UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARDS

INTRODUCTION

Version	Revision 1
Effective Date	April 8, 2019
Approved By	
	Director: Design, Engineering & Construction

TABLE OF CONTENTS

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 0
2	Paint	RD-01	Painting	Final Rev 0
3	Elevator	RD-02	Elevator	Final Rev 0
4	Door Hardware	RD-03	Hardware	Final Rev 0
5	Signage	RD-04	Signage	Final Rev 0
6	Roofing	RD-05	Roofing	Final Rev 0
8			Landscaping	Not Issued
9			Classroom	Not Issued
10			Laboratory	Not Issued
11			Vivarium	Not Issued
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 0
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

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSA-01

ARCHITECTURAL, SPACE PLANNING AND FINISHES

Version	Revision 0
Effective Date	10-23-2014
Approved By	Oct. 23rd. 14
	Manager, Architectural Design, DEC
Reviewed By	Dec 1 - 14
	Director, MES

TABLE OF CONTENTS

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

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.

2.2 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).

2.3 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.

2.4.4 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 AirBarrier 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 40% 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

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.

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.

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.

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 & 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.

.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.

.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.

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.

2.15 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.

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: 812.8(2'-8"), 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 There shall be no glazing in the bottom half of any door, however a light panel shall be incorporated in the top half of each door.

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.

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.

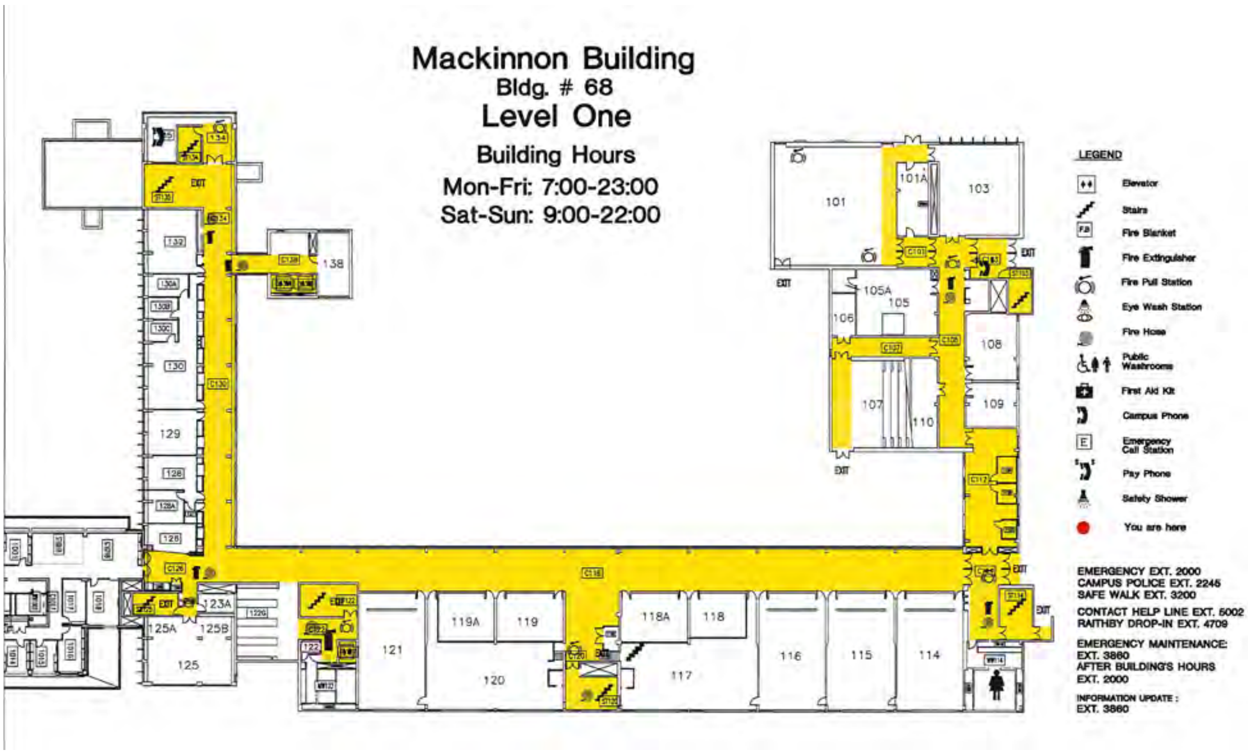
.5 Holders for these signs should follow building standards and generally would be Vista for lobby signs then Vista or a simple acrylic sleeve for subsequent locations and floors as best suited to project. In aggressive environments (Student Residences) or high quantity situation printed vinyl decals 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° 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.

2.20.4 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.

2.21 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

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 A recommended inventory list for extra stock (product and quantity) shall be presented to the Manager, Architectural Design for consideration prior to release of tender documents. Typically things like carpet, ceramic tile, fixed seating components, and specialty ceiling tiles would be considered and an extra square footage that is reasonable given the project. For example, if there is 1500 sq. ft. of carpet tile a 10% extra stock should be requested rounded down to the closest box. This list shall be prepared giving consideration to the following:

.1 Likely hood that the inventory material will be required in the short term (1-3 years) and long term (3-5 years).
.2 Amount and application and any applicable warranties of the product
.3 Availability and procurement lead
.4 Cost

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		

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
			$\frac{\text{Projected area roof meeting minimum SRI}}{0.75} + \frac{\text{Area of vegetated roof}}{0.5} \geq$ 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 $L/s/m^2$ (0.30 cfm/ft^2) 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.

Office Space Allocation Guidelines

UNIVERSITY of GUELPH

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

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TABLE OF CONTENTS

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. Level 1 - Basic:
   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. Level 2 - Standard:
   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. Level 3 - Superior:
   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. Level 4: Supreme:
   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	[illegible] Oct. 23rd '14
	Manager, Architectural Design, DEC
Reviewed By	[illegible] Dec 1-14
	Director, MES

TABLE OF CONTENTS

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	Hydraulic, with PVC - Duplex	4	4	
8	69	Crop Science	Large (west)	17514	Dover			1814	Service	Hydraulic, 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			

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD RD-03

HARDWARE

Version	Revision 0
Effective Date	10-16-14
Approved By	Oct. 23rd '14 Manager, Architectural Design, DEC
Reviewed By	Dec 1-14 Director, MES

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 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 4 doors or less, door hardware may be procured from the University Lock Shop via a requisition issued by the University Construction Coordinator/Project Manager. 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. In existing buildings, the University Project Manager 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.
  .4 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.
  .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.
  .6 All requests for single or multiple electronic door access systems and/or information systems must be directed to the Manager of Operations, Security Services who will then forward the request to the University Project Manager for system design approval and implementation. “Stand Alone Units” shall be a “Millennium System” and of the card or fob design. Key pad units are not to be used.

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 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.

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 Manufacturer's names or trademarks are not permitted on exposed surfaces of hardware.
.3 Hardware for fire rated and labeled door and frame assemblies shall be ULC listed or as accepted by authorities having jurisdiction.
.4 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.

.5 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 - Markar HG305-630
  - .2 Retrofit of new doors in existing frame or situation which may require plumb or vertical adjustment
    - Standard - Markar HG315-630
  - .3 All new door and frame installations
    - Standard - Markar FM300-630
  - .4 Continuous hinges shall be full height piano type providing full height door support:
    - To supports weights up to 600 lbs.
    - Material to be 14 gauge, 304 stainless steel
    - .25 diameter 304 stainless pin
    - Each knuckle 2", including split nylon bearing at each separation for a quiet, smooth, self-lubricating operation
    - Finish: Polished Stainless (US 32) 630
    - Non-handed
    - All hinges shall be furnished with manufacturer's recommended hardware pack per specific model application
    - Hinges shall meet 1,500,000 cycle test (ASTM 156.1)
    - Symmetrically templated hole pattern
  - .5 10 year Warranty on all Continuous Hinges
  - .6 When using any continuous hinge featuring the plumb or vertical 'adjusta-screw', e.g. Marker HG305, 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.
- .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.
- .2 Approved alternate: None

.5 Exit devices

- .1 Standard: Sargent
  - Exterior - no trim when possible, ETL trim when required
  - Vertical rod devices only to be used when in conjunction with magnetic hold opens
  - Doors requiring after-hour access will use a separate lock-unlock cylinder than entrance cylinder
  - Removable mullions to be key removable type
  - 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
  - Function 16 to be used on doors with ETL operative outside trim requiring after hour access.
  - When functional exterior trim is required use ETL design.
  - Use prefix12 on all series for fire rated applications.
- .2 Approved alternate: Precision Exit device models

.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: Norton 7500, finish and arm type as required by site conditions
  - Use PA mount when possible
  - Use Norton only to replace existing Norton
  - 8500 closers may be used in low traffic interior areas

.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: None

.8 Flush Bolts
.1 Standard: Glynn Johnson
- UL-FB6-26-D

.2 Approved alternate: None

.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 Weatherstripping
.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 'PowerSwing' electro-hydraulic opener.

.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"X8'0"
- 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

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 Medeco cylinders.

.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		

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD RD-04

SIGNAGE

Version	Revision 0
Effective Date	October 14, 2014
Approved By	Oct. 23rd, 14
	Manager, Architectural Design, DEC
Reviewed By	
	Director, MES

UNIVERSITY of GUELPH

SIGNAGE STANDARDS

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SIGNS&RECOGNITION

www.nothers.com
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323Horton St.
London, Ontario.
N6B 1L5

Issued; July, 2010

Background and Purpose

In 1967 a Signage Study for the University of Guelph was executed by the Design Collaborative and Project Planning Associates Ltd. From this was generated the original guidelines which were subsequently revised in 1982, the last revision to the campus Signage Standards. This document is the further evolution of the standards, still based on first principles, but taking into account new technologiesand a growing campus. The purpose of this document is to create a concise outline of the current signage standards complete with guidelines for implementation and approvals.

Defining governing standards that apply to most permanent signage at the University of Guelph will serve to support a welcoming, safe and easily negotiated campus. The University of Guelph's identity and the aesthetic value of the campus should be enhanced through using these uniform signage elements. This document is meant to support and develop upon standards set in the University of Guelph, Campus Master Plan Du Toit Allsopp Hillier Lea Consulting Ltd., Oct. 30th, 2002 and Physical Resources Policy, PR 2.030, On-Campus Signage. The standards as defined here will ease the process for the University community to procure typical signage, ie. signage that conforms to the types as listed herein.

The scope of the signage standards for both interior and exterior, include but are not limited to: Directional Information, Facility Identification, Information, Caution, Life Safety, and Regulations. Signage should provide useful information and allow for a more convenient interaction between the users and the University Facilities. Visual Unity should be created on the campus grounds through common elements of exterior signage and each individual university building will be uniform on the interior.

These standards are based on current signage manufacturing technologies. As signage does evolve, this standard is structured for revisions as implemented by Physical Resources.

Signage Design Principles

1. Standardization of Signs

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). This process can be initiated through a work order, see Physical Resources website for details.

2. Approvals

2.1. All new buildings will have proposed signage for interior and exterior reviewed by Physical Resources, Design Engineering and Construction, Architectural Services (PR, DEC, Arch.).

2.2. All room numbers will be verified with PR, DEC, Space and Facilities Renewal Group.

2.3. Any signs that these standards don't apply to or ones contained within that are marked Custom must be developed with PR, DEC, Arch..

3. 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.

3.1. Roads and Walkways; only the main north/south walkway – WineGard Walk and the two main East /West walkways will be named by signage.

3.2. Important Features; certain important features, such as Branion Plaza, could also be named and signed, while others (such as the green in front of Johnston Hall could be named on the map of the campus in order to establish their names in common usage.

3.3. Buildings; 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 by occupant should also be avoided as this changes too frequently.

3.4. Parking Lots; permanent Parking lots should be numbered and signed with standard signage outlined in this document.

1. Exterior

Aluminum signs are preferred for exterior applications and will be brown anodized panels with engraved natural aluminum or white painted letters. Engraving should be used when changes are not anticipated.

1.1. 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 route.

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 sufficiently 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.

1.1.1. 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.

1.1.2. Pedestrian Directional signs
To provide guidance to pedestrians on campus, to assist them in orienting themselves and in finding the correct direction to any desired area or building. Details of the campus, specific building names are best shown on campus maps.

1.1.3. 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.

1.1.4. Building Identification Signs
Inform pedestrians and drivers in the vicinity of a building the name of that building. In addition to this it provides a unifying design element to the fabric of the campus. Main Identifying signs will be mounted to standards outlined herein with concrete plinth as preferred choice, then building mounted as secondary acceptable option. For new buildings the proposed exterior signage package is to be reviewed by PR, DEC, Arch. Services. Signs are not to be attached at right angles to walls.

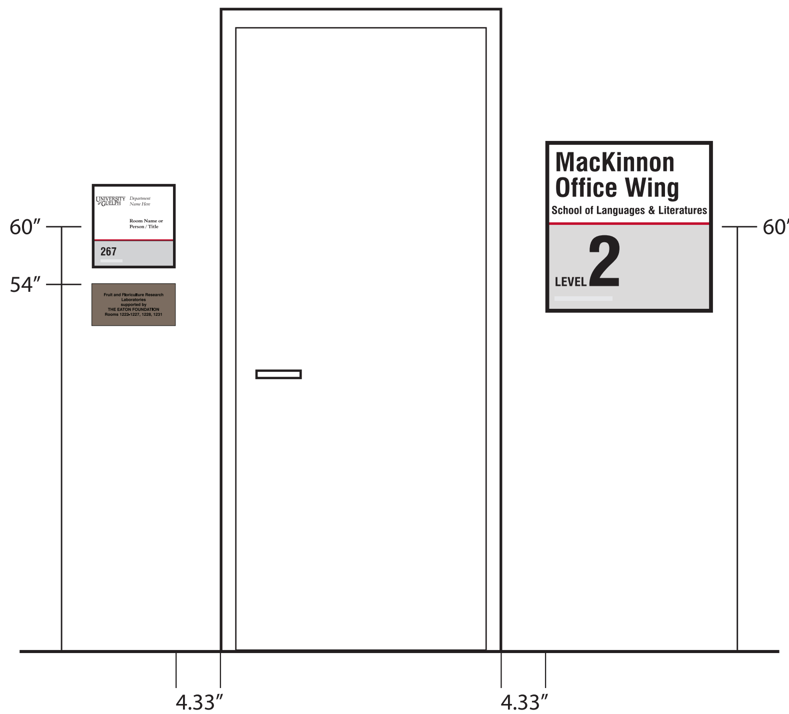
Standard Mounting Heights are shown on individual exterior pages but are dependant on sightlines and context.

