PROJECT MANUAL
Issued for Tender

Queen's University - Stauffer Library Main Floor New Layout

Queen's University

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END OF SECTION

1.1 GENERAL SCOPE

.1 The "General Conditions", "Labour Conditions and Rates", and all documents listed in the tender will apply to, and govern, all phases of the work specified throughout this specification and/or as shown on attached drawings which form part of the contract documents.

.2 The work under this Contract comprises the furnishing of all labour, materials, tools and equipment required for work at Stauffer Library, Queen's University, Kingston, Ontario.

1.2 DESCRIPTION OF WORK

.1 The intent of this project is to modernize the main floor of the award-winning Stauffer Library build in 1994. The project includes relocation and renovation of library and student service offices, workspaces, and seating areas to create flexible, collaborative, state-of-the-art learning and teaching spaces. In support of the project, all affected areas will require retrofit the mechanical and electrical systems.

.2 The work will include, but is not necessarily limited to, the following:

.1 Removal of existing finishes: flooring, ceiling, walls, and build-in furniture.

.2 Erection of new walls and installation of interior doors and glazing.

.3 Upgrades to mechanical ventilation systems.

.4 Upgrades to electrical systems including lighting.

.5 Installation of new suspended ceiling system.

.6 Installation of new interior finishes and build-in furniture.

.3 The University's preference is to complete the Work in a single phase by August 2024. however, in reference to Drawings A031 and A032, portion of the work could be completed by December 2024.

.4 The Work is not anticipated to require the removal of hazardous materials, refer to third party report for details and procedures.

.1 If discovered, the abatement of all hazardous materials must be completed by a licensed abetment contractor prior to any demolition of the work.

1.3 COST BREAKDOWN

.1 Before submitting first progress claim, submit breakdown of contract price in detail as directed by the Consultant and aggregating contract price. After approval, the cost breakdown will be used as basis for progress payment.

1.4 DOCUMENTS REQUIRED

.1 Maintain at the job site one (1) copy of each of the following:

.1 Working drawings.

.2 Contract drawings.

.3 Specifications.

.4 Addenda.

.5 Change Orders.

.6 Other modifications to contract.

.7 Copy of approved work schedule.

.8 Approved shop drawings.

.9 Manufacturers' installation and application instructions.

.10 Notice of project (Ministry of Labour).

.11 Building Permit.

.12 "Hot Works" Permit.

.13 Fire Safety Plan.

.14 Health and Safety Plan.

.15 Pollution Prevention Plan.

1.5 BUILDING PERMIT

.1 The Queen's University Representative will allow work to proceed only when Building Permit is obtained.

.2 No claim will be made against Queen's University due to work interruption caused by failure to obtain a Building Permit.

1.6 UTILITY SHUTDOWNS

.1 When it is required to shut down any utility to perform any work under this contract, the Contractor is required to request the shut down, in writing, detailing the affected areas to the Queen's University Representative no less than 10 working days before required.

.2 The Queen's University Representative will allow utility shutdowns to proceed only when authorized by Queen's University.

.3 No claim will be made against the Queen's University due to work interruption caused by failure to request a utility shutdown.

1.7 CODES

.1 Perform work in accordance with Ontario Building Code (OBC) 2012 and any other code of provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements will apply.

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.8 SITE ACCESS

.1 Access to the site is subject to the following restrictions:

.1 All possible steps will be taken to provide the Contractor with access to the area at all times. However, library activity may require some closure of the area. At least one (1) week's notice will be supplied to the Contractor if the contract area is to be closed due to library activity.

1.9 ACCEPTABILITY OF MATERIALS

.1 Contractors will base bids on materials specified and will not allow in tenders for substitution of materials. All requests for substitution of materials will be referred to the

Consultant and Queen's University Representative, prior to the tender closing date, in accordance with the RFP terms and supported by such manufacturer's test data, samples and installation manuals as may be required to carry out an assessment of substitutes. In no event will the substitute deviate substantially from the original specified.

.2 Where products are specified "no equal", there is a requirement to maintain conformity and/or compatibility. In this case, no substitutes will be considered.

.3 Where no material is specified, all material used will be similar or equal in design and quality to existing or as directed by the Consultant.

.4 Where the Contractor uses materials and equipment unsatisfactory for a permanent installation, the Contractor will replace them with satisfactory items before claiming payment but no claim other than for satisfactory items will be made.

