3 Building Entry Room (BER)

.1 A dedicated BER shall be provided in all new construction and major renovations with the exception that a BER may be consolidated with the Communications Equipment Room with the prior approval of the Manager, Electrical, DEC; requests for approval shall be tabled for consideration before finalization of the Schematic Design.

.1 BER shall be capable of supporting fibre optic ‘backbone’ cable, splice enclosures and service loops as well as copper backbone cabling, lightning protectors, terminations and cross-connects.

.2 All of the cables, enclosures and devices shall be mounted on a ¾” fire-rated plywood backboard; the plywood backboard shall be painted once the fire rating labels (stamps) are verified by the Engineer but before any devices or equipment is mounted.

.2 A 7m (25 ft.) fibre service loop shall be provided in the BER to accommodate incoming Fibre Optic Cable.

.3 A minimum of two (2) 6-strand fibre cables (for redundancy) shall be pulled through the BER into the Communication Equipment Room (CER).

.4 Copper backbone cables shall be pulled through the BER into the CER’s or terminated and cross-connected to smaller cables in the BER.

2.4 Communications Equipment Room (CER)

.1 At least one (1) dedicated CER shall be provided on every floor; exceptions shall be tabled for consideration by the Manager, Electrical Design, DEC, before finalization of the Schematic Design.

.1 Communication Equipment is to be terminated to the Horizontal Distribution Cable and interconnected to the Backbone within the CER.

.1 One Workstation and one CER Patch Cord shall be provided for each Horizontal Cable.

.2 Workstation Patch Cords shall be 3.0m (10ft.) in length.

.3 CER Patch Cords shall be 2.2m (7ft) in length.

Patch Cords	
Part Number	***Manufacturer and Description***
UC1AAA2-0ZF007	CommScope® Uniprise, Category 6A Modular Patch Cord 7'
UC1AAA2-0ZF010	CommScope® Uniprise, Category 6A Modular Patch Cord 10'
HC6AB07	Hubbell, NEXTSPEED® Ascent Category 6A 7’ Patch Cord
HC6AB10	Hubbell, NEXTSPEED® Ascent Category 6A 10’ Patch Cord

.2 The Voice Intra-building backbone cable shall be terminated on BIX 1A connectors (Nordx).

.1 All traditional voice cables shall be labelled using Nordx Designation Strips; identification labels must follow the colour scheme tabulated below

Application	Colour
Central Office Terminations	Green
Network	Orange
Switching and Data Equipment Terminations	Red, White or Silver
MDF to IDF Cabling Terminations	Purple
IDF to TC Cabling Terminations	Grey
Horizontal Cabling Terminations	Blue
Auxiliary, Maintenance Alarm, and Security	Yellow
Key Telephone Systems	Red

.3 Data termination shall be completed using CAT 6A Patch Cords, length sized to limit the quantity of Patch Panels.

.4 Fibre termination / splice panels shall be utilized for all CER fibre terminations; minimum requirements are as tabulated below.

Description	Part Number	Quantity
ADC Krone Termination/Splice Panel	FL2-24TS525	1
ADC Krone Splice Wheel	FST-DRS12-HS	1
ADC Krone Fibre Clamp	FL2-ACC007	1
ADC S/M fibre pigtail and adapter	FL2-6P7SC603W	2

.5 Copper patch panels shall be used for all copper backbone terminations (using the appropriate number of 25 pair, 24 gauge, Category 3 cables); minimum requirements are as tabulated below

Description	Part Number	Quantity
CommScope® Uniprise or Hubbell Category 5E (or higher) Patch Panel, , 24-Port, RJ45 T568A (4-Pair) Wiring (Active Pins 1 - 8)	UNP500-24 or P5E48U	1 (small CER with ≤ 50 pr. copper backbone)
CommScope® Uniprise or Hubbell Category 5E (or higher) Patch Panel, , 48-Port, RJ45 T568A (4-Pair) Wiring (Active Pins 1 - 8)	UNP500-24 or P5E48U	1 (large CER with > 50 pr. copper backbone)

.2 In CER's utilizing multiple racks and vertical cable managers, each rack shall be bolted to its cable manager and each cable manager bolted to the next rack to form a single unified unit (assembly).

2.5 Communication Racks

.1 Communication Racks shall be “R F Mote” floor mounted, 19” communication Free Standing Relay Racks.
  .1 R F Mote racks shall incorporate a vertical cable manager on the both sides.
  .2 Cable management panels shall be reserved for patch cords, pigtails and jumper wire; minimum requirements are as tabulated below

Manufacturer	***Part Number***	***Description***
R.F. Mote	RFM-1944-RB	19”, 44u Relay Rack
R.F. Mote	RFM-FMS-12	12” Vertical cable manager

2.6 Communications Cabling & Wiring

.1 Communications cabling & wiring shall satisfy the minimum requirements outlined below:
  .1 The Backbone shall be provided by a single mode fibre based communications system.
  .2 The basic workstation communications shall be provided utilizing unshielded twisted pair cabling.

.2 Fibre Backbone/Riser Cable
  .1 Fibre Backbone/Riser Cable shall be
    .1 9/125μm Single Mode Optical Fibre Cables, with a loss of not more than 0.40 dB/km at 1310 nm and 0.35 dB/km at 1550 nm.
    .2 Loose tube construction. 6 & 12 strand fibre cable shall be of single tube construction; 24 strand or greater fibre cable shall have 12 fibres per tube
    .3 Suitable for indoor/outdoor with FT- 4 rating. 7m loop
  .2 Standard of Acceptance: Cable constructed with Corning Glass

.3 Copper Backbone and Riser Cable
  .1 Copper Backbone / Riser Cable shall meet the following minimum requirements
    .1 Backbone/Riser shall be constructed using Multipair Copper Cables, PIC (Plastic Insulated Conductor) in 25 pair multiples
    .2 Building Backbone feeder cable shall be of a ALPETH construction
    .3 Riser cable shall be FT-4 rated

.4 Horizontal Cabling
  .1 Maximum lengths of individual cable runs shall be 90m (…..ft.); a pull box shall be provided every 27m (90 ft).
  .2 Maximum 180deg bends between pull-box.
  .3 Cabling shall be completed utilizing CAT 6A, 4-pr UTP, 24 AWG cables.
  .4 Cable shall be sweep tested and characterized to 350 MHZ
  .5 The cables shall be CMR (FT4) rated or CMP (FT6) depending on the applications and local fire code.
  .6 Use of Splicing or intermediate termination of UTP cable is not permitted.
  .7 Cabling shall be installed in conduit; conduit sweep (bend) radius shall be at least 10 times the conduit diameter.
  .7 Cable shall meet the following minimum requirements:

Horizontal Category 6A Cable	
Part Number	**Description**
UN884031014/10	CommScope® Uniprise, CS44R BLU C6A 4/23 U/UTP CPK 1KFT (blue riser)
UN874035114/10	CommScope® Uniprise, CS44P BLU C6A 4/23 U/UTP CPK 1KFT (blue plenum)
C6ASRB	Hubbell NEXTSPEED® Ascent Category 6A FT-4 (blue)
C6ASPB	Hubbell NEXTSPEED® Ascent Category 6A FT-6 (blue)

.5 Communications cabling & wiring shall be physically separated from power sources; minimum separation shall be as tabulated below

Power Source	***Minimum Separation (Clearance)***
Fluorescent ballasts	150mm (6”)
Conduit and cables used for electrical distribution less than 1kV	300mm (12”)
Conduit and cables used for electrical distribution greater than 1kV	1000mm (36”)
Motor	1200mm (48”)
Transformer	1200mm (48”)

2.7 Communications Outlet

.1 Communications Outlets shall be provided throughout the facility to satisfy the functional needs and intended use of the facility.

  .1 At a minimum one Communications Outlet shall be provided in the following areas. Final outlet count shall be as outlined in the Functional Program and/or Room Data Sheets.