2. Interior

The historical legacy of signs on campus spans decades and fabrication technologies particularly in terms of interior signage. The intent is to create standards of what is acceptable within the context of this, ie. a building with the older style of engraved interior room signs will have replacement signs of the same type until a major project replaces the majority of signs within the building with the current standard. New buildings will be done with the most current technology as defined by this document see cover page for signage systems for this designation.

2.1. New or additional signage in existing buildings will follow standards as listed in this document for the type of signage already present in the same area of the building. See Appendix A for a map of which buildings contain which signage. All new buildings will employ the most current system and the proposed interior signage package is to be reviewed by PR, DEC, Arch. Services.
2.2. All main entries will have a full colour lobby map and directory as appropriate. Where upgrades occur in existing buildings with older signage systems, the current system would still be the standard system to upgrade to.
2.3. Main internal directional signage will be done in most current system even for

replacement situations.
2.4. Main stairs and elevators will be labeled and signed.
2.5. Washrooms will be signed. Shared mens and womens washroom with or without the barrier free symbol will state washrooms only.
2.6. Safety Plans must be put throughout new buildings with the correct orientation to the wall they are mounted on. North wall mounting and orientation is preferred. They need to identify current location, washrooms, elevators, stairs and safety features such as pull stations, fire hose cabinets, exits and blue lights. The number and placement depends on the size and complexity of the circulation within the buildings. See drawing for further details.
2.7. Offices, meeting rooms will be signed as per standards. Room numbers remain as is with any changes made only through approval of Physical Resources, Design Engineering and Construction, Space and Facility Renewal. Names of individuals in offices should be initial and last name rather than full first name for personal security reasons.
2.8. Environmental Health and Safety - Safety Signage will be implemented with input from Environmental Health and Safety (EHS) in accordance with S.O.P. PR4.002. Signs include but are not limited to Radioactive material signs, Radiation Area, X-ray room, bio hazard, laser rooms printed by user and put into Acrylic Sleeves or Vista Sign system. See EHS website at http://www.uoguelph.ca/ehs.
2.9. Misc. signs - To keep consistency these small miscellaneous signs are generally no larger than 6"x6", engraved sign white with red imprint to convey short messages unique to the situation. An appropriate use would be 'First Aid Kit is Located in Room#335'. Anything larger than the stipulated maximum size should be considered custom and approval from PR, DEC, Arch. will be required.
2.10. Mounting - Signs are to be mounted directly to wall surface without grommets unless wall is extremely textured. To mount signs on **doors** tape mount is to be used to preserve fire rating of door.
2.10.1. Typical Mounting Heights are to be as shown below.



The most current University of Guelph Graphic Standards can be found at http://www.uoguelph.ca/web/graphicstandards/. Below is an excerpt from the website, April 2010.

Introduction

The University of Guelph publishes a Graphic Standards Guide to provide information regarding the appropriate use of the University's name, logotypes, crests and images. The University of Guelph community has achieved a reputation for excellence in its teaching, research and service objectives. It is essential that we maintain a recognizable, consistent and high quality visual identity as an ongoing affirmation of that level of excellence.

The University of Guelph protects its visual identity through registration under the Canada Trademarks Act. No person may use any trademark identical to, or confusingly similar with, the trademarks and official marks identified in this document without written approval from the University of Guelph. To submit a request, contact the Director of Communications and Public Affairs.

Policies and recommendations contained in this guide apply to all departments and divisions of the University of Guelph and external organizations that are approved users of University trademarks and logotypes. All inquiries should be directed to the Department of Communications and Public Affairs.

University of Guelph Identifier

® UNIVERSITY of GUELPH

The University of Guelph Identifier is the graphic symbol of the University, readily recognizable wherever it is used. A source of pride and an indicator of quality, it should be used in printed and electronic formats to represent excellence and the distinctive character of the University of Guelph.

Side-by-side, adjacent or contiguous presentation of the Identifier with the trademark or design mark of a separate entity (outside the University of Guelph community) is not permitted without prior approval from the University of Guelph. To submit a request, contact the Director of Communications and Public Affairs.

The University's trademark Identifier is intended to be a stand-alone logotype and should take precedence over other logos developed and used by internal campus units. The Identifier must be used with consistency and as a component of good design; always maintain the clarity and integrity of the University Identifier.

The University of Guelph Identifier is not available in a French-language version for general use; only Collège d'Alfred has authority to use French spelling.

Guidelines for Using the Identifier:

- Use it on all university communications;
- Do not use the Identifier to promote an event or service that is not officially sponsored by the University of Guelph even though that event may be held on campus;
- Do not combine or integrate the Identifier with other logos or graphic elements;
- Use the artwork provided in this guide; choose the highest resolution appropriate for your use; the minimum size is 2.5 mm for printed material, 80 pixels on the web;
- Use the Identifier in the proportions given; do not alter the image or distort the relative horizontal and vertical dimensions;
- Position the Identifier parallel to the top of the page or screen; do not rotate;
- Separate the Identifier (on all sides) from text and graphic images by a space equal to or greater than the height of the large U;

UNIVERSITY of GUELPH

- Ensure the Identifier is distinctive when printed over photographs or other images;
- Do not animate the Identifier;
- Reproduce the Identifier in a single solid colour;
- Do not use the Identifier as a background for text;
- When used on the same page or screen with another U of G logo, separate the images by as much space as possible.

For additional information, consult the U of G Web Design Guidelines or contact Communications and Public Affairs.

Messaging and Typography

The fonts used in the communications materials form an integral part of the University's identity. Consistent use of typefaces improves the effectiveness of University communications and recognition in the marketplace.

- Use Helvetica as the primary typeface for headings, printed communications and core identify implementations;
- Use Bembo as the complimentary typeface for body text;
- For all cross-platform applications such as Websites, PowerPoint and e-mail, use Arial as the default font for Helvetica and Times for Bembo.

Helvetica

Primary sans serif font

Bembo

Complementary serif font

Arial

Cross-platform substitute for Helvetica

Times

Cross-platform substitute for Bembo

University designers are encouraged to make bold use of the various fonts by varying the size and colour of words within a headline to emphasize the key message.

Use of Photography

Photography used in University of Guelph communications should be as bold as the typography. Select images that are expressive, optimistic, inclusive, spontaneous and dynamic. As often as possible, use images that depict real-life situations. Varied crops and details of images will help enhance the story.

A number of copyright-free images are included in the Graphic Standards Guide photo gallery. They are available in various formats for use by University departments and/or off-campus media.

Use of Colour and White Space

A core colour palette has been approved for presentation of the Cornerstone and tag line brand mark. Pantone, CMYK, RGB and Hexadecimal values of the primary colours are provided below. University departments are also encouraged to use these colours frequently in the design of communication materials to ensure a consistent “look” for the University of Guelph brand.

University of Guelph Crest

The symbol commonly referred to as the crest is, in fact, a logotype registered under the Canada Trademarks Act. It is used primarily for business cards, citations, certificates and ceremonial occasions. The crest also appears as a watermark on official University of Guelph letterhead.

Because the crest is not generally recognized off campus, it has limited value as a defining image for the University and is not normally appropriate for external audiences.

Guidelines for Using the Crest:

- Position the Crest in a position that is visually subordinate to and widely separated from the University of Guelph Identifier; do not use the Crest with any other logo;
- Do not combine or integrate the Crest with other graphic elements;
- Use the artwork provided in this guide; choose the highest resolution appropriate for your use;
- Use the Crest in the proportions given; do not alter the image or distort the relative horizontal and vertical dimensions;
- To use the Crest without the motto “rerum cognoscere causas,” choose the

appropriate image from this guide;
- Position the Crest parallel to the top of the page or screen; do not rotate;
- Do not animate the Crest;
- Reproduce the Crest in a single solid colour; or use the official full-colour image (red/gold/black) provided in this guide;
- Do not use the Crest as a background for text;
- Ensure the Crest is distinctive when printed over photographs or other images.

History of the Crest

The University of Guelph Crest was designed by Eric Arthur and John Hall of the University of Toronto School of Architecture. The three components of the design — the crest, shield and motto — represent the University's links with the City of Guelph and the University of Toronto (the degree-granting body for Guelph's founding colleges before the University of Guelph was incorporated in 1964).

The white stallion in the crest links U of G with the House of Hanover's coat of arms. The name "Guelph" comes from "Welfen," the family name of the House of Hanover, which intermarried with the English royal line. The three-part shield combines a book (symbolizing learning, the liberal arts and the University of Toronto connection), an astrolabe (symbolizing science) and a cornucopia (a symbol for abundance and agriculture).

The crest and shield are used with or without the motto "rerum cognoscere causas," a quote from Virgil which means "to learn the meaning of reality."

For additional information, consult the U of G Web Design Guidelines or contact Communications and Public Affairs.

Other U of G Logos and Crests

By using the Identifier on all external communications, departments and units across campus contribute to the development of the University of Guelph "brand" as an institution of excellence. Conversely, it is advantageous for individual academic and administrative units to be recognized in association with the central identity of the University.

While many campus units have developed secondary logos for internal (on-campus) use, there are some situations where a historic or secondary logotype may also enhance external marketing objectives. Examples include revenue-generating units and arms-length operations of the University that would benefit from the development of their own "brand," and secondary logos developed to promote a special anniversary year or event, joint academic program or research collaboration.

Departments that wish to use a secondary logo with the Identifier for external distribution should contact Communications and Public Affairs.

Guidelines for internal use of departmental logos and crests:

- Do not use the logo to promote an event or service that is not officially sponsored by the department/unit represented by the logo;
- Use artwork provided in this guide or prepared by a skilled graphic designer; choose the highest resolution appropriate for your use;
- Do not combine or integrate the logo with other graphic elements;
- Use the logo in the proportions given; do not alter the image or distort the relative horizontal and vertical dimensions;
- Position the logo parallel to the top of the page or screen; do not rotate.
- Do not animate or use logos as a background for text;
- Ensure the logo is distinctive when printed over photographs or other images;
- When used on the same page or screen with another logo, separate the two images by as much space as possible;
- Separate the logo (on all sides) from text and other graphic elements by a space equal to its height;
- When the University of Guelph Identifier is used with a secondary logo, follow the guidelines outlined in the section Guidelines for Using the Identifier.

University of Guelph Colours

The University's official colours are black, red and gold, with blue added as an element of the Cornerstone graphic system.

- Pantone (coated paper) — black; red (200C); gold (123C or 873C metallic); blue (549C)
- Pantone (uncoated paper) — black; red (192U); gold (115U); blue (549U)
- Process — black (0C, 0M, 0Y, 100K); red (0C, 100M, 65Y, 15K) ; gold (0C, 30M, 95Y, 0K); blue (52C, 6M, 0Y, 25K)
- RBG Colours — black (0.0.0): red (153.0.0); gold (255.204.0); blue (102.153. 204.0)
- Hexadecimal Colours — black (#000000); red (#990000); gold (#ffcc00); (#6699cc)

Trademarks and Logotypes

Trademarks

U of G Identifier & Cornerstone
Alfred Identifier & Cornerstone
Kemptville Identifier & Cornerstone
Ridgetown Identifier & Cornerstone
Gryphon
U of G Alumni Association

Crests

U of G Crest
OAC Crest
OVC Crest

Secondary Logos

College of Arts
CME (in progress)
CSAHS (in progress)

Spelling

For official documents, the University of Guelph uses the Funk & Wagnalls New Canadian College Dictionary and The Globe and Mail Style Book.

Tactile & Braille Compliant Signs:

1. Tactile Signs -should be present on signs which designate permanent room and spaces: room numbers, restrooms, and exit signs.

Tactile Depth: 1/32" minimum
Letter Height: 5/8" - 2"
Letter Type: Uppercase
Letter Style: San Serif

Contrast: Characters and symbols must contrast with the sign background. Light characters/symbols on dark background or vice versa.

Finish: Non-glare (eggshell or matte) finish.

Pictograms: Pictograms shall have a field height of 6" minimum. Tactile characters & Braille shall not be located in the pictogram field. Standard pictogram size is 4- 4 1/2".

2. Braille - is to be located below the corresponding text. If text is multi-lined, Braille shall be placed below the entire text, 1/4" minimum from any other tactile characters. Grade 2 Braille is not a " letter for letter" translation of the text; it contains more than 250 contractions, plus single characters used to represent whole words or groups of letters. All Braille should be lowercase, except proper names or letters which are part of a room designation.

3. Non-Tactile Signage - Signs that provide direction to or information about functional spaces within a facility can be wall mounted, projected or suspended overhead. They are not required to contain tactile characters or Braille, but must meet requirements for character width, line spacing, finish, and contrast. Common visual-only signs include directional signs and overhead area identification signs.

ADA Guidelines

This signage program has been designed in comliance with the signage regulation defined by the Americans with Disabilities Act of 1990.

Integrity of Logos and Fonts

Do not square or stretch logos or fonts. Do not use drop shadows or underlining.

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.