.5 The Contractor will not remove any salvageable material or equipment from the job site without permission from the Queen's University Representative. All items not remaining the property of Queen's University will become the property of the Contractor and be removed from the site by them.

1.10 MATERIAL HANDLING

.1 The General Contractor is responsible to ensure that all materials transported, supplied, stored, handled, used and disposed of, under this contract, will conform to the appropriate requirements designated by the Provincial and Federal Departments of Environment wherever applicable.

1.11 WORK SCHEDULE

.1 A construction bar format schedule is required for this project. The baseline schedule shall be broken down by activities, including the delivery of critical equipment that could affect the overall completion of the contract. The baseline schedule shall be submitted, for the approval of the Consultant and Queen's University Representative, at the same time as the contractor submits the insurance for the project.

.2 The Contractor will update the schedule once a month, comparing the work completed to-date against the baseline schedule. If the bar chart indicates the project is behind, the Contractor will submit along with the updated version, a plan on how they intend to bring the project back on track. The revised schedule will be submitted a minimum of once a month along with the progress draws, and as per the terms of payment. The Contractor's progress claim will not be processed until all conditions have been met to the satisfaction of the Consultant and Queen's University Representative.

.3 Work of this contract may be performed:

.1 During normal working hours, 0800 through 1700 on working days, Monday to Friday, except holidays; or

.2 Outside normal working hours except holidays when the Queen's University Representative gives prior written approval.

1.12 MANUFACTURER'S DIRECTIONS

.1 All manufacturers' items will be supplied and/or installed as directed by the manufacturer unless otherwise specified to the contrary.

1.13 STORAGE FACILITIES

.1 No storage facilities are available at the site. Therefore, the Contractor will provide and maintain suitable facilities for storing and protecting materials, tools and equipment required to carry out the work of this contract. Type and location of such facilities will be subject to the Queen’s University Representative's approval.

.2 Remove temporary facilities from the site when directed by the Queen’s University Representative.

1.14 TEMPORARY SERVICES

.1 Queen’s University can provide, on request to the Queen’s University Representative, in writing, water and temporary electrical power provided the Contractor pays all costs connected with the installation of equipment and temporary lines required to place these services from the nearest permanent outlet to work site and provided also that the supply of temporary services aforesaid by Queen’s University is subject to owner requirements and may be discontinued by a representative of the Queen’s University on site at any time without notice to the Contractor and that Queen’s University will not be responsible for any damage due to delays caused by such withdrawal of temporary services.

.2 The Queen’s University Representative will determine delivery points and quantitative limits. The Queen’s University Representative's written permission is required before any connection is made. Connect to existing power supply in accordance with the Canadian Electrical Code (latest edition).

1.15 WORKMANSHIP

.1 All work will be carried out by qualified personnel.

.2 Workmanship will be of a uniformly high quality and in strict accordance with the best standard practices.

.3 Mediocre or inferior workmanship will be replaced by work of first-class quality, without cost, to Queen’s University, when so ordered by the Queen’s University Representative.

1.16 CONTROL

.1 On arrival at the site and prior to the commencement of any "site" work, the Contractor will report to the Queen’s University Representative.

.2 All work will be scheduled with the approval of the Queen’s University Representative.

1.17 PROTECTION

.1 It is the Contractor's responsibility to take all required precautions to protect from damage all Queen’s University property and to make good damage caused by them during the performance of this Contract.

.2 Arrangements will be made through the Queen’s University Representative to provide adequate notice, if required, in advance of starting date to enable occupants to remove, relocate or to be advised as to protection for the contents of the building.

.3 The Contractor assumes all risk of loss, damage or injury to the person or property of the Contractor and their servants, agents or employees.

.4 Provide temporary dust screens, barriers, warning signs in locations where renovation and alteration work is adjacent to areas used by public or staff.

.5 Existing utilities, where shown on the drawings, are for the convenience of the Contractor. Determining the exact locations of existing utilities is the Contractor's responsibility. The Contractor is responsible for protecting the existing utilities where required.

1.18 OVERLOADING

.1 Ensure no part of the work is subjected to a load which will endanger its safety or will cause permanent damage.

1.19 SECURITY REQUIREMENTS

.1 The Contractor will abide by all Security Regulations as laid down by Queen’s University. It will be the responsibility of the Contractor to enforce these regulations.

.2 Contractor will attend a security briefing organized by the Queen’s University Representative prior to gaining access to the worksite.