    .1 Every Workstation
    .2 Each Office
    .3 Training, Meeting & Board Rooms
    .4 Security Rooms
    .5 Electrical Rooms
    .6 Dorm Room
    .7 Equipment Rooms
    .8 Mechanical Rooms

.9 Labs and Teaching Spaces
.10 Other areas as defined in the Room Data Sheets

.2 Communication Outlet – Wall faceplates
.1 All outlets shall be 2-port (minimum) face plates.
.2 Minimum requirements shall be as tabulated below

Wall Faceplates and Surface Boxes	
Part Number	***Manufacturer and Description***
M10L-246	SYSTIMAX, Modular faceplate, 1 port, Ivory**
M12L-246	SYSTIMAX, Modular faceplate, 2 port, Ivory**
M14L-246	SYSTIMAX, Modular faceplate, 4 port, Ivory**
M16L-246	SYSTIMAX, Modular faceplate, 6 port, Ivory**
M102SMB-246	SYSTIMAX, Surface mounted box, 2 port, Ivory**
M104SMB-246	SYSTIMAX, Surface mounted box, 4 port, Ivory**
M106SMB-246	SYSTIMAX, Surface mounted box, 6 port, Ivory**
M112SMB-246	SYSTIMAX, Surface mounted box, 12 port, Ivory**
IFP11EI	HUBBELL, Modular faceplate, 1 port, Ivory**
IFP12EI	HUBBELL, Modular faceplate, 2 port, Ivory**
IFP14EI	HUBBELL, Modular faceplate, 4 port, Ivory**
IFP16EI	HUBBELL, Modular faceplate, 6 port, Ivory**
ISM2EI	HUBBELL, Surface Housing, 2 port, Ivory**
ISM4EI	HUBBELL, Surface Housing, 4 port, Ivory**
ISM6EI	HUBBELL, Surface Housing, 6 port, Ivory**
ISM12EI	HUBBELL, Surface Housing, 12 port, Ivory**

.3 Modular Outlets – 8-position Data
.1 Minimum requirements shall be as tabulated below

Modular Jacks	
Part Number	**Manufacturer and Description**
UNJ10G	CommScope® Uniprise, Ultra 10® UNJ10G Category 6A Modular Jack (blue)
HXJ6AB	Hubbell, NEXTSPEED® Ascent Category 6A Modular Jack (blue)

.2 White module to be used for traditional voice applications (such as fax lines).
.3 Pin-out Termination Sequence shall be to T568A.

.4 Patch Panels – 8-position Data
.1 Minimum requirements shall be as tabulated below

Patch Panels	
Part Number	**Manufacturer and Description**
UNP-6A-DM-1U-24	CommScope® Uniprise, Category 6A, UTP, 1U, 24 port patch panel
UNP-6A-DM-2U-48	CommScope® Uniprise, Category 6A, UTP, 2U, 48 port patch panel
HP6A24	HUBBELL, NEXTSPEED® Ascent Category 6A 24 port patch panel
HP6A48	HUBBELL, NEXTSPEED® Ascent Category 6A 48 port patch panel

.2 Pin-out Termination Sequence to T568A.

2.8 Equipment Cable Assemblies
.1 UTP Patch Cables
.1 Stranded patch cables with characteristics of 100Ω CAT 6A cables
.2 Rated for performance at 20°C.
.2 Single Mode Fibre Optic Patch Cords
.1 Dual strand, 9/125μm single mode cable, connectors to suit end equipment.
.2 Standard of Acceptance: Cable constructed with Corning Glass.

2.9 Fibre Splice Panels
.1 Fire Splice Panels shall meet the following minimum requirements:

Manufacturer	***Part Number***	***Description***
Tyco Electronics	FOSC-400-A4-24-1-NGV	Fibre Optic Splice Closure (buildings with ≤ 2 C.E.R.'S)
Tyco Electronics	F-CB24-4AAAA-00000-0	Fibre Optic Splice Closure (buildings with > 2 C.E.R.'S)

2.10 Copper Lightning Protectors.
.1 Copper Lightning Protectors shall meet the following minimum requirements

Manufacturer	***Part Number***	***Description***
Circa	2100B-25	25 pair lightning protector
Circa	2100B-100	100 pair lightning protector
Circa	4B1S-300	Solid State Module

2.11 Special Requirements – Animal Facilities

.1 All Outlets within wet areas or areas that may be washed down to be equipped with water-tight covers.

3 INSTALLATION STANDARDS

3.1 General

.1 The requirements outlined in the following clauses are applicable to all Electrical IT & Communication Systems; Application Specific requirements are outlined under clauses 3.2 – 3.x

.2 Communications wiring shall be installed within a conduit sized at no less than ¾" diameter; a conduit shall be no more than 50% full at time of initial installation.

.3 All Patch Panels shall be sized with 25% spare capacity at the time of the original installation.

.4 Comm Rooms shall be commissioned well in advance of substantial / networking installation.

3.2 Wi-FI System

.1 A Wi-Fi Router will be provided by the University. Comm Outlet(s) to support Router(s) shall be provided in consultation with the Manager, Electrical Design, DEC.

3.3 Emergency Phones

.1 Emergency Phones (Code Blue Phones) shall be provided Indoors and Outdoors.

.2 Emergency Phones are to be wired over the “Copper” network.

3.4 Alarms

.1 High Security Alarms shall be hard-wired and interfaced with the Campus ONYX Works system.

4 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
0	2014-10-23	Entire Standard	Original Issue
1	2019-03-26	2.4.1 2.4.5 2.6.4 2.7.3 2.7.4 2.8.1.1	1. Revise 'Cat 6' to 'Cat 6A' 2. Revise obsolete part manufacturer part numbers

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSE-05

ACCESS CONTROL SYSTEMS

Version	Revision 1
Effective Date	03-26-2019
Approved By	Manager, IT Systems

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1 INTRODUCTION

1.1 General

.1 This Access Control Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Access Control Systems installed on campus.

.2 This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

1.2 Compliance Criteria

.1 Full compliance is mandatory on projects involving new construction.

.2 Full compliance is mandatory for new Access Control System installation within projects involving significant renovations.

.3 Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing Access Control Systems infrastructure

.4 Any deviations from the minimum requirements outlined in this Standard must be approved by the Manager of Information Services, Physical Resources Department

1.3 Responsibility of the Designer

.1 The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.

.2 It is the responsibility of the System Designer to engage the U of G E-Access team prior to the completion of the schematic design stage.

.3 Any conflict between applicable Codes & Standards and this Standard shall be identified and presented to the Manager of Information Services, Physical Resources Department, together with proposed measures for addressing the conflict before the finalization of the Schematic Design.

1.4 Design Innovation

.1 This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.

.2 All proposed Design Innovation shall be tabled for consideration by the Manager of Information Services, Physical Resources Department, before the completion of Schematic Design.

1.5 Reference Documents

.1 Underwriters Laboratories

.1 UL 294-[1999], Standard for Safety for Access Control System Units.

.2 CAN/ULC-S302-M91 - Standard for Installation and Classification of Burglar Alarm Systems for Financial and Commercial Premises, Safes and Vaults

.3 CAN/ULC-S303, Local Burglar Alarm Units and Systems.

.4 CAN/ULC-S304, Intrusion Detection.

.5 CAN/ULC-S306, Intrusion Detection Units.

.6 CAN/ULC-S304-06, Signal Receiving Centre and Premise Burglar Alarm Control Units.

.7 CAN/ULC-S3-1-M88 Standard for Central and Monitoring Station Burglar Alarm systems.

.8 ORD-C634, Connectors and Switches for Use with Burglar Alarm Systems.UL 1076-[1995], Standard for Safety for Proprietary Burglar Alarm Units and Systems.

.9 ULC-S318, Power Supplies for Burglar Alarm Systems.

.10 CAN/ULC-S524-06 – Installation of Fire Alarm Systems

.11 CAN/ULC-S559-04 – Equipment for Fire Signal Receiving Centers and Systems

.12 CAN/ULC-S561-03 – Installation and Services for Fire Receiving Centers and Systems

.2 Canadian Standards Association (CSA International)

.1 CSA C22.1-[98], Canadian Electrical Code, Part 1 (18th edition) Safety Standard for Electrical Installations.

.3 Applicable local Building Codes and Fire Codes

.4 Manufacturer’s specifications, latest issue.

1.6 Definitions

.1 24/7: Twenty four (24) hours, seven (7) days a week, three hundred and sixty five (365) days a year including all holidays.

.2 Authority Having Jurisdiction (AHJ): An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

.3 Backbone Cabling: Cabling and connecting hardware that provides interconnections between telecommunications rooms, equipment rooms, and entrance facilities.

.4 Backbone: A facility (e.g., pathway, cable or conductors) between telecommunications rooms, or floor distribution terminals, the entrance facilities and equipment rooms within or between buildings.

.5 U of G: means the University of Guelph.

.6 Equipment Room (ER): An environmentally controlled centralized space for telecommunications that houses a main or intermediate cross-connect.

.7 Fire Alarm System: is designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion.

.8 Horizontal Cable: The cabling between and including the work area telecommunications outlet/connector and the horizontal cross-connect/patch cord in the telecommunications room.

.9 Internet Communications Protocol (IP): is the principal communications protocol used for relaying datagrams (also known as network packets) across an internetwork using the Internet Protocol Suite responsible for routing packets across network boundaries.