V-ROO
Standard Room Sign

V-MTG
Meeting Room Sign

V-WSH-A
Washroom Sign


V-LOB
Lobby Map and Directory

V-DPT-1
Department Sign

V-STR
Stair Sign

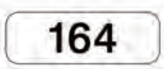

V-ELE
Elevator Sign

| CURRENT STANDARD | VISTA

A-WSH-1
Washroom Sign

A-ROO
Unassigned Room Sign

A-MTG
Meeting Room Sign

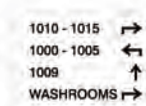


A-TRD
Room Number Sign

A-DOC-ROO
Insert Room Sign

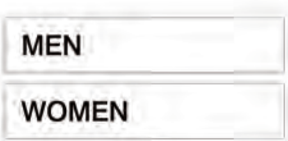
A-DOC-1
Insert Sign

A-STR
Stair Sign



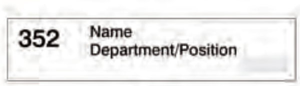
A-COR
Corridor Sign

ACRYLIC



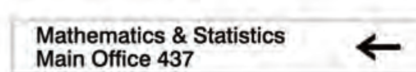
E-WSH
Washroom Sign

E-WSH-1
Washroom Sign



E-ROO
Room Sign

E-TRD
Room Number Sign



E-COR
Corridor Directional Sign

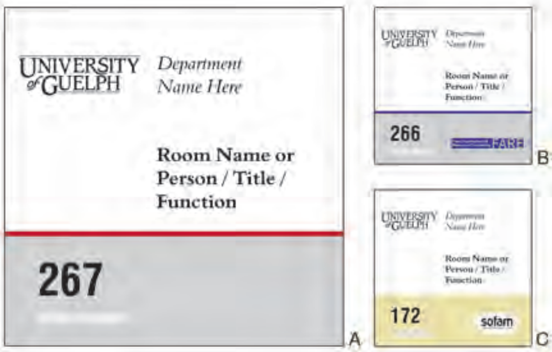
ENGRAVED

Signage Standards

Vista Section

3.V

Vista to be used in all new buildings
and substantial renovations.



V-ROO
Standard Room Sign
(If using person's name on sign include first initial and last name only for reasons of personal security)

8.5" W x 8.5" H
Vista - WFP157

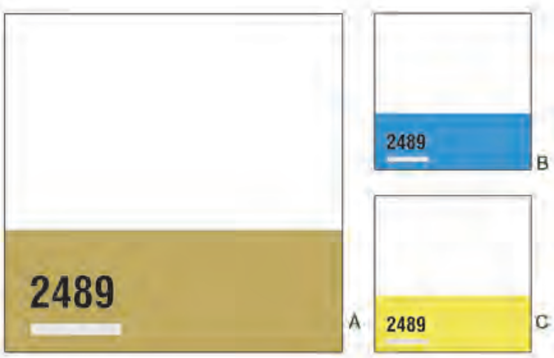
silver frame with grey end caps

clear flex cover - 8.5" W x 5 5/8" H

paper insert - 8.5" W x 5 5/8" H
logo - top left
font - aldine401 BT

separator strip - 8.5" W x 3/16" H
red - #29885
blue - #29885

bottom portion - 8.5" W x 2 5/8" H
silver grey - #29900
candlewick - #29899
black tactile font - swis721 CN BT
Braille - grade 2
department logo - optional



V-ROO-1
Unassigned Room Sign

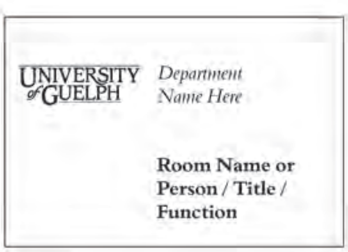
8.5" W x 8.5" H
Vista - WFP157

silver frame with grey end caps

separator strip - none

background
candlewick - #29899
blue - paint numbers to be supplied
yellow - paint numbers to be suppluied

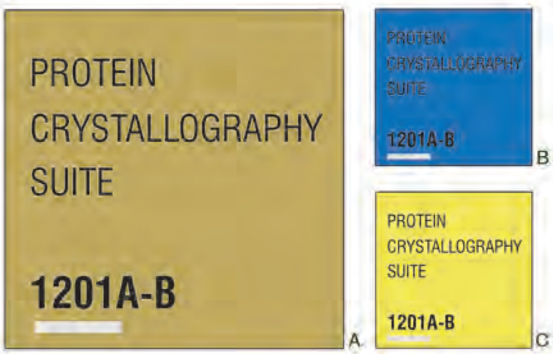
black tactile font - swis721 CN BT
Braille - grade 2



V-ROO-i
Standard Room Sign Insert
(If using person's name on sign include first initial and last name only for reasons of personal security)

8.5" W x 5 5 3/4"

logo - top left
font - aldine401 BT



V-ROO-2
Dedicated Room Sign

8.5" W x 8.5" H
Vista - WFP157

silver frame with grey end caps

separator strip - none

background
candlewick - #29899
blue - paint numbers to be supplied
yellow - paint numbers to be supplied

black tactile font - swis721 CN BT
Braille - grade 2

V-MTG
Meeting Room Sign

8.5" W x 8.5" H
Vista - WFP157

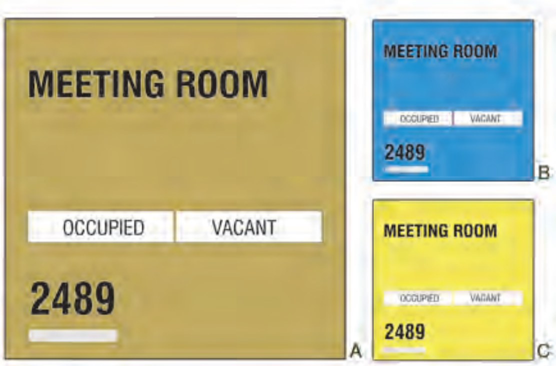
silver frame with grey end caps

white plastic - 8.5" W x 5 5/8" H
black tactile font - aldine401 BT

slider - 6.25" W x 0.875" H

separator strip - 8.5" W x 3/16" H
red - #29885

bottom portion - 8.5" W x 2 5/8" H
silver grey - #29900
black tactile font - swis721 CN BT
Braille - grade 2



V-MTG-1
Meeting Room Sign

8.5" W x 8.5" H
Vista - WFP157

silver frame with grey end caps

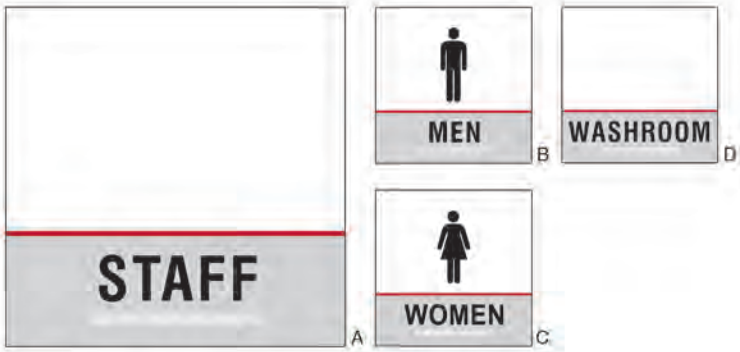
clear flex cover - 8.5" W x 5 3/4" H

background 8.5" W x 8.5" H
silver grey - #29900

black tactile font -swiss721 Md BT

separator strip - none

Braille - grade 2



V-WSH
Washroom Sign

8.5" W x 8.5" H
Vista - WFP157

silver frame with grey end caps

pictogram - center
black - #37037

separator strip - 8.5" W x 3/16" H
red - #29885

bottom portion - 8.5" W x 2 5/8" H
silver grey - #29900
black tactile font - arial
Braille - grade 2

V-WSH-A
Accessible Washroom Sign

8.5" W x 8.5" H
Vista - WFP157

silver frame with grey end caps

pictogram - center
black - #37037

separator strip - 8.5" W x 3/16" H
red - #29885

bottom portion - 8.5" W x 2 5/8" H
silver grey - #29900
black tactile font - arial
Braille - grade 2

V-WSH-1A
Accessible Washroom Sign

8.5" W x 8.5" H
Vista - WFP157

silver frame with grey end caps

pictogram - center
black - #37037

separator strip - none

bottom portion - 8.5" W x 2 3/4" H
candlewick - #29899
black tactile font - arial
Braille - grade 2

V-LOB
Lobby Map and Directory

23.625" W x 23.625" H
Vista - WFP145

silver frame with grey end caps

clear flex cover
full colour poster insert
16.75" W x 23.625" H

separator strip - 23.625" W x 3/16" H
red - #29885

bottom portion - 23.625" W x 6 9/16" H
clear flex cover
medium grey vinyl
black text

V-LOB-Mi
Lobby Map Insert

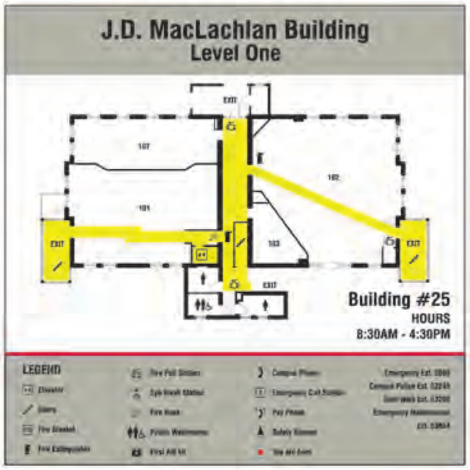
23.625" W x 16.75" H
Vista - WFP145

clear flex cover
full colour poster insert

V-LOB-Li
Lobby Map List Insert

16.625" W x 6 9/16" H
Vista - WFP145

clear flex cover
medium grey vinyl
black text



V-LOB-2
Lobby Map and Directory

23.625" W x 23.625" H
Vista - WFP145

silver frame with grey end caps

clear flex cover
full colour poster insert
16.75" W x 23.625" H

separator strip - 23.625" W x 3/16" H
red - #29885

bottom portion - 23.625" W x 6 9/16" H
clear flex cover
medium grey vinyl
black text

V-LOB-3
Lobby Map and Staff Directory

23.625" W x 23.625" H

silver frame with grey end caps

clear flex cover
full colour poster insert
23.625" W x 23.625" H

separator strip - none

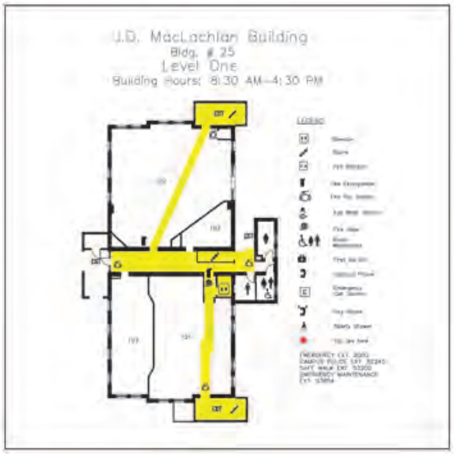
V-LOB-4
Lobby Map

23.625" W x 23.625" H
Vista - WFP145

silver frame with grey end caps

clear flex cover
full colour poster insert
23.625" W x 23.625" H

separator strip - none



V-LOB-5
Lobby Map (mounted with corridor directory)

30" W x 30" H
Vista - custom

silver frame with grey end caps

clear flex cover
full colour poster insert
30" W x 30" H

separator strip - none

V-COR-2
Corridor Directory (mounted with lobby map)

15.75" W x 30" H
Vista - WFP118

silver frame with grey end caps

clear flex cover
full colour poster insert
15.75" W x 30" H

separator strip - none

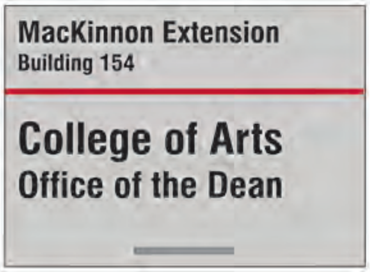
V-DOC
Document Holder

8.7" W x 11" H
Vista - WFP84

silver frame with grey end caps

clear flex cover
white paper insert
8.5" W x 11" H

separator strip - none



V-DPT
Department Sign

11.875" W x 8.75" H
Vista - WFP95

silver frame with grey end caps

clear flex cover
full colour print on clear
backed with medium grey vinyl
11.875" W x 8.75" H

grade 2 Braille

V-DPT-1
Main Office Department Sign

15.75" W x 15.75" H
Vista - WFP111

silver frame with grey end caps

black tactile text

top portion
background - white #29880

separator strip - 3/16"
red - #29885

bottom portion
background - silver grey #29900

grade 2 Braille

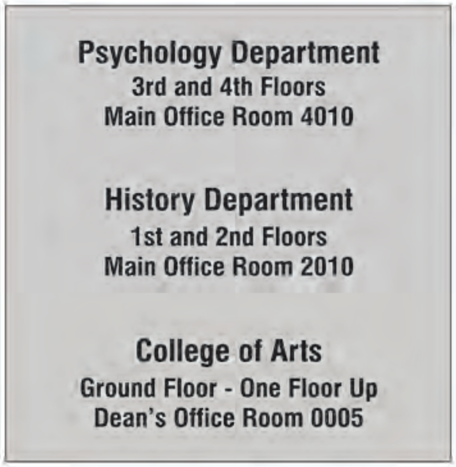
V-DPT-2
Main Office Department Sign

23.625" W x 23.625" H
Vista - WFP145

silver frame with grey end caps

clear flex cover
full colour poster insert
23.625" W x 23.625" H

separator strip - none



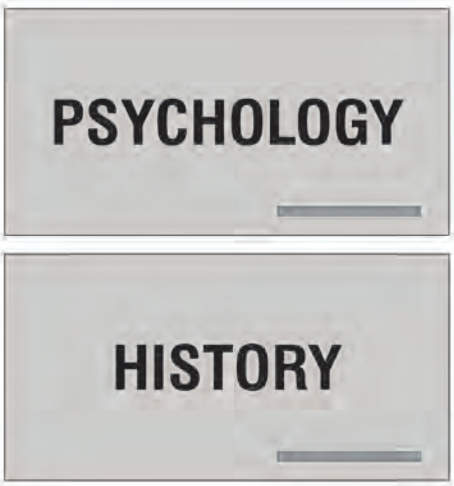
V-DPT-3
Office Department Sign

15.75" W x 15.75" H
Vista - WFP111

silver frame with grey end caps

background - silver grey #29900
black tactile text

separator strip - none



V-DPT-4
Department Sign

15.75" W x 7.88" H
Vista - custom

silver frame with grey end caps

background - silver grey #29900
black tactile text

separator strip - none

grade 2 Braille

V-DPT-5
Department Sign

12" W x 12" H
Vista - custom

silver frame with grey end caps

background - silver grey #29900
black tactile text

separator strip - none

grade 2 Braille

V-STR
Stair Sign

15.75" W x 15.75" H
Vista - WFP111

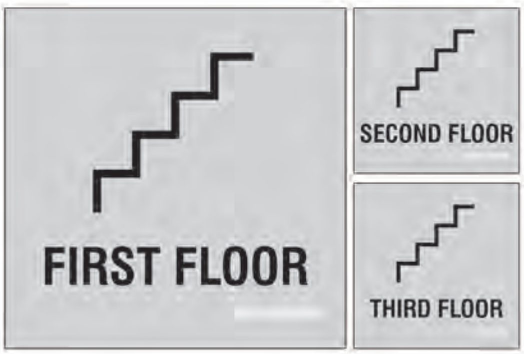
silver frame with grey end caps

top portion
black tactile text

separator strip - 3/16
red - #29885

bottom portion
background - silver grey #29900
black tactile text/pictogram

grade 2 Braille



V-STR-1
Stair Sign

8.5" W x 8.5" H
Vista - WFP157

silver frame with grey end caps

background 8.5" W x 8.5" H
silver grey - #29900

black tactile font -swiss721 Md BT
pictogram - black tactile

separator strip - none

Braille - grade 2

V-STR-2
Stair Sign

15.75" W x 15.75" H
Vista - WFP111

silver frame with grey end caps

font - swiss721 Cn BT

black tactile text - #37037
pictogram - black tactile

background - colour to be supplied

separator strip - none

grade 2 Braille

V-COR
Corridor Sign

11.875" W x 8.75" H
Vista - WFP95

silver frame with grey end caps

clear flex cover
full colour print on clear
backed with medium grey vinyl
11.875" W x 8.75" H

grade 2 Braille

V-COR-1
Corridor Sign

15.75" W x 15.75" H
Vista - WFP111

silver frame with grey end caps

font - swiss721 Cn BT

black tactile text - #37037

background - colour to be supplied

separator strip - none

grade 2 Braille

V-ELE
Elevator Sign (perpendicular)