.3 Conditions of the security requirements will be monitored by the Queen’s University Representative.

1.20 STANDARDS

.1 Throughout this specification, reference has been made to certain local and national standards. These standards will be considered an integral part of the specification and will be read in conjunction with the drawings and specifications as if they were reproduced herein.

.2 When reference is made to certain detailed drawings, catalogues, or similar related data as published by the manufacturers, the Contractor will be responsible for obtaining sources.

.3 Where reference is made to standards, the latest edition will always govern unless a specifically dated edition is mentioned.

1.21 ALTERATIONS AND SUBSTITUTIONS

.1 The Contractor will not make any changes in the design and/or installation of items being repaired or replaced without prior authority of the Queen’s University Representative.

1.22 WARRANTY

.1 The Contractor will warranty all newly installed equipment, materials and the labour involved in work carried out by the Contractor under this contract for a period of one (1) year. Where the manufacturer's warranty exceeds the one (1) year period, the Contractor will have the warranty(ies) made out in favour of Queen’s University and a copy delivered to the Queen’s University Representative on completion of the work. All warranties are to be in effect as of the date of completion of the work.

1.23 TRANSPORTATION AND ACCOMMODATION

.1 Transportation and accommodation on and off the site will be provided by the Contractor for their employees, their tools, equipment and materials.

1.24 SETTING OUT OF WORK

.1 Assume full responsibility for and execute complete layout of work to locations, as requested by Queen’s University Representative.

1.25 ADDITIONAL DRAWINGS

.1 Queen’s University Representative may furnish additional drawings to assist proper execution of work. These drawings will be issued for clarification only.

1.26 SMOKING REGULATIONS

.1 The Contractor and their personnel will be required to adhere to the no smoking regulations, as set out for the buildings/areas concerned, during the execution of the work on this contract.

1.27 CLEAN-UP

.1 Cleaning will consist of daily policing and clean-up for the duration of the work period. On completion of the work requirement, all tools, equipment, surplus materials and debris will be removed from the work area and the site left in a clean and tidy condition.

1.28 CONTRACTOR'S SUPERINTENDENT

.1 The Contractor’s Superintendent shall be on site during working hours or he/she may designate a foreman on site who represents the company and can speak or make decisions on behalf of the Company and is familiar with the company safety policies and procedures.

END OF SECTION

1.1 GENERAL

.1 Submit to the Consultant, for review, shop drawings, product data, mock-ups and samples specified.

.2 Present shop drawings, product data, mock-ups and samples in SI metric units.

.3 Until submission is reviewed, work involving relevant product may not proceed.

1.2 SHOP DRAWINGS

.1 Drawings to be originals prepared by Contractor, Sub-contractor, Supplier or Distributor, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate Sections.

.2 Identify details by reference to sheet and detail numbers shown on contract drawing.

.3 Maximum sheet size: 707 x 1000 mm.

.4 Reproductions for submissions: opaque diazo prints or monochrome paper copies.

1.3 MOCK-UPS

.1 Mock-up: field-erected example of work complete with specified materials and workmanship.

.2 Erect at locations acceptable to the Queen's University Representative.

.3 Reviewed and accepted mock-up will become standards of workmanship and material against which installed work will be verified.

1.4 COORDINATION OF SUBMISSIONS

.1 Review shop drawings, product data, mock-ups and samples prior to submission.

.2 Verify:

.1 Field measurements.

.2 Field construction criteria.

.3 Catalogue numbers and similar data.

.3 Coordinate each submission with requirements of work and contract documents. Individual shop drawings will not be reviewed until all related drawings are available.

.4 Contractor's responsibility for errors and omissions in submission is not relieved by the Consultant's review of submittals.

.5 Contractor's responsibility for deviations in submission from requirements for contract documents is not relieved by the Consultant's review of submission unless the Consultant gives written acceptance of specified deviations.

.6 Notify the Consultant, in writing at time of submission, of deviations from requirements of contract documents.

.7 After the Consultant's review, distribute copies.

1.5 SUBMISSION REQUIREMENTS

.1 Schedule submissions at least 14 days before dates, reviewed submissions will be needed.

.2 Submit number of opaque diazo or monochrome paper copies of shop drawings and product data which Contractor requires for distribution, plus two (2) copies which will be retained by the Consultant.

.3 Accompany submissions with transmittal letter, in duplicate, containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Number of each shop drawing, product data, mock-up and sample submitted.
- .5 Other pertinent data.