.10 Others: specifies U of G divisions and/or U of G designated and registered Contractors

.11 Owner: specifies the U of G or a designated representative of U of G.

.12 Power Over Ethernet (POE): Power-over-Ethernet (PoE) or "Active Ethernet" eliminates the need to run 120/220 VAC power to Wireless Access Points and other devices on a wired LAN. Using Power-over-Ethernet system installers need to run only a single Ethernet cable that carries both power and data to each device.

.13 Project Manager, Program Manager, Project Coordinator and U OF G Representative: specifies the main contact person at the U OF G for all matters relating to the project. Manager of a team of U OF G staff assigned to the project.

.14 Protective Wiring: Any of the various recognized forms of conductor, such as conductive foil, open-wire lacing, grooved stripping, screens, and connectors and switches, used for protecting windows, doors, transoms, vents, skylights, walls, floors and ceilings.

.15 Protector: A device used to protect facilities from and equipment from abnormally high voltages or currents.

.16 Provide: The term "provide" shall be synonymous to, and complementary with, "supply", "install", "configure", "make operational", and "warranty", in reference to any and all hardware, equipment and materials, unless explicitly stipulated otherwise.

.17 Pull Point: A Pull Point is a space use to transition between floors for backbone and horizontal cabling within a building riser system.

.18 Repair: To furnish and/or restore an equipment module and/or system to its fully functional state without any additional costs to U OF G. This applies to all warranty and non-warranty equipment.

.19 Riser Cable: Telephone, data, audio, video, coaxial and other structured cabling system cables extending vertically and/or horizontally between the BDF and each area IDF to support low voltage systems.

.20 Services: specifies all services and deliverables to be provided by a Contractor(s) working with U of G.

.21 Shop Drawings: specifies drawings, diagrams, illustration, schedules, performance charts, brochures and other data, which are to be provided by the Contractor(s) working with U OF G.

.22 Solution: specifies a set of goods and services meeting the U OF G's requirements, as set out within their Installation Standards.

.23 Structured Cabling System (SCS): the complete collective configuration of a telecommunications cabling and associated hardware at a given location.

.24 Tampering: Attempting to compromise the protection.

.25 Wiring: specifies all final and necessary terminations and connections of cable to the equipment, components and devices; including all necessary connectors and fasteners.

.26 Work: The term "work" includes all labour, materials, equipment and services required and implied as shown and described in the contract documents, supplied and installed or erected, complete at the designated place, in compliance with the laws and regulations of the locality.

1.7 Acronyms

.1	ACS	Access Control System
.2	AFF	Above the Finished Floor
.3	CAT	Category
.4	CCTV	Closed Circuit Television
.5	DCU	Door Control Unit
.6	DGP	Data Gathering Point
.7	DPU	Distributed Processing Unit
.8	EMI	Electromagnetic Interference
.9	ER	Equipment Room
.10	JB	Junction Box
.11	KVM	Keyboard, Video, Mouse console
.12	LAN	Local Area Network
.13	PB	Pull Box
.14	PP	Pull Point
.15	RAM	Random Access Memory
.16	REX	Request to Exit Motion Detector
.17	RXP	Request to Exit Push Button
.18	SCS	Structured Cabling System
.19	SPOC	Single point of Contact

.20	TR	Telecommunications Room
.21	UPS	Uninterruptible Power Supply
.22	UTP	Unshielded Twisted Pair

2 DESIGN STANDARDS

2.1 General

.1 This standard is to be utilized in conjunction with contract specifications and associated drawings issued for project initiation and implementation.

.2 The procurement, detailed design, installation, terminations, programming, integration, testing and demonstrating system functionality shall be formally presented, documented and verified to U of G or its elected representatives prior to implementation.

.3 All required cabling, connectors, hardware, software, hardware and software updates, hardware and software upgrades and licenses to allow for the required functionality under this standard shall be provided.

.4 The products and performance levels specified are those that have been standardized by the U of G and are intended as mandatory performance levels for the system. Alternative architectures and solutions are not acceptable.

.5 Current various site conditions and existing system configurations shall be reviewed and taken into consideration prior to providing proposed ACS design detail.

.6 Labour and material must be provided to comply with manufacturer's requirements and applicable standards and codes for grounding of devices.

.7 Equipment shall be installed as per manufacturer recommendations or as otherwise noted within this standard as well as specification and specification drawings issued at the time of award or project initiation.

.8 Coordination of work with all applicable trade contractors (including and not limited to U of G's IT Services Group) on site shall be managed by this Contractor's project manager.

.9 The Contractor(s) shall remain responsible for the safe keeping and protection of system equipment while work is in progress and until the system is fully accepted by the U of G after the commissioning process.

.10 Equipment and material provided to U of G shall be CSA/ULC certified. Where there is no existing rating to equipment specified, the Contractor shall obtain special prior written approvals from Electrical Inspection Department.

.11 The ACS including all equipment / hardware, software and documentation shall be warranted by any Contractor(s) working with U of G as well as maintain the ACS in compliance with manufacturer specified preventative maintenance schedule throughout the project implementation period.

.12 The Contractor shall provide detailed system wiring diagrams to U of G standards to the Owner or Owners representative. It is the responsibility of Contractor to finalize the wiring diagrams to meet any site specific conditions and provide a fully functional system. The Contractor shall submit the finalized drawings for approval to the Owner or Owners representative in RAW editable format.

2.2 Operational Systems

.1 Work shall be executed to minimize the impact or the disruption of the existing, operational, systems and facility operations. At any time during the performance of the work, if the existing, operational, systems are affected beyond the expectation approved through the Implementation Plan or there is an imminent danger to be affected beyond the approved expectation, the Contractor shall stop work and minimize the impact on the operational systems. The Contractor shall immediately inform the Owner or Owners representative. On the owner's request, the Contractor shall perform all Work to implement a temporary solution to enable the functionality for the operational systems. The Contractor is to proceed with permanent Work only after a solution is approved by the Manufacturers Engineer and U of G.

.2 Failure to fully comply with the above paragraph will make the Contractor directly responsible for all damages and all costs required to respond to the incident and to remedy the failure.

2.3 Hazardous Materials

.1 Some U OF G sites may contain asbestos and other hazardous materials. Prior to the start of any work, the Contractor shall consult with U OF G and obtain relevant documentation from U OF G that identifies specific locations and areas containing hazardous materials. The Contractor shall be required to follow U OF G policy along with relevant regulations and standards prior to, and when preforming work where such materials are present.

2.4 Warranty

.1 The Security Contractor shall warranty the completed solution including all equipment, computer software, documentation and latent defects delivered shall perform in accordance with and conform to all applicable standards, requirements, specifications, descriptions, and other requirements included in their proposal and shall be without defects in materials, workmanship and design. The warranty shall commence upon Substantial Completion as defined by the Owner's Representative.

.2 Expose, and assign to the owner, any manufacturer's warranties including all associated documentation of such warranty. Include for 12 month all-inclusive parts and labour with 12 month warranty as part of the tender price.

.3 As a minimum during the warranty period and at no extra cost to the owner, the Security Contractor shall include a guaranteed response time of two (2) hours for a major system failure and eight (8) hours for a minor system failure on a 24 hour per day, 7 days per week basis. A major system failure shall be defined as the failure of any operator controls as well as any system controller, processor or communication link which renders more than 10% of a specific security subsystem of systems inoperative. A minor system failure shall be defined as the failure of a single security device such as a card reader, egress device, camera, intercom unit, etc.

.4 As part of the submission, provide a complete list of recommended spare parts which should be held in the Country as well as a list of parts available on Company premises for fast system repairs and/or replacements.

.5 Preventive and corrective maintenance performed by a maintenance contractor other than this Contractor after or during the warranty period shall not void warranty on labour, hardware and software provided by this Security Contractor.

2.5 System Description

.1 The current approved Access Control Platform at the University of Guelph is Genetec Security Centre. No substitutions shall be considered. Only contractors certified by the manufacturer shall be permitted to work on the system.

.2 The Access Control System (ACS) consists of field devices including, but not limited to:

.1 Cards
.2 Credential Readers
.3 Door Control Units (DCU)
.4 Electrified door hardware such as electric strikes, latches and locks
.5 Electric Power Transfer and concealed hinges/switches
.6 Request to Exit Motion Detectors
.7 Request to Exit Push Buttons
.8 Tamper Alarms
.9 With ancillary connections to:
.10 Intercom Stations for door release
.11 Fire Pull Stations
.12 Hold open devices (Fire alarm release)
.13 Power and automatic door operator units
.14 Control and termination equipment including, but not limited to:
.15 Access Control System Server
.16 Operator Work Stations
.17 Power supplies

.18 Batteries

.19 Uninterruptable power supplies (UPS)

.3 All system devices / doors connect to centrally located Door Control Panels, connectivity from Door Control Panels to the system server front end is based on Ethernet IP based protocols over the U of G network.