6" W x 8.75" H
Vista - WFP111

silver frame with grey end caps

font - none

pictogram/arrows - black tactile

background - white/grey

separator strip - none

Braille - none

Signage Standards

Acrylic Section

3A

See Appendix A for buildings
where this system is acceptable

A-WSH
Washroom Sign

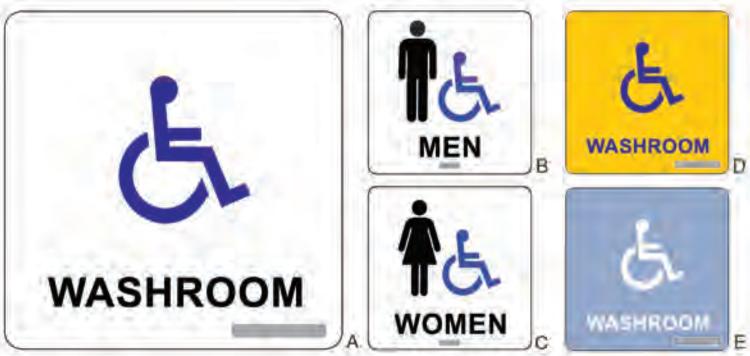
8" W x 8" H
1/8" acrylic

corners - 1/4" radius

front
tactile pictogram - black
tactile text - black
grade 2 Braille - bottom right

back
full white vinyl

application - foam tape on back



A-WSH-1
Accessible Washroom Sign

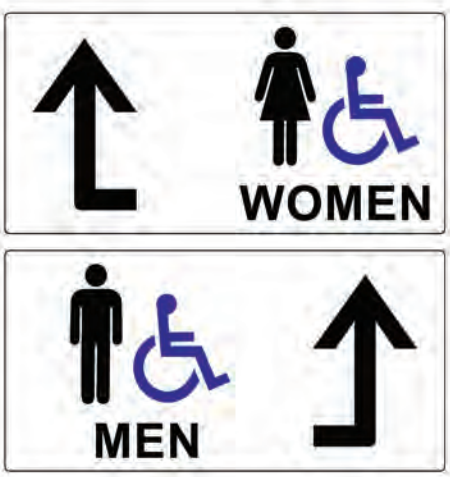
8" W x 8" H
1/8" acrylic

corners - 1/4" radius

front
tactile pictogram/text - black/black
blue/black
blue/blue
white/white
grade 2 Braille - bottom right

back
full white vinyl
full wedgewood blue vinyl
full crome yellow vinyl

application - foam tape on back



A-WSH-2
Washroom Directional Sign

24" W x 12" H

corners - 1/4" radius

front
tactile text - black
tactile pictogram - black
tactile arrows - black
grade 2 Braille - bottom right

back
full white vinyl

application - foam tape on back

A-ROO
Unassigned Room Sign

8" W x 8" H
1/8" acrylic

corners - 1/4" radius

front
tactile text - black, white
grade 2 Braille - bottom right

back
full white vinyl
full black vinyl
full blue vinyl
fill yellow vinyl

application - foam tape on back

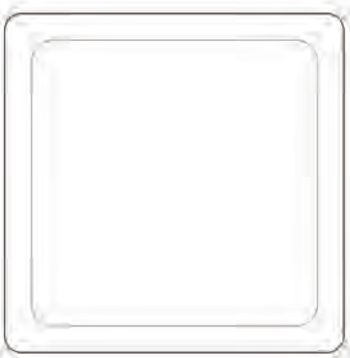
A-ROO-1
Room Sign

7.875" W x 7.875" H
1/8" acrylic

corners - 1/4" radius

back
blue imprint on clear background
full white vinyl

application - 4 screw holes



A-DOC
Insert and Room Sign

8" W x 8" H
1/8" acrylic

corners - 1/4" radius

front
vinyl - white from back with window

back
white vinyl

application - foam tape on back

A-MTG
Meeting Room Sign

8" W x 8" H
1/8" acrylic

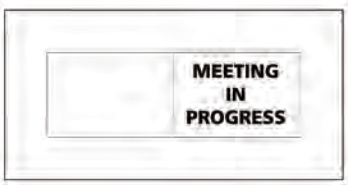
corners - 1/4" radius

slider - 7" W x 2.5" H

front
tactile text - black
grade 2 Braille - bottom right

back
full white vinyl

application - foam tape on back



A-MTG-1
Meeting Room Sign (slide only)

8" W x 4" H
1/8" acrylic

corners - square

slider - 6" W x 2" H

front
white frame

paper insert - black text

back
full white vinyl

application - foam tape on back

A-TRD
Room Number Sign

3" W x 1" H
1/8" acrylic

corners - 1/4" radius

front
tactile text - black

back
full white vinyl

application - foam tape on back

A-DOC-ROO
Insert Room Sign

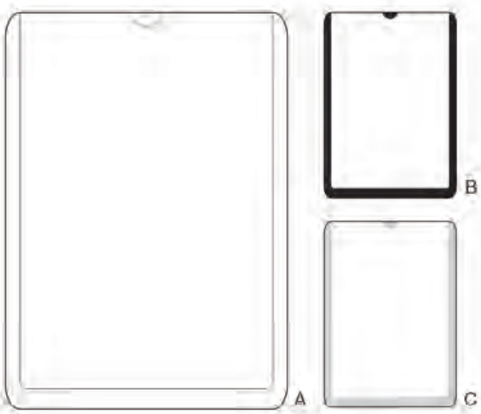
9.625" W x 14.5" H
holds - 8.5" x 11" paper
1/8" acrylic

corners - 1/4" radius

front
tactile text - black/white
grade 2 Braille - bottom right

back
white vinyl with 8.5x11 window

application - foam tape on back



A-DOC-1
Insert Sign

9.625" W x 11.625" H
holds - 8.5" x 11" paper
1/8" acrylic

corners - 1/4" radius

front
white/black/silver vinyl - from back with window

back
full white/black/silver vinyl

application - foam tape on back

A-DOC-2
Insert Sign

9.625" W x 14.5" H
holds - 8.5" x 14" paper
1/8" acrylic

corners - 1/4" radius

front
white vinyl - from back with window

back
full white vinyl

application - foam tape on back

UNIVERSITY of GUELPH

A-STR
Stair Sign

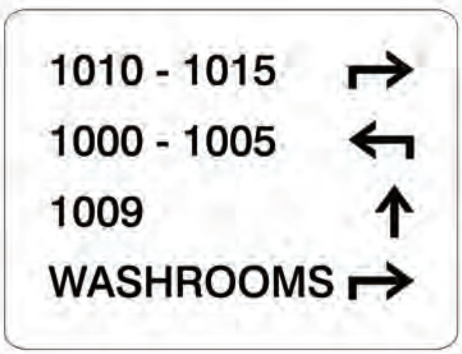
18" W x 8" H
1/8" acrylic

corners - 1/8" radius

front
tactile text - black
Braille - bottom right

back
full oyster vinyl

application - foam tape on back



A-COR
Directional Corridor Sign

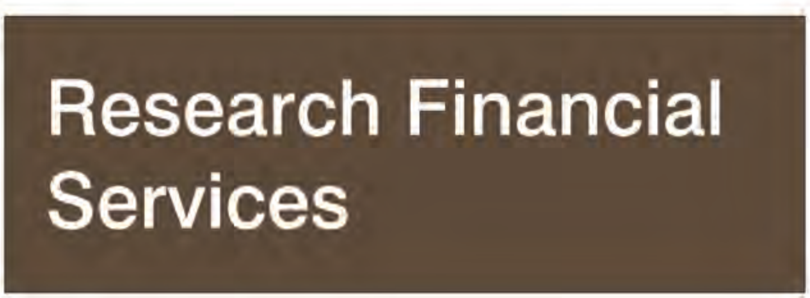
16" W x 12" H
1/8" acrylic

corners - 1/8" radius

front
tactile text - black
tactile arrows - black
Braille - bottom right

back
full oyster vinyl

application - foam tape on back



A-DPT
Hanging Department Sign

10" W x 29" H
1/8" acrylic

corners - 1/4" radius

front
tactile text - white

back
brown background

application - hang from ceiling

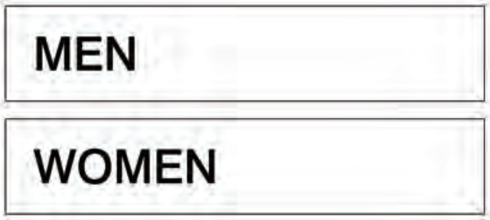
UNIVERSITY of GUELPH

Signage Standards

Engraved Section

3E

See Appendix A for buildings
where this system is acceptable



E-WSH
Washroom Sign

12" W x 2.375" H

front
engraved text - black

background - white

application - full adhesive on back

E-WSH-1
Washroom Sign

8" W x 8" H

front
tactile pictogram - candlewick
tactile text - candlewick

background - slate

grade 2 Braille - bottom center

application - foam tape on back

E-WSH-2
Washroom Sign

8" W x 8" H

front
tactile pictogram - candlewick
tactile text - candlewick

background - slate

grade 2 Braille - bottom center

application - foam tape on back

A1101

352 Name
Department/Position

201 Custodial Closet

E-ROO
Room Sign

8" W x 1.75" H

front
engraved text - black
grade 2 Braille - bottom right

background - white

application - full adhesive on back

222

314

E-TRD
Room Number Sign

4" W x 2" H

front
engraved text - black

background - white

application - full adhesive on back

601

602

603

E-TRD-1
Room Number Sign

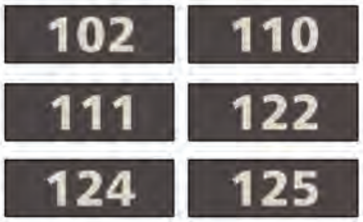
8" W x 1.75" H

front
engraved text - black

background - white

grade 2 Braille - none

application - foam tape on back



E-TRD-2
Room Number Sign

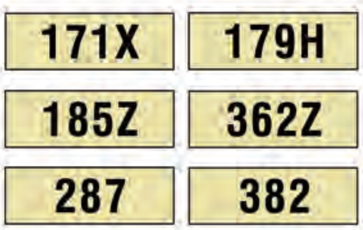
3" W x 1" H

front
tactile text - candlewick

background - slate

grade 2 Braille - none

application - foam tape



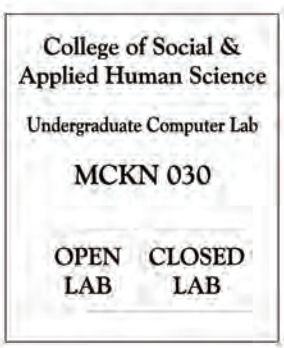
E-TRD-3
Room Number Sign

3" W x 1" H

front
tactile text - black

background - candlewick
grade 2 Braille - none

application - double sided tape



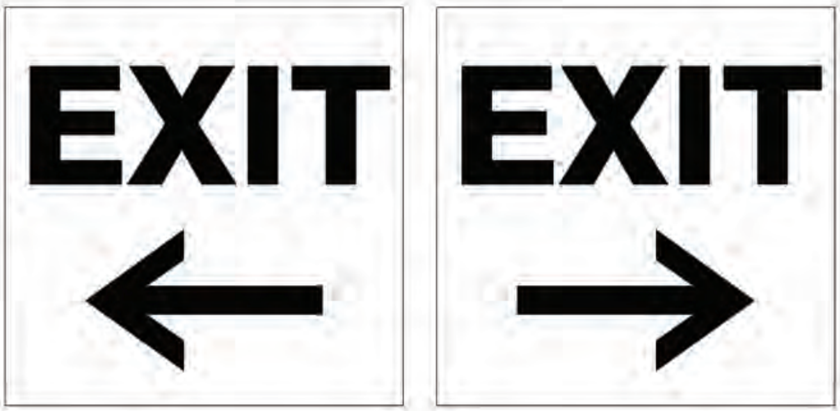
E-MTG
Meeting Room Sign (slider)