.4 Submissions shall include:

- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name of:
  - .1 Contractor.
  - .2 Sub-contractor.
  - .3 Supplier.
  - .4 Manufacturer.
  - .5 Separate detailer when pertinent.
- .4 Identification of product or material.
- .5 Relation to adjacent structure or materials.
- .6 Field dimensions, clearly identified as such.
- .7 Specification Section number.
- .8 Applicable standards, such as ASTM, ULC, CSA, CGSB numbers, etc.
- .9 Contractor's stamp, initialled or signed, certifying review of submission, verification of field measurements and compliance with contract documents.

END OF SECTION

1.1 GENERAL

.1 Contractors, and their personnel, shall be familiar with all the requirements specified in this Section.

1.2 FIRE SAFETY PLAN

.1 The Contractor shall provide a Fire Safety Plan in accordance with the National Fire Code of Canada (NFCC 2015) section 5.6.1.3.

.2 The Contractor's responsibility for a Fire Safety Plan is limited to their construction activities and not the entire building.

.3 Responsibility for fire safety of the building areas outside of the construction limits remains with Queen's University. Queen's University is responsible for the Fire Safety Plan for the occupied portions of the building.

.4 The Contractor shall submit the Fire Safety Plan to Queen's University Representative, within 10 business days of award, for approval.

.5 Work shall commence only after the Fire Safety Plan has been approved by Queen's University.

.6 A copy of the approved Fire Safety Plan shall be posted and maintained on site at all times during construction.

.7 The Contractor shall ensure all persons accessing the construction site are briefed on, and adhere to, the requirements of the Fire Safety Plan.

1.3 REPORTING FIRES

.1 Know the civic address, report immediate fire incidents to the Fire Department thru 911, person calling the Fire Department is to remain on site to direct the Fire Department to the fire.

.2 Know the location of nearest fire alarm box and telephone, including the emergency phone number.

.3 Report immediately all fire incidents to the Fire Department as follows:

.1 Activate nearest fire alarm box; or

.2 Telephone local 911 (emergency only).

.4 When reporting a fire by telephone, give location of fire, name or number of building and be prepared to verify the location and include the civic address.

1.4 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS

.1 Fire protection and alarm systems shall not be:

.1 Obstructed in any way.

.2 Shut off.

.3 Left inactive at the end of a working day or shift without notification and authorization from the Fire Chief or their representative.

.2 Fire hydrants, standpipes and hose systems shall not be used for other than fire fighting purposes unless authorized by the Fire Chief.

1.5 FIRE EXTINGUISHERS

.1 The Contractor shall supply fire extinguishers, as scaled by the Fire Chief, necessary to protect the work in progress and the Contractor's temporary facilities on-site.

.2 For hot work involving welding, cutting, grinding, soldering, thawing pipes, or any process where there's an open flame or where sparks are generated, every worker who may be required to use fire extinguishing equipment shall be trained to use the equipment.

.3 Roofing Contractor's kettle operators and torch-applied roofers shall be trained in the use of fire extinguishers, and they shall be knowledgeable in the roofing operations and the hazards involved.

1.6 INSTALLATION AND/OR REPAIR OF ROOF CONTRACTOR'S PHYSICAL PLANT SITE

.1 The Contractor shall notify the Fire Chief of the location of any asphalt kettles and the dates that the kettles will be in use. The Contractor, in the course of roofing work, shall ensure that they and/or their personnel use and take the following precautions:

.1 Use only kettles equipped with thermometers or gauges in good working order.

.2 Locate kettles in safe place outside of building or, if approved by the Queen’s University Representative and/or Fire Chief, on non-combustible roof at location to avoid danger of igniting combustible material below.

.3 Maintain continuous supervision while kettles are in operation and provide metal covers for the kettles to smother any flames in case of fire. Fire extinguishers shall be provided as required herein.

.4 Prior to start of work demonstrate container capacities to the Queen’s University Representative and/or Fire Chief.

.5 Use only glass fibre roofing mops.

.6 Used roofing mops shall be stored away from building and combustible materials.

.7 All roofing materials shall be stored in locations no closer than 3 m to any structures.

1.7 BLOCKAGE OF ROADWAYS

.1 Advise the Fire Chief of any work that would impede fire apparatus response. This includes violation of minimum overhead clearance, as prescribed by the Fire Chief, erecting of barricades and the digging of trenches.