2.6 Data Gathering Panels / Door Controller Units

.1 Control units for Board facilities shall be located and mounted to the area of the greatest protection and shall be electrically supervised against tampering.

.2 Control units shall be sized on per project basis to appropriately support the total number of devices and areas required.

.3 For new or expansion of existing DGP configurations provide cable troughs, conduit, and essential power circuits. Cable troughs shall be grounded to earth ground.

.4 All Equipment mounted in each DGP configuration shall be mounted on fire rated plywood supplied and installed by this Contractor.

.5 Access Control equipment, cable troughs, conduit, and emergency power circuits, shall be wall mounted.

.6 Prior to start of installation of any equipment this Contractor shall remove all water, dirt and debris of any kind from the room. It shall be the responsibility of the Contractor to keep communications / equipment rooms clean and free of dust at all times during the installation.

.7 Power Failure

.1 The system is currently capable of operating even in the event that the system management server is unavailable. Future expansions and additional of the system shall maintain this ability.

.2 Following a power failure and the restoration of main or backup power, the ACS shall revert automatically, within 3.5 minutes, to normal service status without the need for operator intervention. The system shall restart in the same state as existed before the power interruption with no loss of functionality or transaction data.

.3 In the event that communication between the door control panel and access control server is unavailable, the functionality of the door control panel shall be preserved such that door functionality at every door is unaffected.

.4 This will apply for all card records that were recorded in the access control system database prior to the loss of communication between the panel and access control system server.

.8 Portal Definitions

.1 Refer to “door typical” drawings included in this standard for required door configuration and functionality.

.2 For specific door types that do not match those provided in this document, the Contractor shall create a new “door typical” drawing and submit to U of G for approval.

.9 Network Communication

.1 Connectivity from door controller panels to the system front end shall be based on Ethernet IP based protocols over a U of G supplied network. The Contractor shall connect access control equipment to communication rooms containing U of G network switches and connect to associated network patch panels.

.2 The Contractor shall coordinate and facilitate all connections with the Physical Resources IT group. Follow existing procedure for obtaining IT resources..

.3 The Contractor shall ensure all IP addressing schemes used on access control equipment are coordinated and approved by the Physical Resources IT group. Follow existing procedure for obtaining IT resources **ACS Server.**

.4 All access control system servers are currently and shall remain in Secure Communications rooms.

2.7 Monitoring & Control Locations

.1 Client software is installed and maintained by the Physical Resources IT group. Physical Resources IT group shall provide temporary access to the Security Contractor on request to allow for configuration and testing of new equipment.

2.8 Interface with Other Systems

.1 Elevators

.1 Where elevators require card access, the card reader shall be mounted inside the cab and shall provide for floor by floor control. The elevator on a valid card read shall unlock all floors pertaining to the cardholders access rights. Once a floor is chosen the elevators shall be directed to the restricted floor. The system shall capture information as to the floor that was chosen by the card holder.

.2 All work, equipment, and supplies relating to the installation of Card Access, and/or modification of elevators to support card access in building elevators shall be performed by the existing elevator maintenance company. The Contractor shall carry in their bid all cost associated with this work.

.3 The Contractor shall be responsible for coordinating and identifying all installation requirements to the elevator company.

.4 The Contractor shall ensure and maintain the functionality of the elevator fireman’s override key switch such that on activation the security system shall relinquish all control over the elevator call buttons and the elevator shall function normally.

.5 The Contractor shall provide to the elevator company all required security equipment such as card readers, controllers, cabinet, power supplies, resistors, varistors, diodes, etc. required for elevator security.

.6 The Contractor shall connect all equipment to the Access Control system and shall restrict and track access of card holders to each elevator floor.

.7 The Contractor shall be responsible to coordinate the installation testing and commissioning of all required elevator security equipment with the elevator company in relation to security system components and devices.

.2 Network Time Protocol

.1 All Access Control System devices that utilize time and date shall be maintained with NTP time. The NTP master clock shall be provided by U of G.

.3 Parking Garage Entrances, Gates and Exit Overhead Doors

.1 For such new facilities the Contractor shall be responsible for coordination, supply, installation and integration of access control and intercom system components and cabling to all locations where required.

.2 Where required the Contractor shall be responsible for ensuring that roll up doors and gates shall integrate to the access control system to open on a valid card read or remote operator action.

.3 Contractor shall provide for all entrance and exit gates to have an override option for remote open and close of gates via the access control system software.

.4 Power Requirements

.1 120 VAC power on essential power shall be provided for additional security system components at each location required. This includes all modifications to existing systems required to accomplish this task.

.2 The power solution shall comprise of CSA listed power supplies and transformers to distribute low voltage power to system components.

.3 The power solution shall include lockable, hinged covered, terminal cabinets for all power supplies, transformers, and power distribution terminal strips. The Contractor shall provide all conduit and wiring from the 120 VAC facilities to the terminal cabinets.

.4 The power solution shall provide protection against surges, spikes, noise, harmonic distortion and other line problems for all system equipment and their components. In addition to generator support, all power sources shall be equipped with uninterrupted power supply capable of supporting all attached equipment for a period of 20 minutes.

.5 All equipment and system components which are powered by more than 48 volts AC or DC shall be ULC listed for safety. This includes equipment or system components classified as non-power limited.

.6 All system power supplies shall be monitored, by the Access Control System, for line failure on a dedicated monitoring input point. Therefore, when an AC line fails, a unique alarm condition will be caused.

.5 Labeled Fire Doors and Frames

.1 Any labeled fire door or frame which will require modification to meet the system specifications must be immediately brought to the attention of the U of G.

.2 The Contractor shall be responsible for replacing any labeled fire door or frame that is modified, by the Contractor, without written approval from U of G.

2.9 Field Devices

.1 Electrified Door Hardware

.1 All Contractor provided door hardware shall conform to U of G Standards for Door Hardware, latest revision.

.2 All electrified door hardware provided shall be field convertible between 12 and 24v.

.3 All electrified door hardware shall be configured for 24v operation.

.2 Mullion Disconnect

.1 For door locations with removable mullions a sealed cable to cable connection is required.

.2 Sealed cable to cable connectors be shall MX150 series connectors as manufactured by Molex.

.3 Each connection shall consist of the following part numbers:

.1 1 x Female receptacle, part number 33471-0201

.2 2 x Female receptacle terminals, part number 33001-3003

.3 1 x Male receptacle, part number 33481-0201

.4 2 x Male receptacle terminals, part number 33011-0004

.4 All connections shall be crimped with the approved Molex crimp tool.

.3 Door Position Switches

.1 In locations with door position switches, they shall be supplied and installed by this contractor.

.2 Door position switches shall be concealed discrete devices unless otherwise noted and shall not be integral to other devices such as strikes, maglocks, etc.

Where exposed mounting is necessary devices shall be mounted so as to limit easy access to unauthorized personnel.

.3 At high security locations, E.O.L. resistors shall be installed at the door contact.

.4 Acceptable devices are as follows:

.1 Concealed – Sentrol 1078, 1076, 1840 or approved equivalent

.2 Surface – Sentrol 1045T or approved equivalent. (may be used where approved only)

.3 Overhead – Sentrol 2200 Armoured Cable or approved equivalent. (One overhead doors)

.5 Frame mounted magnetic door contacts, hinge mounted plunger type switches, are not acceptable.

.4 Electromagnetic Locks

.1 Electromagnetic locks shall be designed and provided by Division 8 (Door Hardware) It is the responsibility of the security contractor to coordinate these locations and provide control and power for these devices.

.2 Power connections shall have a metal oxide varistor connected at the lock termination point.

.3 Applicable permits, inspections, and testing shall be the Contractor's responsibility at the contractor's expense, unless stated otherwise in project specific contract specifications.

.5 Automatic Door Operators

.1 Where automatic door operators are present they are to be interfaced with the access control system as described in common portal functions.

.2 Where automatic revolving or sliding doors are to be installed, the door shall be capable of being locked securely when parked. Door contacts shall be provided on all door leafs to monitor door status.

.6 Door Release Push Buttons (Security Push Buttons to Exit)

.1 For use only on maglock doors, each door release push button shall be 8825-13 F system standard which provides double pole, double throw configuration.

.2 One pole is to request exit from the system, the other shall redundantly release the magnetic lock by power interruption.

.3 The exit pushbuttons shall be totally fail-safe, to release the doors in the event of a failure of the exit control circuitry within the reader interface module.