10" W x 12" H

front
engraved text - black

background - white
grade 2 Braille - none

application - foam tape



E-COR-1
Corridor Sign

12" W x 12" H

front
tactile text - black
tactile arrow - black

background - white

application - full adhesive on back

E-COR-2
Corridor Sign

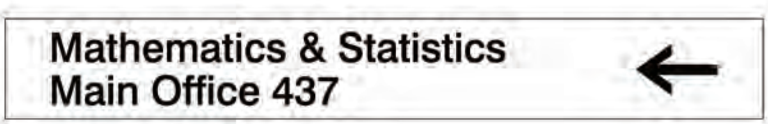
18" W x 3.375" H

front
engraved text - black
engraved arrows - black

background - white

grade 2 Braille - none

application - full adhesive on back



E-COR-3
Corridor Directional Sign

18" W x 2.375" H

front
engraved text - black
engraved arrows - black

background - white

grade 2 Braille - none

application - full adhesive on back

E-COR
Corridor Sign

18" W x 3.375" H

front
engraved text - black

background - white

grade 2 Braille - none

application - tape on back

E-DSK-1
Desk Name Sign

16.5" W x 3.5" H

front
engraved text - white

background - chocolate brown

application - full adhesive on back

UNIVERSITY of GUELPH

Signage Standards

Donor and Miscellaneous Section

4.00

MV-DON-N
Donor Name Sign

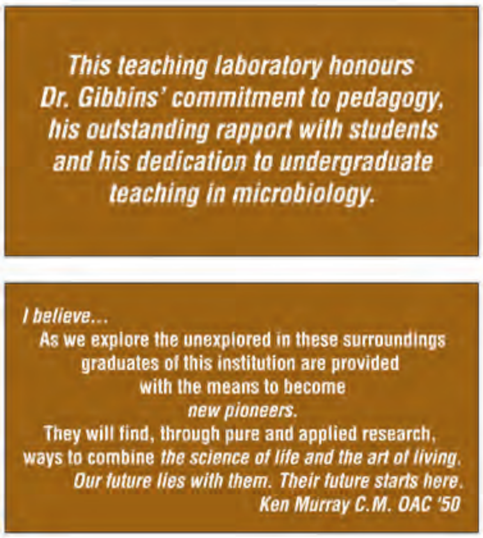
8.5" W x 6" H

silver frame with grey end caps

white tactile text (donor name)

white cut vinyl - applied to the back (statement)

painted on reverse - nobel PMS #1395 brown



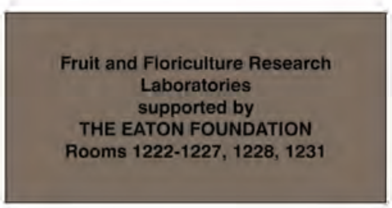
MV-DON-Q
Donor Quote Sign

11.8" W x 6" H

silver frame with grey end caps

white cut vinyl - applied to the back (statement)

painted on reverse - nobel PMS #1395 brown



ME-DON-R
Donor Room Sign

8" W x H (depends on text)

brush gold plastic

engraved text - black

application - double sided tape

A

B

ME-SMO
No Smoking Door Sticker

4" W x 4" H

red / black / green / dark green imprint

white background

Braille - none

ME-MISC
Miscellaneous Information Signs

various up to 8" W x 6" H

red engraved letters

white background

Braille - none

UNIVERSITY of GUELPH

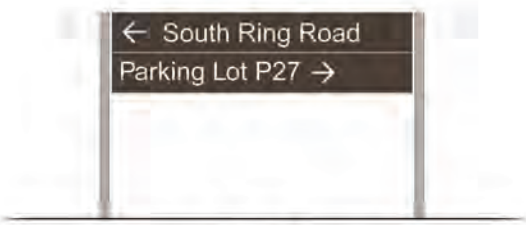
Signage Standards

Exterior Section

5.00

EX-MAP
Map Console

EX-LOGO
University Identification Sign

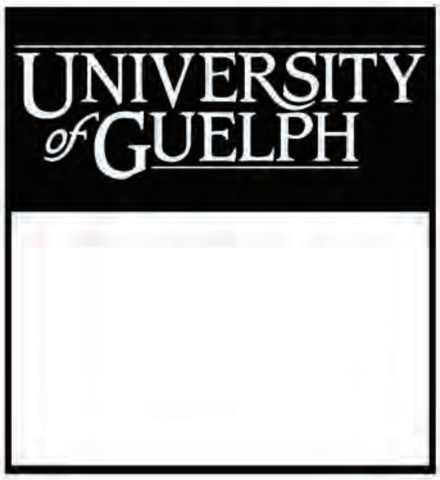


EX-DIR
Vehicle Wayfinding Sign

EX-DPT
Free Standing Building Department Sign

EX-DPT-2
Building Department Sign

EX-PARK
Parking Signs



EX-MAP
Map Console

52.5" W x 57" H

existing frame
clear window - 51"W x 31"H

vinyl - black
logo - white

application - vinyl insert in existing frame

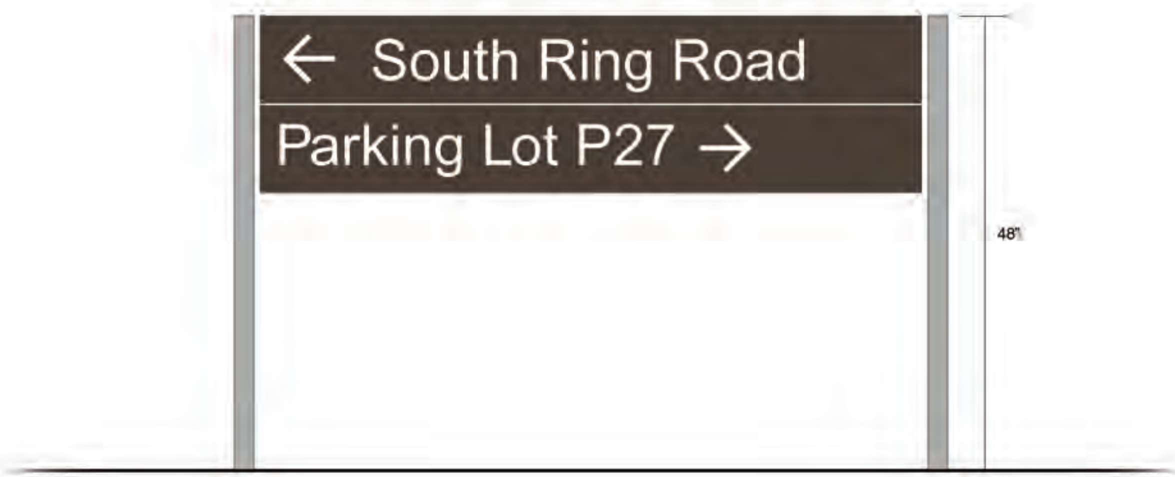
EX-DIR
Vehicle Wayfinding Sign

60" W x 8" H (each blade)

aluminum blades - brown

font
helvetica light
4" capital letter height
engraved - white colourfil

application - attched to aluminum posts



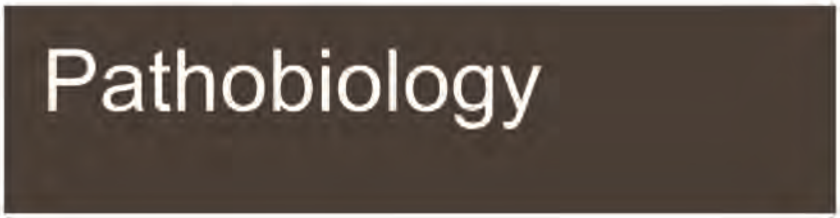
EX-LOGO
University Identification Sign

88.75" W x 88" H
blades - 88.75" W x 8" H (x11)

aluminum blades - brown

font
helvetica light
10" capital letter height
engraved - white colourfill
crest logo - white

application - attached to aluminum posts



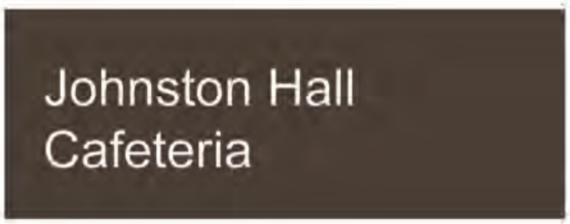
EX-DPT
Free Standing Building Department Sign

72" W x 18" H

aluminum - brown

font
helvetica light
5" capital letter height
engraved - white colourfil

application - attched to concrete mould
center of sign at 5' or higher if obstructed



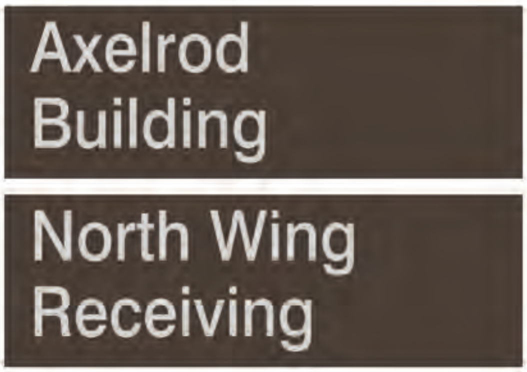
EX-DPT-1
Free Standing Building Department Sign

48" W x 18" H

aluminum - brown

font
helvetica light
5" capital letter height
engraved - white colourfil

application - attached to concrete mould
center of sign at 5' or higher if obstructed



EX-DPT-2
Building Department Sign

36" W x 18" H

aluminum - brown

font
helvetica light
5" capital letter height (secondary door)
2" capital letter height (back door)
engraved text - white

application - adjacent to rear/secondary entrance
center of sign at eye level unless obstructed

EX-DPT-3
Building Department Sign

36" W x 18" H

1/4" plexiglass - clear

font
helvetica light
4" capital letter height
vinyl cut out - white

vinyl applied to back - dark brown

application - adjacent to rear/secondary entrance
center of sign at eye level unless obstructed

UNIVERSITY of GUELPH

EX-PARK-ID
Parking Lot Identification Sign

16.5" W x 24" H

aluminum - brown

font
helvetica light
5.5" / 1.2" / 0.6" capital letter heights
engraved text - white

coloured decals - plastic
2.75" diameter

application - attched to aluminum post

EX-PARK
Regulatory Parking Signs

12" W x 18" H

aluminum - white

text - black cut vinyl
pictograms - various cut vinyl

application - attached to steel u-post

EX-PARK-A
Accessible Parking Sign

12" W x 18" H

aluminum - white

text - blue cut vinyl
pictogram - blue cut vinyl

application - attached to steel u-post

A B

EX-SMO
Smoking Signs

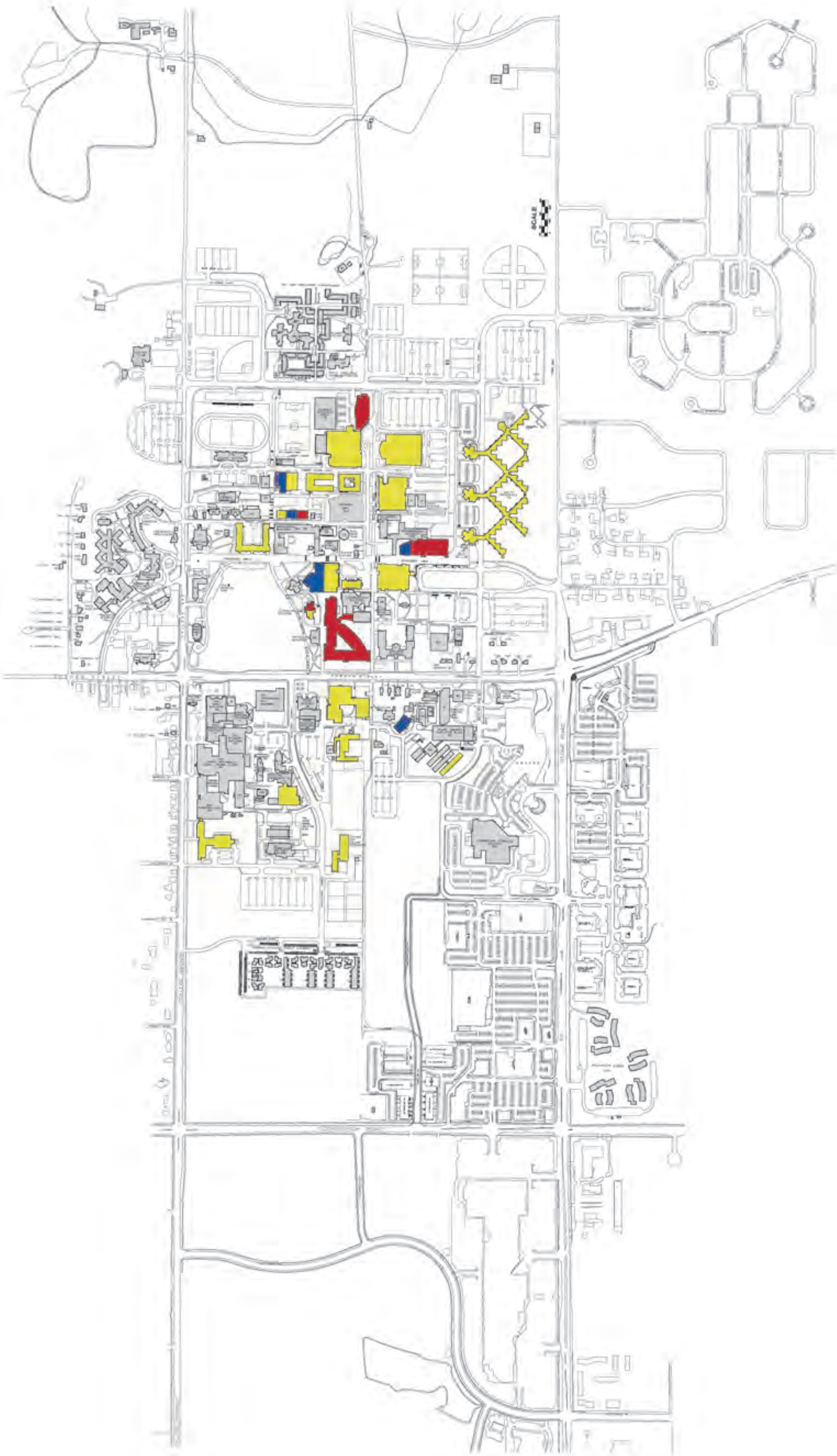
12" W x 18" H

aluminum - white

text - black/red cut vinyl
pictogram - various cut vinyl

application - wall mounted at eye level

APPENDIX A



UNIVERSITY of GUELPH

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

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, found under clause 3 in the Plumbing Standard. 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 ^{o}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