.4 All exit pushbuttons shall be labeled to meet local codes.

.7 Magnetic Lock Master Reset Switches

.1 Where required by code provide Locknetics 640 Series magnetic lock reset keyswitch. This switch shall be set-up to “enable” when turned one way and “disable” when turned the other.

.2 In accordance with the Authority having jurisdiction, this switch should be normally located inside the Fire Panel System Room and shall indicate the lock control system status with red and green LED indicators at the switch.

.8 Card Readers

.1 HID Dual Technology Contactless smart card readers are to be provided and shall securely read access control data from SIO-Enabled 13.56 MHz contactless smart cards as well as 125 KHz proximity cards.

.2 The contactless smart card reader shall be optimally designed for use in access control applications by providing:

.1 Secure access control data exchange between the smart card and the reader utilizing key diversification and mutual authentication routines.

.2 Universal compatibility with most access control systems.

.3 The ability to read expanded data format lengths up to 144 bits.

.4 Backwards compatibility with legacy 125 KHz proximity access control formats (E.g. 26-bit, 32, 35-bit, 37-bit, 56-bit, and HID Corporate 1000 formats).

.3 The contactless smart card reader shall be configurable to provide multiple hierarchical degrees of key compatibility for accessing the smart card access control data. Compatibility shall be provided for the following key structure options:

.1 Compatibility with the default iCLASS key structure to ensure convenient off the shelf compatibility with iCLASS cards and readers.

.2 Compatibility with higher security HID managed ELITE keys which provide a site-specific, unique, protected key structure.

.3 Compatibility with high security user-managed custom keys.

.9 Tamper Alarms

.1 All ACS equipment cabinets including system power supply cabinets, shall be equipped with sensors, which detect and remotely annunciate their opening.

.2 All communication and alarm device cabling at the door and between the DGP and the door shall be supervised to detect and remotely annunciate "open", "high impedance", "low impedance", and "short" conditions. The end of line supervision device shall be installed as close as possible to the security device.

2.10 Conduits, Boxes and Raceways

.1 The Contractor, unless otherwise stated in project specific contract specifications shall be responsible for providing all cable, conduits, boxes, and raceways deemed necessary to provide a quality turn-key installation.

.2 All electronics modules shall be properly housed in steel enclosures or junction boxes as required.

.3 The Contractor shall be responsible for providing these enclosures or boxes where necessary.

.4 The Contractor shall be responsible for ensuring that all back boxes, conduit, and raceways meet equipment and wiring requirements for the system.

.5 The Contractor shall inspect the raceway system during construction and shall notify U of G of any problems found, prior to the finishing of the wall, ceiling, or floor surface.

.6 All junction boxes are to be accessible for future service. All junction boxes shall be secured with tamperproof screws where installed below 8 feet.

.7 Location of all boxes and access panels are to be approved by U of G prior to installation.

.8 No access panels may be located where they will affect the finished appearance of the surrounding area.

2.11 Cabling

.1 Samples of all wire and cable types shall be submitted to U of G for acceptance prior to installation.

.2 All cables must be whole. Splicing of cable is Only permitted in extreme cases where approved by EA PR.

.3 All cabling shall be stranded. Solid core cable is not acceptable.

.4 Indoor cabling shall be installed in existing cable tray where and when possible and in EMT conduit when exposed or when required by applicable codes. Outdoor cabling shall be installed in PVC liquid tight conduit.

.5 Where required, cables shall be fire rated to comply with applicable codes.

.6 Conductors shall not be smaller than No. 24 AWG copper wire and of a type rated for burglar alarm system wiring.

.7 Connecting wire between a battery or power supply and a sounding device shall be not smaller than No. 16 AWG.

.8 Cable fill shall not exceed 40% on any new conduit installations.

.9 All cables shall be fastened to the structure at least every ten (10) feet where not in conduit.

.10 Wires shall be protected from abrasion due to sharp corners or projections by at least two layers of electrical insulating tape or the equivalent. Wire that has scrapes, nicks, gouges, or crushed insulation shall not be used and must be removed.

.11 Connecting wires may be attached to plaster or wood by means of acceptable forms of staples, porcelain, or other non-absorptive insulating, or bridle rings or tie wraps.

.12 Connecting wires above suspended ceiling assemblies shall be secured and protected against physical damage.

.13 It is absolutely prohibited to run low voltage power limited wiring in the same wire-ways with, or closely parallel to, high voltage and/or switched power wiring.

.14 For connections and splices all shall be mechanically secured using gel filled crimp connectors designed for use on stranded wire. Twist type connectors shall not be used.

.15 The wire or circuit provisioned shall be no longer than 80% of the maximum allowable length and power consumption for the wire size and application.

.16 Wiring in all cabinets and terminal boxes shall be neatly arranged and bundled with Panduit tie wraps or equivalent.

.17 Code compliant fireproofing techniques shall be used by the Contractor on all penetrations of fire rated partitions and slabs, where the penetrations are made by or used by the Contractor.

.18 All wires and cables shall be ULC listed for their application and shall conform to manufacturer specifications for installation.

.19 All cable and wiring methods shall meet national, provincial, and local code requirements.

.20 All cable must be properly grounded to meet Codes and provide a trouble free system.

2.12 System Programming

.1 The Contractor is required to provide all system programing including but not limited to:

  .1 All system(s) configuration.

.2 All system naming conventions shall U OF G naming conventions as provided by U of G.

.3 The Contractor is required to conduct and chair pre-installation meetings as required with U OF G or their representative to identify specific requirements of the system programming.

.4 All programming or editing of the existing program in the system shall be achieved without interrupting card authentication.

2.13 Testing and Commissioning

.1 Refer to the University of Guelph Commissioning Standard for additional details.

2.14 System As-Built Documentation

.1 Deliver three (3) hard and soft copies of each manual within two (2) weeks of receiving formal system acceptance.

.2 Final documentation soft copies shall be prepared and submitted in the native (editable) electronic format (.vsd, .dwg, .xls, .doc). All documents produced shall be property of U of G Contractor shall have no rights over the entire documentation package or any parts of the documentation package.

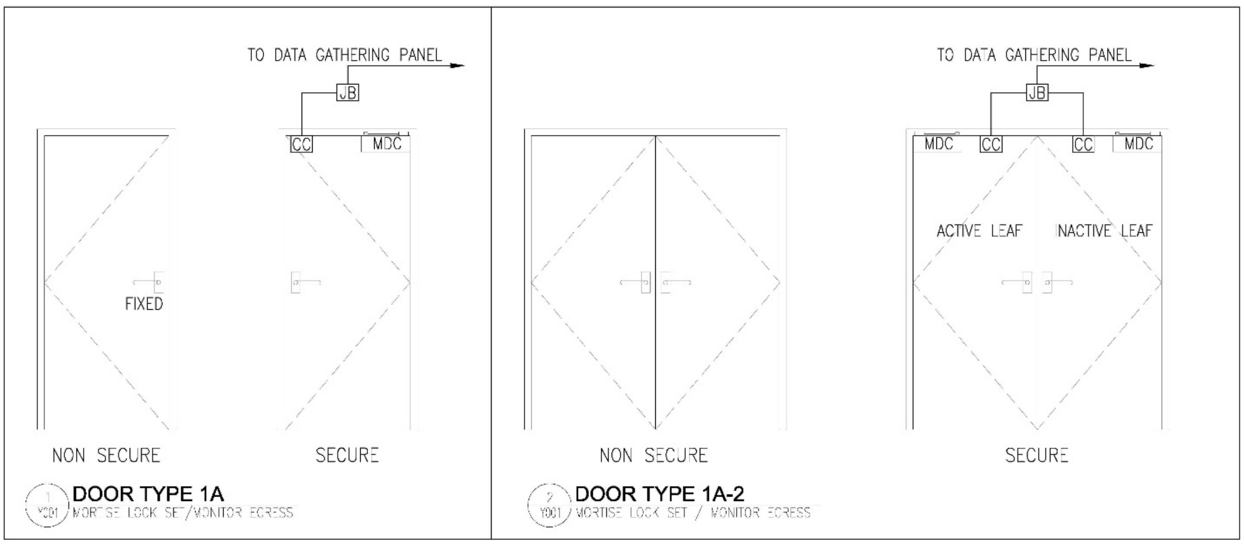
.3 Final As-built Drawings and Turnover Documentation shall consist of the following as a minimum:

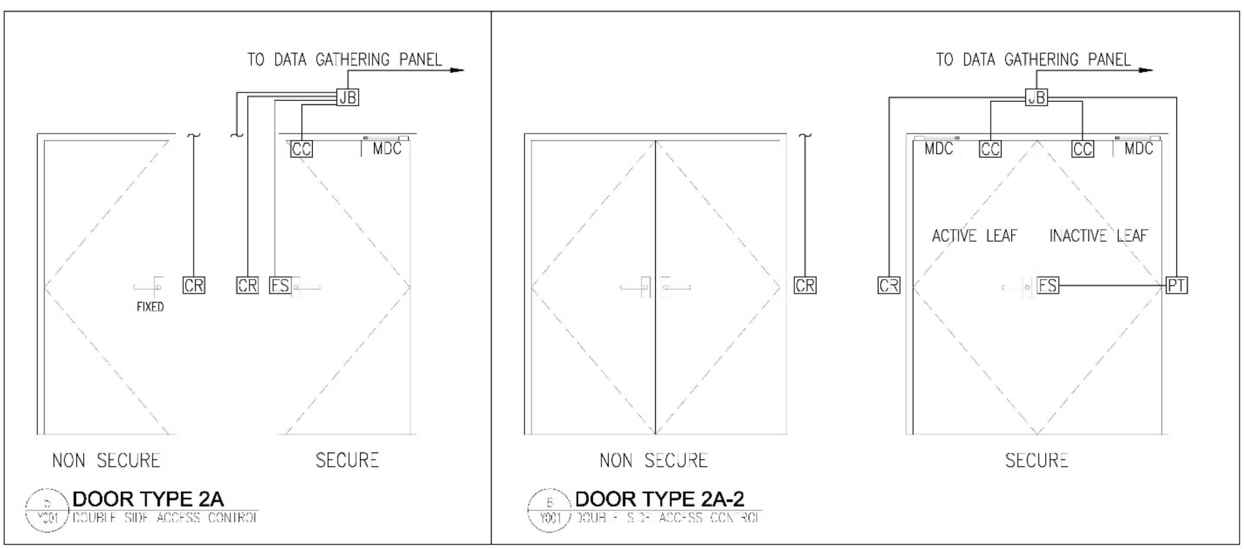
1. Equipment List	
Shall Included as a Mininum:	***Description***
Devices	All Supplied Equipment with Manufacturers Part Number, Model Number & Serial Number and Quantity per Comm. Room
Components	Removable Components that make up the device (example: slotted cards) Showing Part Number, Model Number & Serial Number
Manufacturers	Manufacturer of the Device and the Components that make up the Device (Include contact name , address, phone, fax, email, website)
Suppliers	Company supplying the Component or Device (Include contact name , address, phone, fax, email, website)
Distributors	Distributor or Manufacturers Rep. (Include contact name , address, phone, fax, email, website)
2. Final Revision As-Builds & Shop Drawings	
Shall Included as a Mininum:	***Description***
Interconnect Diagrams	Very detailed drawing showing connection of one device to another (specifically how it's wired)
Equipment Layouts	riser diagrams indicating location of equipment along with IP stack, and system addressing information.
Electrical Schematics	all associated electrical panel and breaker numbers for all powered equipment.
Wiring Diagrams	Detailed drawing depicting exact terminations and component quantities as they have been installed.
Point Allocation Table	Very specific showing all termination points for all devices, components. Shows what is connected to each terminal on each device, component
Architectural drawings (Security System Layout drawings)	Floor plans that show all device locations
3. Software	
Shall Included as a Mininum:	***Description***
Installed software List	For each supplied device including operating system. show current software versions
Equipment Operating System CDs (Installed Version)	For each supplied device in "Equipment List".
Application CDs	For each application noted in "Installed Software List"
Configuration	All Software Configuration Parameters presented in excel spreadsheets (alarming tables, equipment addressing etc…)
Registrations	Software Registration numbers, codes and forms supplied by the manufacturer for each supplied device noted in "Equipment List".
4. Manuals	
Shall Included as a Mininum:	***Description***
Manufacturer Equipment Manuals	Published by the Manufacturer
Manufacturer Operation Manuals	Published by the Manufacturer
Manufacturer Service Manuals	Published by the Manufacturer
Manufacturer Maintenance Manuals	Published by the Manufacturer
Equipment Keys	Keys or combinations that unlock any provided equipment or components
5. Warranties	
Shall Included as a Mininum:	***Description***
Vendor Installation warranties	Include start date and end date, Response times
Vendor equipment warranties	Include start date and end date
Software warranties	
Hardware Warranties	
Manufacturing Warranties	
6. Checklist/Commissioning Forms	
Shall Included as a Mininum:	***Description***
Inspection Check list	
Verification Checklist	
Integration Checklist	camera to door, door to intercom, intercom to camera etc….