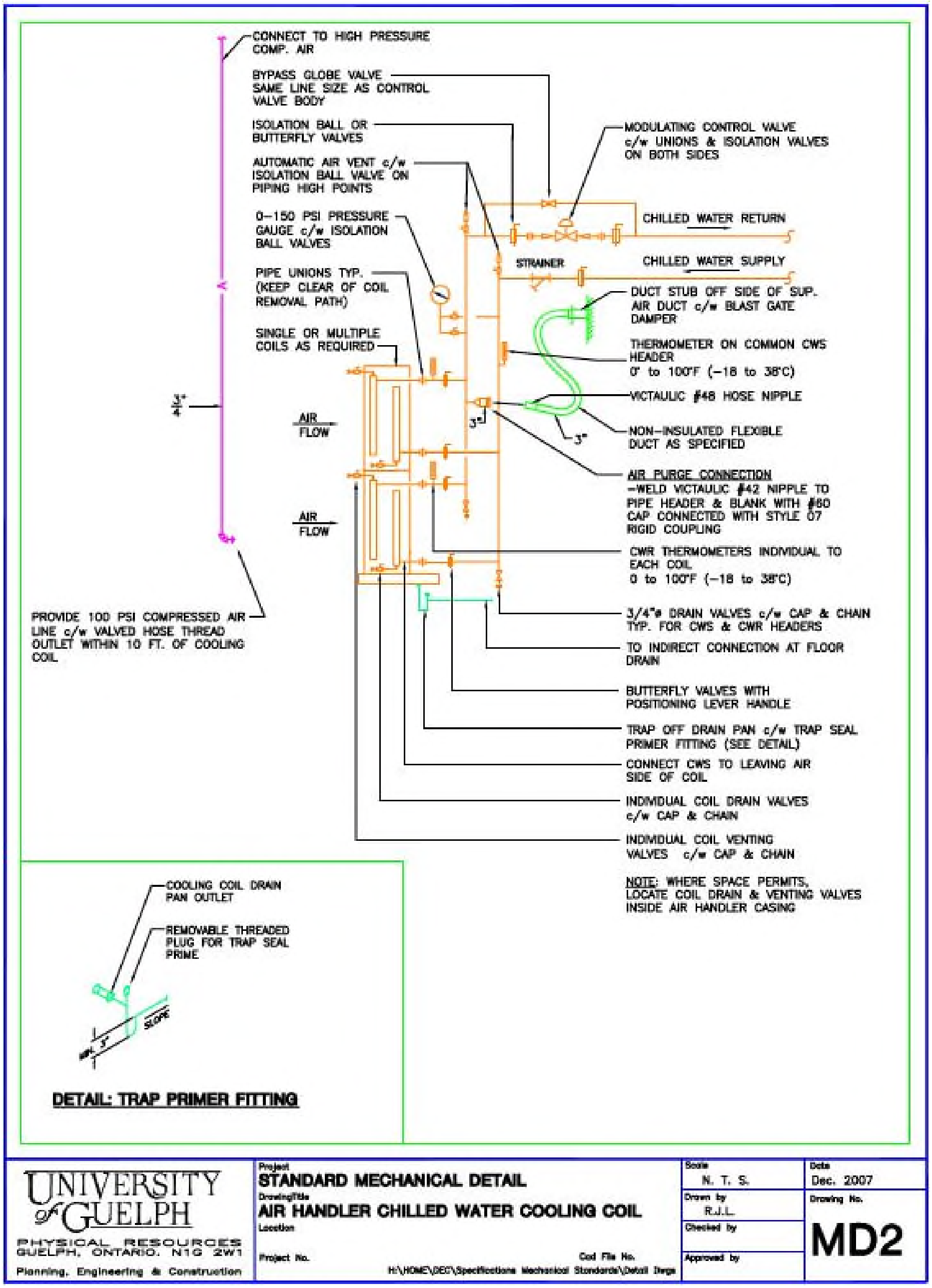
.1 Do not use custom made labeling. Labelling must meet the legend below or receive approval of the Manager, Mechanical Design, DEC for any deviations.

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

UNIVERSITY of GUELPH

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 49

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 ^{o}C (56 ^{o}F)

.2 hot water: 60 ^{o}C (140 ^{o}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.

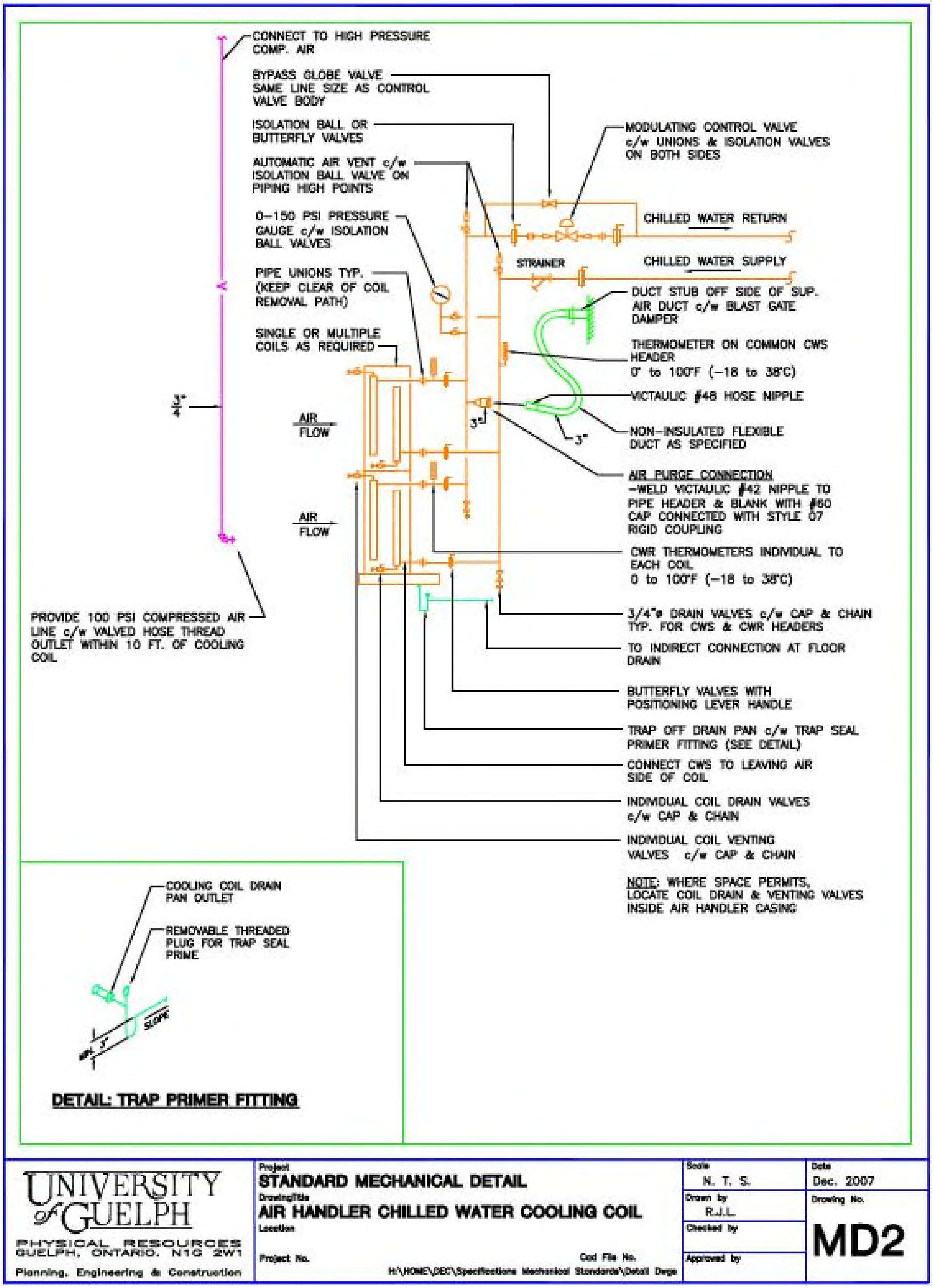
Label Abbreviation	**System, Pipe Contents**	**Label Colors (Text - Background)**
	PIPING	
ACETYLENE	ACETYLENE	Black - Yellow
ACID	ACID	Black - Yellow
BIOHAZARD VENT	BIOHAZARD VENT	Black - Yellow
BIOHAZARD WASTE	BIOHAZARD WASTE	Black - Yellow
BLOW-OFF	Blow-Off	Black - Yellow
BOILER BLOWDOWN	Boiler Blowdown	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

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSM-03

BUILDING AUTOMATION SYSTEMS

Version	Revision 0
Effective Date	15-September-2014
Approved By	
	Manager, Mechanical Design, DEC
Reviewed By	Dec 1-14
	Director, MES

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 BAS systems.
- .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
- .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 Licences and Ownership
  - .1 Ownership of, and licences 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.

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.
  .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
- MODBUS
- LONTalk
- OPC
- SNMP

.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 Supply Air Temperature Reset based on Terminal Unit Damper Position (for VAV Systems) and Reheat Valve Position.
  .6 Mixed Air Temperature as a means of controlling Fresh Air Damper.

.4 Fan Scheduling
  .1 Ability to set fan schedules for Summer and Winter Schedules. This schedule will be based on School terms.
  .2 Override Schedules to turn fans on or off for Holidays and special events.
  .3 Systems that can be shut down will do so based on the schedule
  .4 Systems that cannot be shut down will have their SAT setpoint offset based on the schedule.

.5 Mode Control
  .1 To prevent the various control components (valves and dampers) from competing with one another, they are operated in sequence (based on heating or cooling demand). This sequence is determined by a "mode"; various modes are described below. In each mode the PHT LL controller will always be active and will keep the heating valve from closing when the PHT is below its low limit setpoint. In each mode the MAT LL controller will be active and will close the dampers (even below the min fresh air setting) when the MAT is below its low limit setpoint.
  .2 Mode 0: Shutdown
    - Fans will stop
    - Dampers will close
    - Cooling valves will close
    - Humidity valves will close

- If outside air is colder than the MAT LL SP then the heating valve will modulate to control the MAT at the LL setpoint, otherwise the heating valve will close.

.3 Mode 1: Startup

- This mode is only necessary when it is cold outside otherwise the system will simply jump out of it and into one of the control modes.
- On 100%FA units the heating valve will fully open (on cold days) to preheat the coil before the fan starts (this is necessary since the coils may not respond fast enough when a cold PHT is detected and the unit will trip off on freezestat). Once the fan starts the heating valve will ramp down to the control point.
- On mixed air units the outside dampers will remain closed on cold days (to remove any residual heat that may have accumulated in the duct when it was off). After the morning warm-up the dampers will slowly ramp open to the control point.
- After the morning warm-up period the system will switch out of startup mode.

.4 Mode 2: Damper

- The heating coil will modulate to maintain the PHT LL setpoint.
- Cooling coil will be closed.
- Damper will modulate to maintain the SAT SP

.5 Mode 3: Heating

- Cooling coil will be closed.
- Damper will be at minimum.
- The heating valve will modulate to maintain the SAT at setpoint.

.6 Mode 4: F/B Damper or Reheat

- The damper will be at minimum position.
- The cooling coil will be closed.
- When this mode is active the heating valve will be open at least 75% and the damper will modulate the air around the coil. If the air is being all directed to the coil then the heating valve will ramp open further.

.7 Mode 5/6: Heating Stage 1 and Stage 2

- The damper will be at minimum position.
- The cooling coil will be closed.
- This mode is used for on/off heating stages (gas or electric).

.8 Mode 7: Cooling

- The damper will be at maximum (economizer/enthalpy control may close this to minimum position).
- Heating valve will be closed (PHT LL always active).
- The cooling coil will modulate to maintain the SAT at setpoint.

.9 Mode 8/9: DX Stage 1 and Stage 2

- The damper will be at maximum (economizer/enthalpy control may close this to minimum position).
- Heating valve will be closed (PHT LL always active).

.10 Mode10: Dehumidification *(*without dehumidification wheel)*

- This mode is rarely used (it requires a cooling coil before a reheat coil).
- If a temperature sensor is installed after the cooling coil then the coil will be modulated to maintain the coil discharge temperature at the dew point. If no temperature sensor is installed after the cooling coil then the coil will be 100% open.
- The reheat coil will be used to maintain the SAT at its setpoint.

.6 Mixed Air Handling Units

.1 To prevent a large inrush current draw the fans across the campus are staggered using the following formula:

*Delay time(in seconds) = (Building number) + 10 * (fan number)*

.2 Lag fans (when controlled by the automation system) will start 5 seconds after the lead fan.
.3 When the unit is off, the dampers will be closed and the heating valve will be used to maintain the MAT at its low limit setpoint (cold side of the coil). If the outside air temperature is below the MAT LL SP then a morning warmup flag will be enabled.
.4 On system startup, if the morning warmup is enabled then the dampers will remain closed during the warmup period. Once the warmup period is over the dampers will ramp open to their control point.
.5 The system will operate according to the "Mode Control" as outlined above.

.7 Fresh Air Handling Units
.1 To prevent a large inrush current draw the fans across the campus are staggered using the following formula:

*Delay time(in seconds) = (Building number) + 10 * (fan number)*

.2 Lag fans (when controlled by the automation system) will start 5 seconds after the lead fan.
.3 When the unit is off, the dampers will close automatically and the heating valve will be used to maintain the PHT at its low limit setpoint (cold side of the coil is preferable if a sensor is available). If the outside air temperature is below the MAT LL SP then a morning warmup "Heat Blast" flag will be enabled.
.4 The "Heat Blast" will just open the heating coil 100% for 2 minutes before the fan is given a start command. Once the fan is running the heating valve will ramp down to the control point.
.5 The system will operate according to the "Mode Control" as outlined above.

.8 Variable Air Volume Units (VAV’s)
.1 VAV's will maintain space temperature by adjusting the volume of air into the space while keeping it between an operator adjustable minimum and maximum volume.
.2 If a reheat coil is installed then a discharge temperature sensor after the coil must be provided to identify any leaking valve.
.3 If the space temperature is below the setpoint then the VAV will switch to reheat mode in which case the volume of air will increase to a heating setpoint (minimum air volume may be too little to allow the warm air from reaching the occupants); this is typically 10% of the span between minimum and maximum and then added to the minimum.
.4 A demand limit variable is generated which can be used by the AHU to adjust the duct pressure and supply air temperature (we can't just use the space temperature and setpoint since we won't be able to determine if the VAV had more capacity to satisfy the space temperature). A value of 0% indicates the AHU should increase the supply air temperature while a value of 100% indicates that the temperature should be lowered. The AHU will only use this information if it has feedback from most of the spaces it affects.

.9 Exhaust Fans
.1 Exhaust fans will typically operate based on a predefined Occupancy Schedule.

.10 Standard Reset Schedules
.1 Air handlers will use a standard outdoor air temperature reset schedule unless there is a calculated reset from the space (typically if an AHU only feeds a few areas).

OAT	SP
30	18
20	15

10	18

.2 In the winter it may be possible to throttle (close) a heating valve to a point which causes an air handling unit to trip on a freezestat. To minimize this occurrence a minimum position for the heating valve is calculated from the outdoor air temperature.

OAT	SP
5	0
-15	20

.3 The return air humidity setpoint is also adjusted by an outdoor air temperature reset schedule.

OAT	SP
-25	15
10	40

.11 Heat Reclaim

.1 Plate heat exchanger for air to air systems will use a bypass damper when the exhaust air "ices up" and the pressure increases across the exhaust plates.

.2 "Run around" glycol loops heat reclaim systems will be disabled in the when the energy required to run the pumps is greater than the heat reclaimed (typically OAT > 10 deg C).

.12 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 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 limit the VFD speed for critical global adjustment days (excluding critical areas)

.7 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 Maxiumum 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

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.
    - o 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.

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 At a minimum the following alarms are to be provided:
 .1 Motor not started after commanded on
  - applies to all motors (pumps, fans, etc.)

.2 Motor not stopped after commanded off
- applies to all motors (pumps, fans, etc.)

.3 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
.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
.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 more than 5°C from setpoint for more than 10 minutes
.12 Converter temperatures more than 10°C from setpoint for more than 10 minutes

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 equipemt in question.
- an On-Board UPS Power source with a minimum 12 hour battery life shall be provided withing each BCU & ECU.

.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.

.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
- Tek-Air model Iso-Tek
- TSI
- Honeywell
- Phoenix Controls

.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

.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:
- Low pressure: 2.5 Pa (0.01 in.wc.) relative to adjacent space,
- Resettable to any point over sensing range.

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

2.18 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 • 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		

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; and
    - interstitial ceiling space is within the room where final termination of wire will be made
  .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.

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 bank 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 CO_2 sensor.

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.

3.9 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

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSM-04
FIRE PROTECTION SYSTEMS

Version	Revision 0
Effective Date	15-September-2014
Approved By	
	Manager, Mechanical Design, DEC
Reviewed By	
	Director, MES

TABLE OF CONTENTS

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

UNIVERSITY of GUELPH

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
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UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSE-03

FIRE ALARM SYSTEMS

Version	Revision 0
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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
0	08-29-2014	Entire Standard	Original Issue

UNIVERSITY of GUELPH

PHYSICAL RESOURCES

DESIGN, ENGINEERING, AND CONSTRUCTION

DESIGN STANDARD DSE-04

IT & COMMUNICATION SYSTEMS

Version	Revision 0
Effective Date	10-23-2014
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-05
ACCESS CONTROL SYSTEMS

Version	Revision 1
Effective Date	03-26-2019
Approved By	Manager, IT Systems

TABLE OF CONTENTS

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.

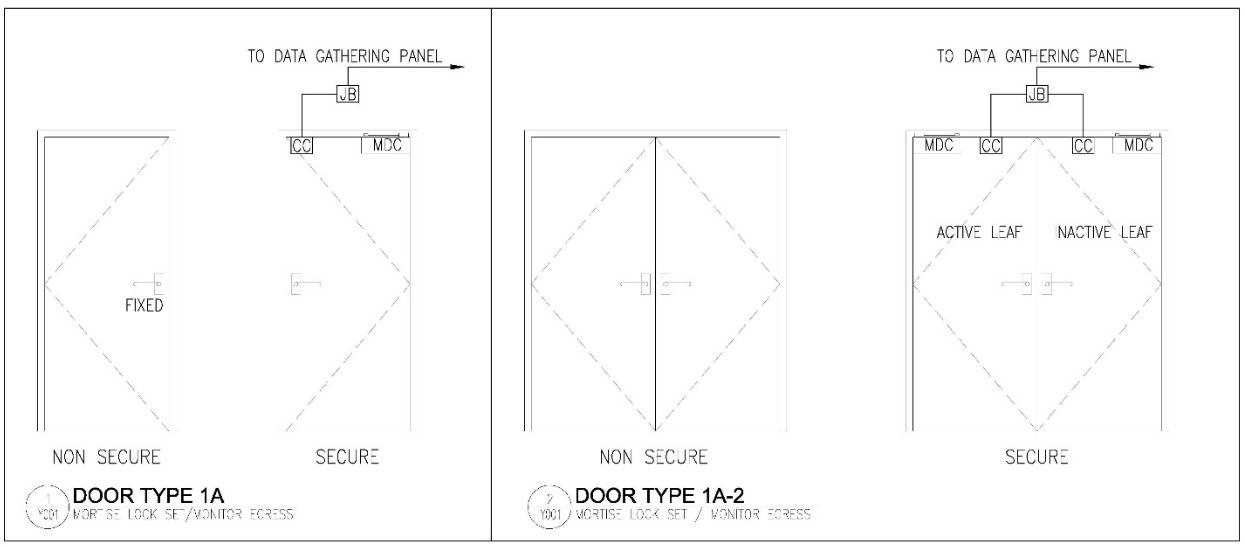
.3 Final As-built Drawings and Turnover Documentation shall consist of the following as a minimum:

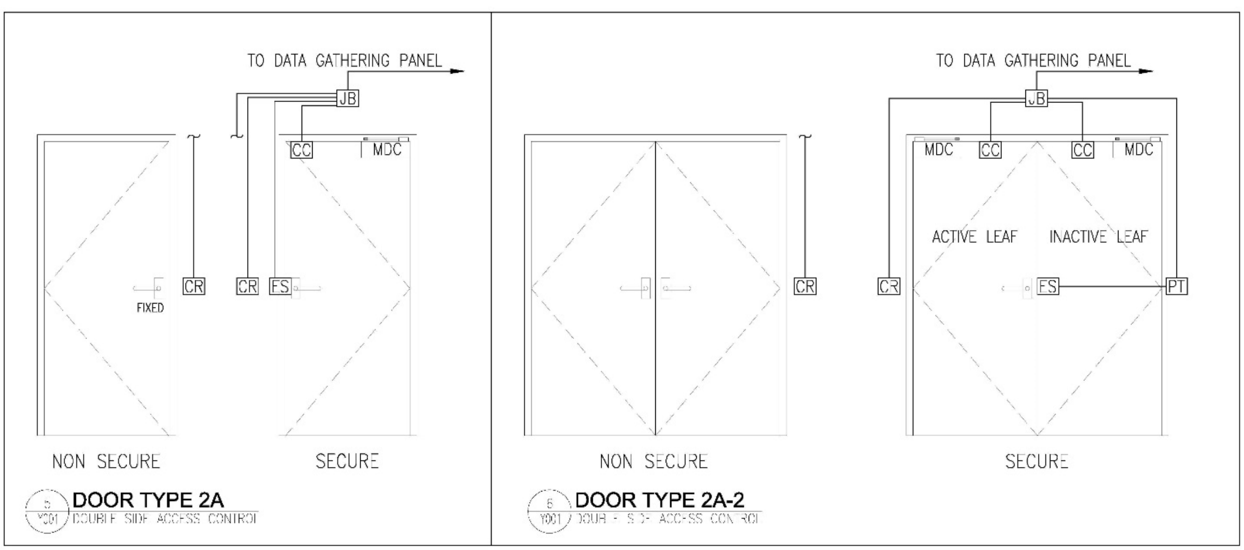
1. Equipment List	
Shall Included as a Mininum:	***Description***
Devices	All Supplied Equipment with Manufacturers Part Number, Model Number & Serial Number and Quantity per Comm. Room
Components	Removable Components that make up the device (example: slotted cards) Showing Part Number, Model Number & 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….