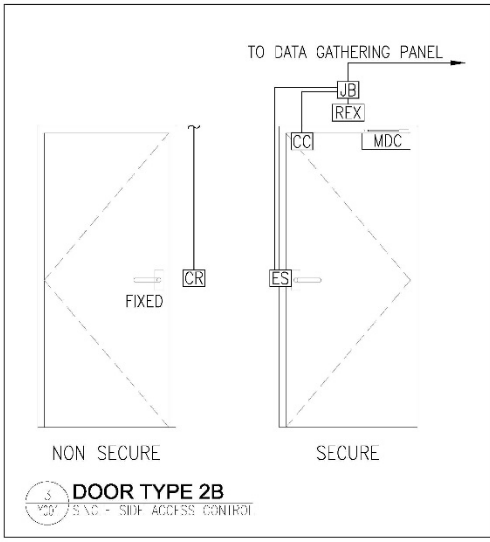
3 DOOR TYPICALS

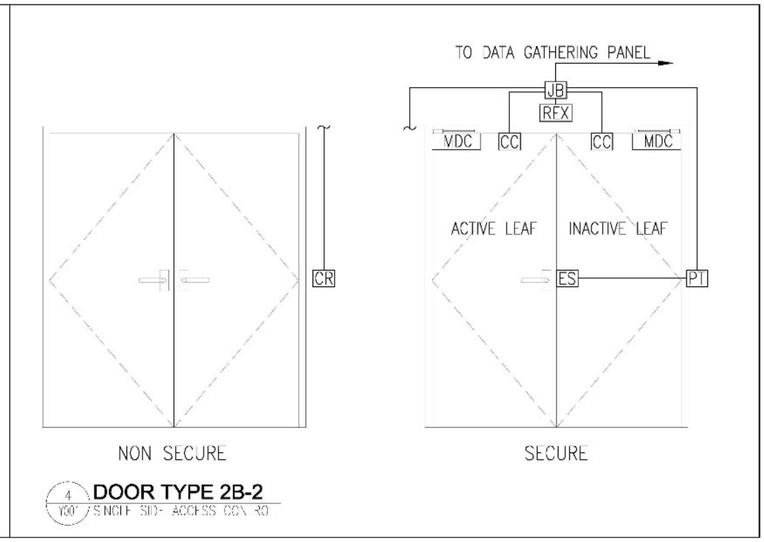
SYMBOL LEGEND

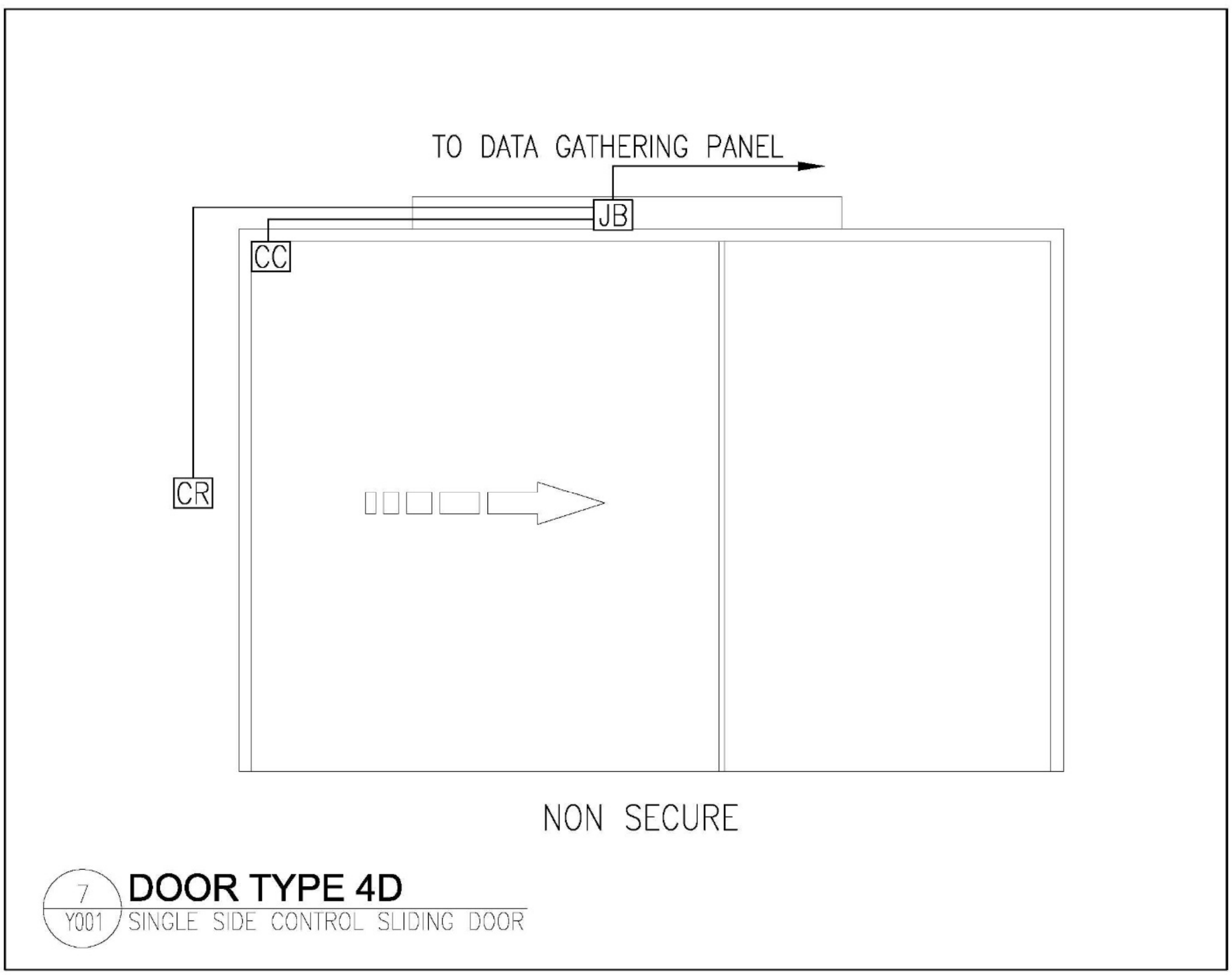
CR	CARD READER
CC	CONCEAL DOOR CONTACT
ES	ELECTRIC STRIKE
PT	POWER TRANSFER
REX	REQUEST TO EXIT MOTION DETECTOR
JB	JUNCTION BOX
MDC	MANUAL DOOR CLOSER