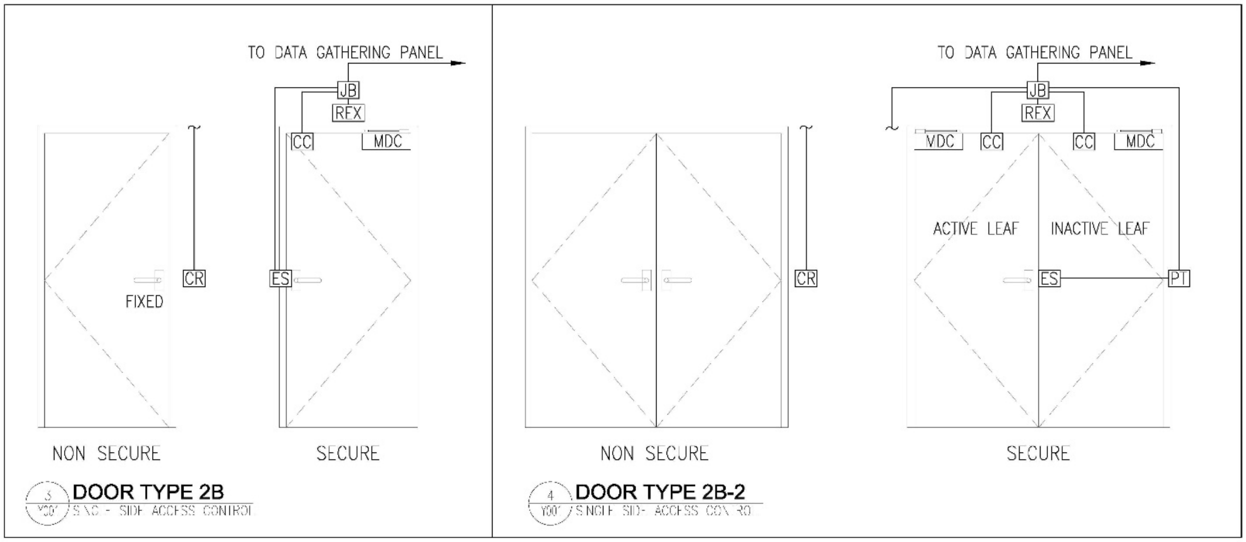
3 DOOR TYPICALS

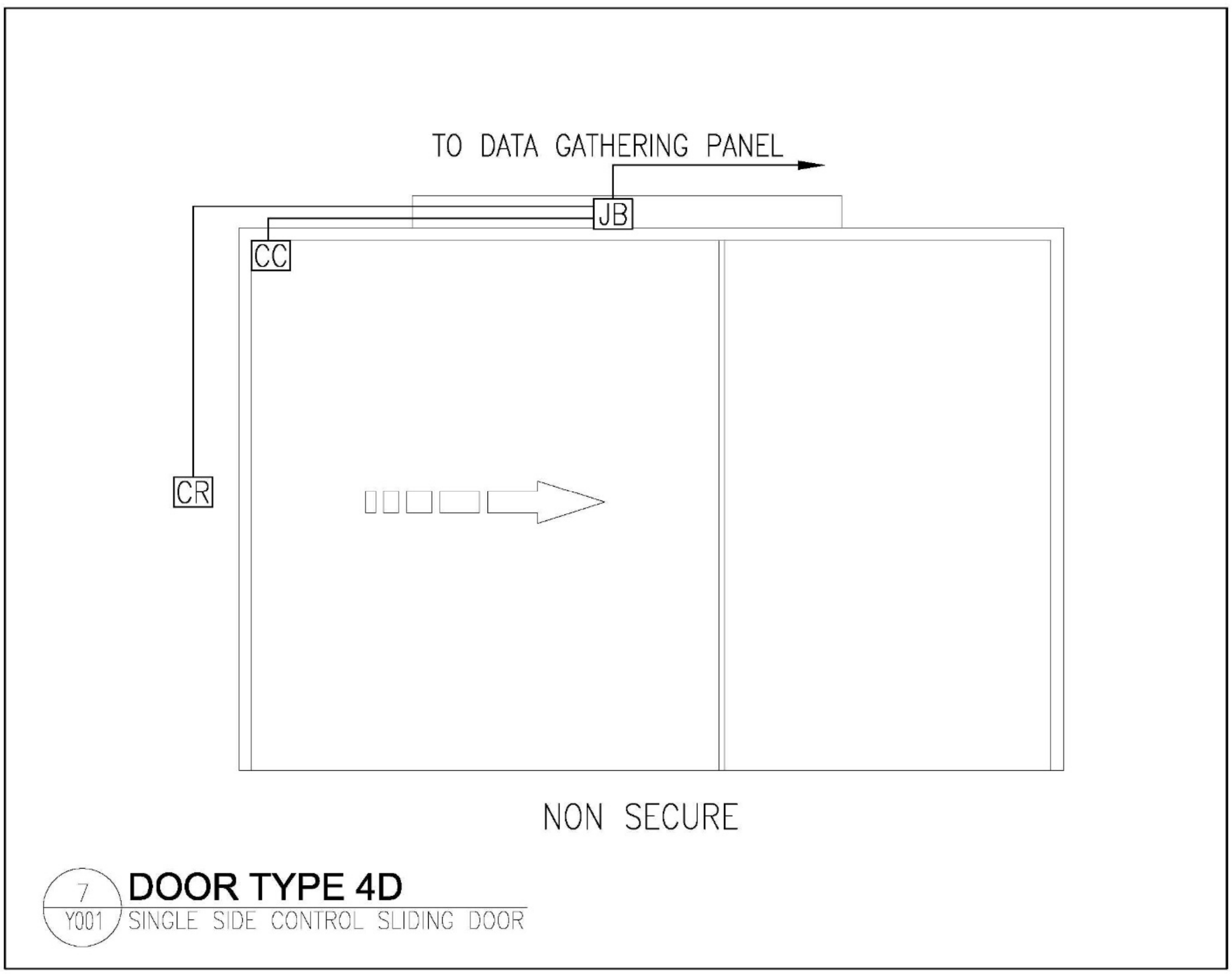
SYMBOL LEGEND

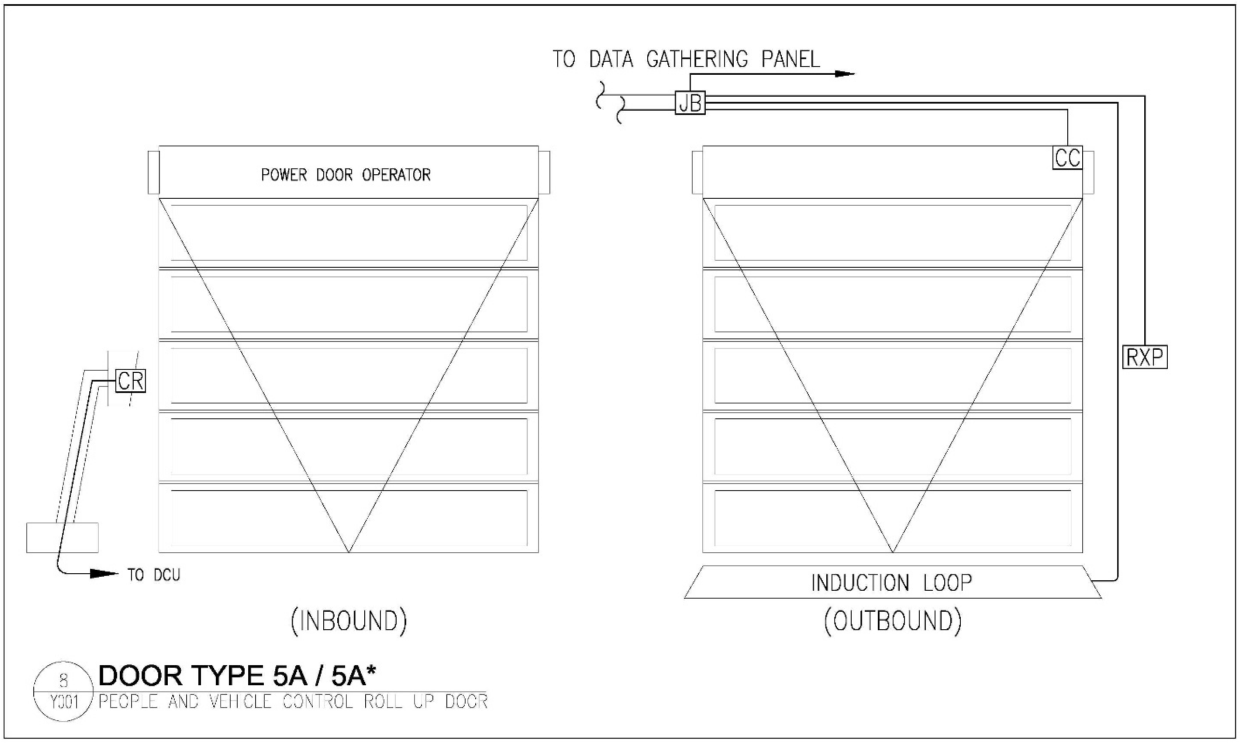
CR	CARD READER
CC	CONCEAL DOOR CONTACT
ES	ELECTRIC STRIKE
PT	POWER TRANSFER
REX	REQUEST TO EXIT MOTION DETECTOR
JB	JUNCTION BOX
MDC	MANUAL DOOR CLOSER

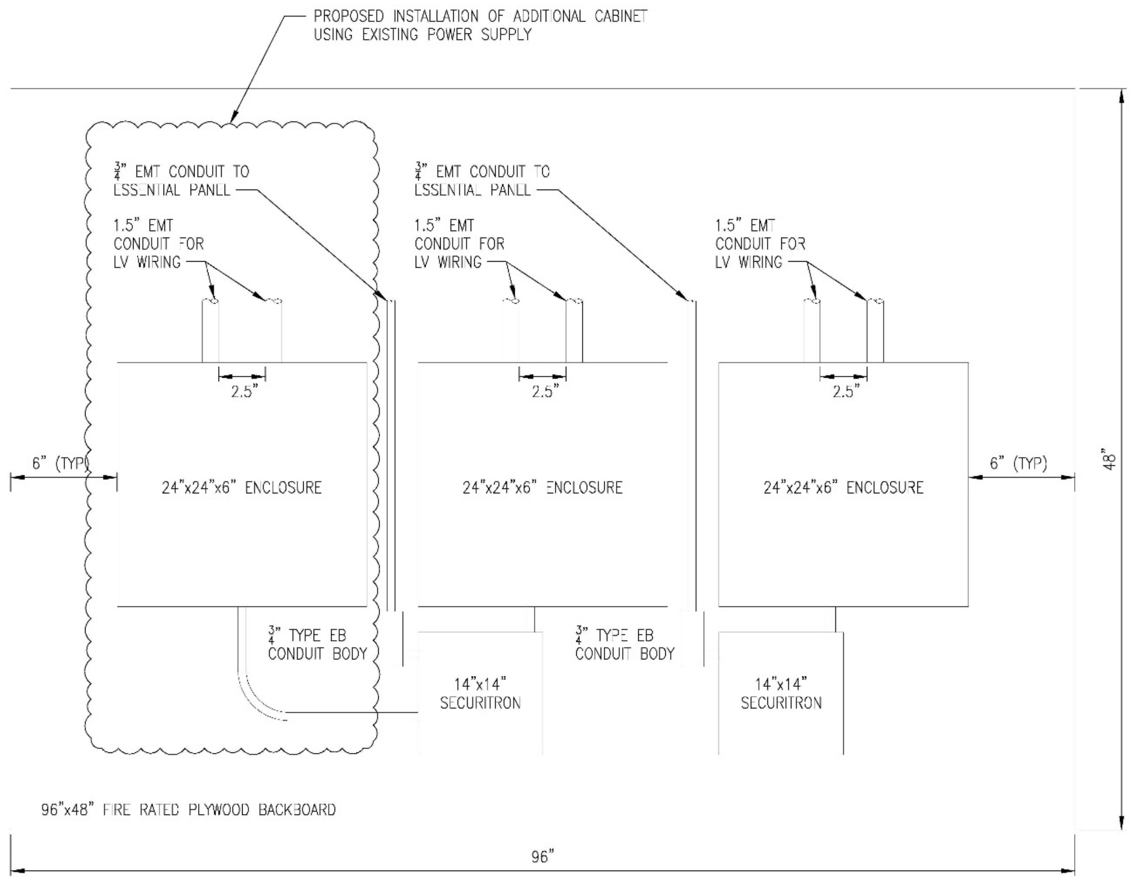




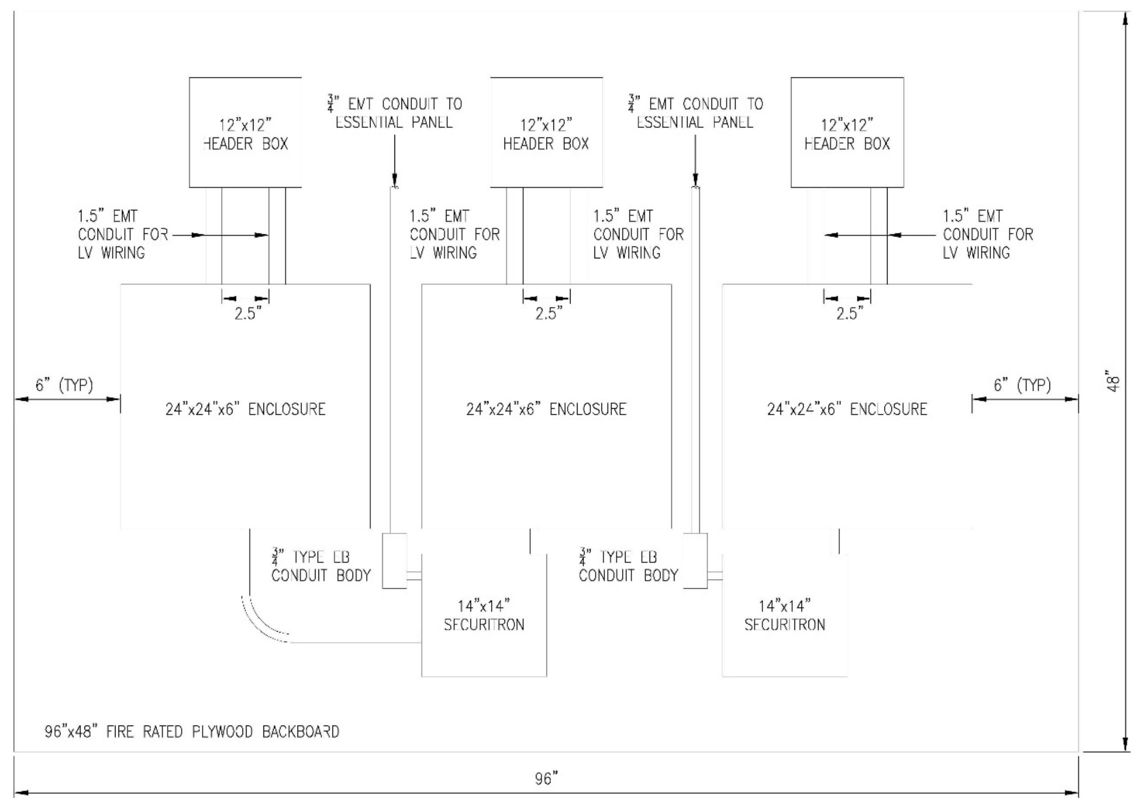

TO DATA GATHERING PANEL
JB
RFX
CC
MDC
CR
ES
FIXED
NON SECURE
SECURE
DOOR TYPE 2B
TO DATA GATHERING PANEL
JB
RFX
VDC
CC
CC
MDC
ACTIVE LEAF
INACTIVE LEAF
CR
ES
PT
NON SECURE
SECURE
DOOR TYPE 2B-2


TO DATA GATHERING PANEL
JB
CC
CR
NON SECURE
7
Y001
DOOR TYPE 4D
SINGLE SIDE CONTROL SLIDING DOOR

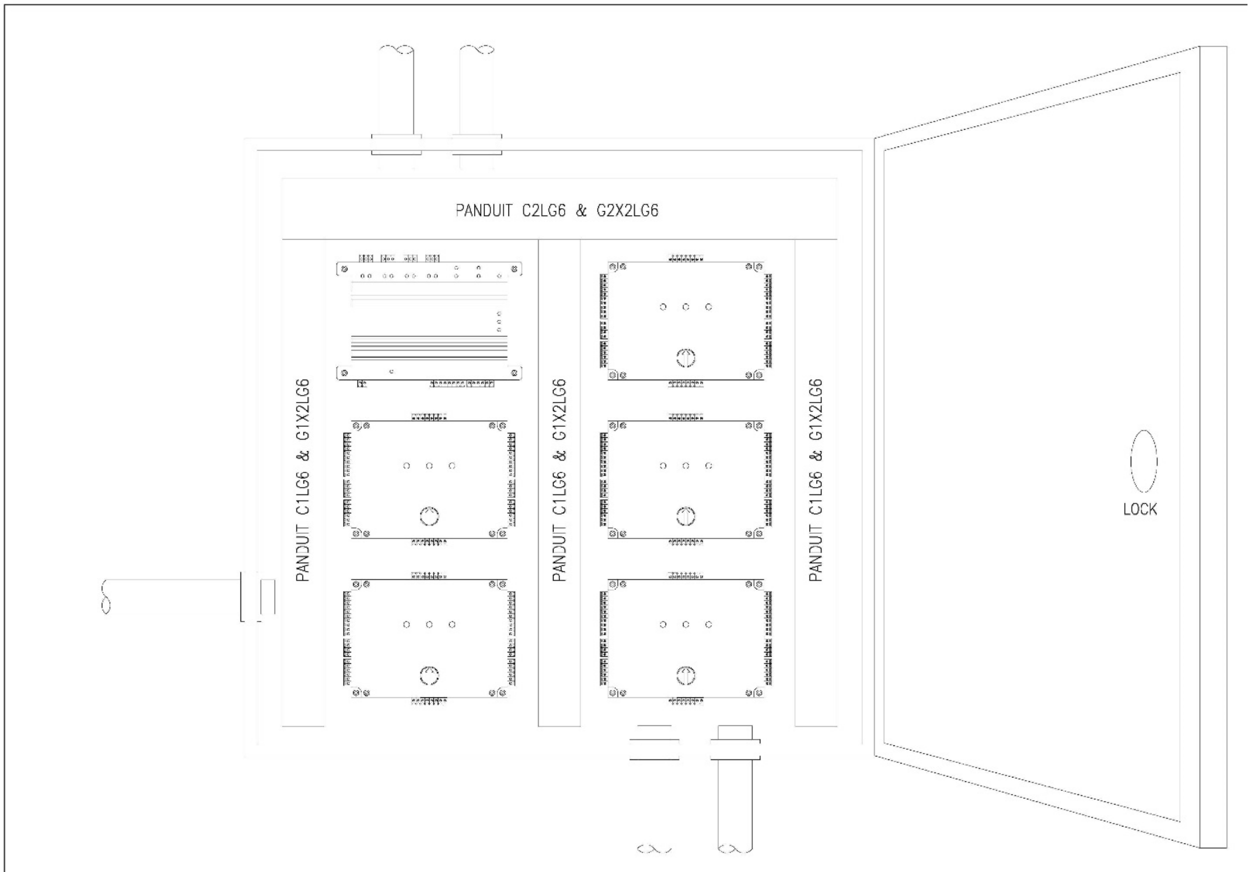

TO DATA GATHERING PANEL
JB
CC
POWER DOOR OPERATOR
CR
RXP
TO DCU
INDUCTION LOOP
(INBOUND)
(OUTBOUND)
8
Y001
DOOR TYPE 5A / 5A*
PEOPLE AND VEHICLE CONTROL ROLL UP DOOR



1 TYPICAL ELECTRONIC ACCESS PANEL LAYOUT
Y002 N.T.S.



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

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: ______________________