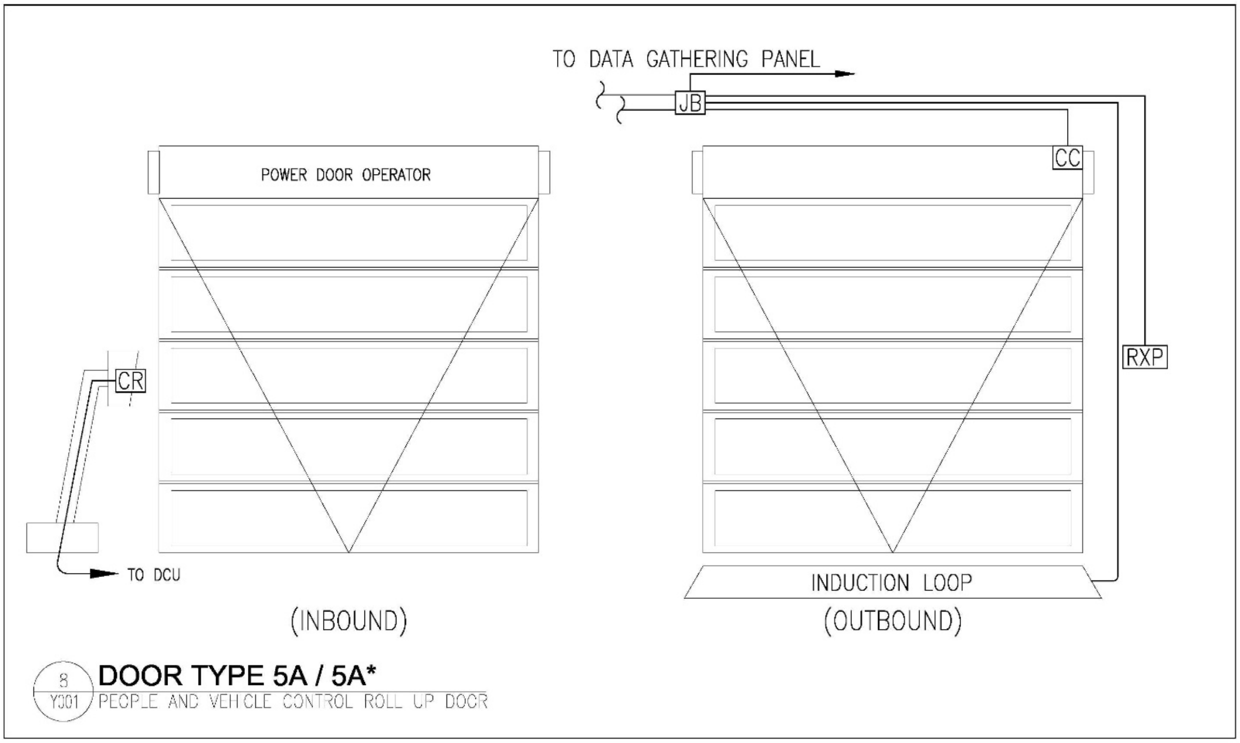


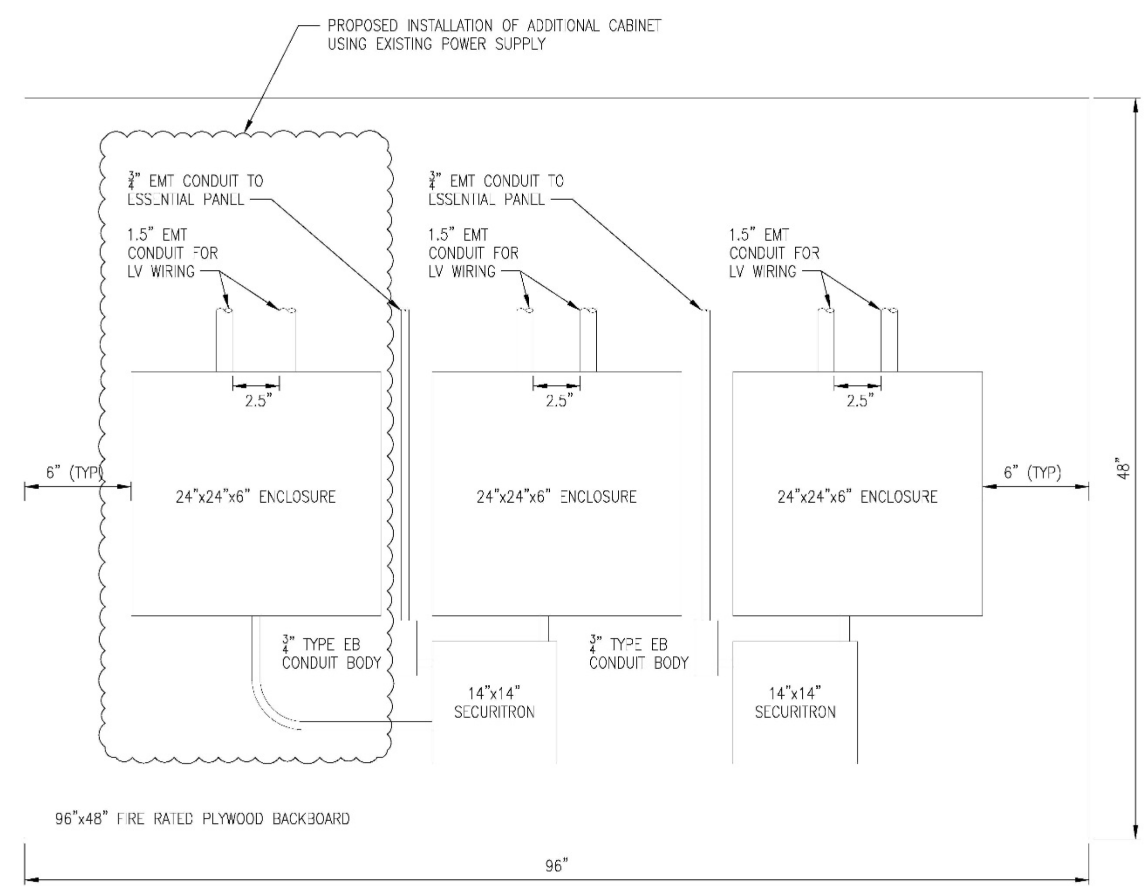



TO DATA GATHERING PANEL
JB
RFX
CC
MDC
CR
ES
FIXED
NON SECURE
SECURE
3
Y001
DOOR TYPE 2B

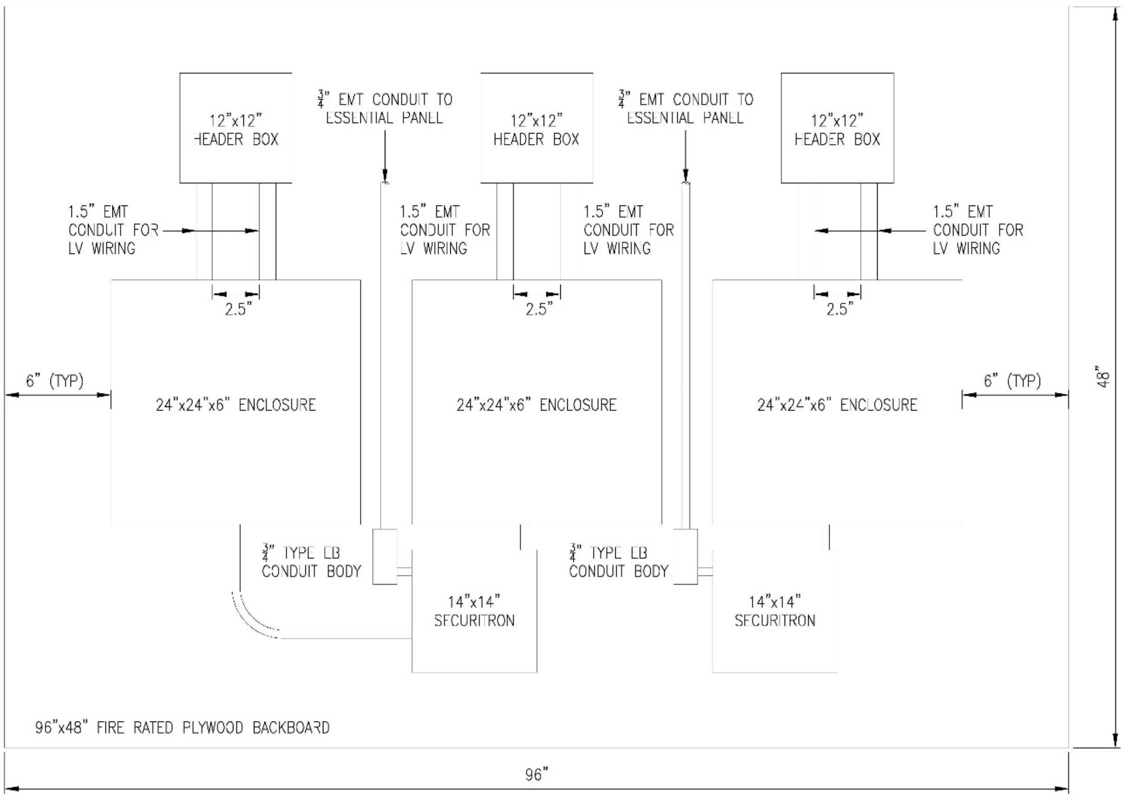

TO DATA GATHERING PANEL
JB
RFX
VDC
CC
CC
MDC
ACTIVE LEAF
INACTIVE LEAF
CR
ES
PT
NON SECURE
SECURE
4
Y001
DOOR TYPE 2B-2


TO DATA GATHERING PANEL
JB
CC
CR
NON SECURE
7
Y001
DOOR TYPE 4D
SINGLE SIDE CONTROL SLIDING DOOR

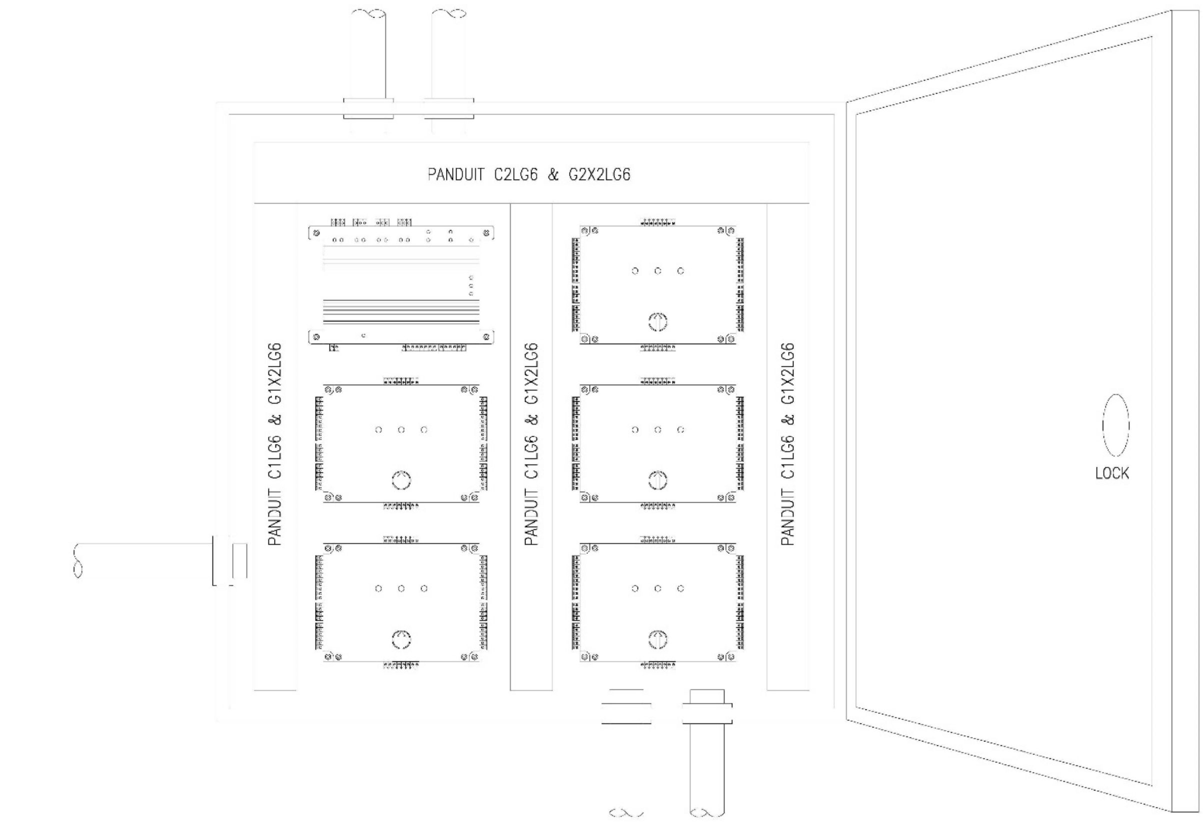

TO DATA GATHERING PANEL
JB
CC
POWER DOOR OPERATOR
CR
RXP
TO DCU
INDUCTION LOOP
(INBOUND)
(OUTBOUND)
8
Y001
DOOR TYPE 5A / 5A*
PEOPLE AND VEHICLE CONTROL ROLL UP DOOR



TYPICAL ELECTRONIC ACCESS PANEL LAYOUT
N.T.S.



2 TYPICAL ELECTRONIC ACCESS PANEL LAYOUT (WITH HEADER BOX)
N.T.S.



HOFFMAN 24 X 24 X 6 NEMA 1 STEEL ENCLOSURE LAYOUT DETAILS
N.T.S.

LAYOUT:

1. PROVIDE 24"x24"x6" NEMA 1 STEEL ENCLOSURE. COLOUR TO BE BAKED ENAMEL GRAY.

CABLING:

1. SECURITY CONTRACTOR TO PROVIDE CABLE AND ELECTRICAL CONTRACTOR TO INSTALL ALL CONDUIT AND PULL CABLES.
2. ALL CABLES TO BE CMG COMMUNICATION CABLE, FT6 RATED.
   - 2.1. DOOR CONTACTS REQUIRED 4C, #22AWG
   - 2.2. REQUEST TO EXIST DEVICES REQUIRE 4C, #22AWG
   - 2.3. CARD READERS REQUIRE 6C, #22AWG
   - 2.4. ELECTRIC STRIKES REQUIRE 4C, #18AWG.
3. PROVIDE PANDUIT AS SHOWN IN DIAGRAM. MODEL NUMBERS ARE INDICATED ON DIAGRAM.

4 VERSION CONTROL SUMMARY

Revision No.	Effective Date	Section / Page	Brief Description of Revision
1	2019-03-26	Entire Standard	Revision 1 Issue