1.8 SMOKING PRECAUTIONS

.1 See Section 01 05 00.

1.9 RUBBISH AND WASTE MATERIALS

.1 Rubbish and waste materials shall be kept to a minimum.

.2 Removal:

.1 All rubbish shall be removed from the work site at the end of the work day or shift or as directed.

.3 Storage:

.1 Extreme care is required where it is necessary to store oily waste in work areas to ensure maximum possible cleanliness and safety.

.2 Greasy or oily rags or materials subject to spontaneous combustion shall be deposited and kept in an approved receptacle and removed from the work site at the end of the work day or shift or as directed.

1.10 FLAMMABLE AND COMBUSTIBLE LIQUIDS

.1 The handling, storage and use of flammable and combustible liquids are governed and guided by the current National Fire Code of Canada..

.2 Flammable and combustible liquids such as gasoline, kerosene and naphtha may be kept for ready use in quantities not exceeding 45 litres, provided they are stored in approved safety cans, bearing the Underwriter's Laboratory of Canada or Factory Mutual Seal of Approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the permission of the Fire Chief.

.3 Transfer of flammable and combustible liquids is prohibited within buildings or on jetties.

.4 Transfer of flammable and combustible liquids shall not be carried out in the vicinity of open flames or any type of heat-producing devices.

.5 Flammable liquids and combustible liquids having a flash point below 38°C, such as naphtha or gasoline shall not be used as solvents or cleaning agents.

.6 Flammable and combustible waste liquids, for disposal, shall be stored in approved containers located in a safe ventilated area. Quantities are to be kept to a minimum and the Fire Department is to be notified when disposal is required.

1.11 HAZARDOUS SUBSTANCES

.1 If the work entails the use of any toxic or hazardous materials/chemicals or explosives, or otherwise creates a hazard to life safety or health, the work shall be in accordance with the National Fire Code of Canada.

.2 When work is being carried out in dangerous and/or hazardous areas involving the use of heat, provide fire watchers, equipped with sufficient fire extinguishers. Determination of dangerous and/or hazardous areas along with the level of precaution necessary for Fire Watch is at the discretion of the Fire Chief. Contractors are responsible for providing fire watch service for work on a scale established and in conjunction with the Fire Chief at the pre-work conference.

.3 Where flammable liquids, such as lacquers or urethanes are to be used, proper ventilation shall be assured and all sources of ignition shall be eliminated. The Fire Chief is to be informed prior to and at the cessation of such work.

1.12 QUESTIONS OR CLARIFICATIONS

.1 Any questions or clarification of Fire Safety, in addition to the above requirements, shall be directed to and cleared through the Fire Chief.

1.13 FIRE INSPECTION

.1 Site inspections by Fire Chief will be coordinated through the Queen's University Representative.

.2 Allow Fire Chief unrestricted access to the work site.

.3 Cooperate with the Fire Chief during routine fire safety inspection of the work site.

.4 Immediately remedy all unsafe fire situations observed by the Fire Chief.

END OF SECTION

1.1 REFERENCES

FEDERAL

.1 *Canadian Environmental Protection Act 1999*. Statutes of Canada 1999 Chapter 33.

.1 PCB Regulations. SOR/2008-273.

.2 *Canada Labour Code- Canadian Occupational Health and Safety Regulations* (SOR/86-304). 2019.

.3 *Canada Occupational Health and Safety Regulations* (SOR/86-304). Canada Labour Code.

.4 *Code of Practice for the Environmental Sound Management of End-of-Life Lamps Containing Mercury*. Environment and Climate Change Canada. 2017.

.5 *Species at Risk Act*, 2003. Chapter 25-29, no.3.

.6 *Transportation of Dangerous Goods Act* and pursuant regulations.

PROVINCIAL

.7 *Technical Standards and Safety Act, 2000* and pursuant regulations, codes, and standards. Statutes of Ontario 2000, Chapter 16.

.8 *Environmental Protection Act*. Revised Statutes of Ontario 1990, Chapter E.19.

.1 Ontario Regulation 102/94. *Waste Audits and Waste Reduction Work Plans*.

.2 Ontario Regulation 103/94. *Industrial, Commercial, and Institutional Source Separation Programs*.

.3 Ontario Regulation 347. *General—Waste Management.* Revised Regulations of Ontario 1990

.4 Ontario Regulation 362. *Waste Management – PCB's*.

.9 *Occupational Health and Safety Act*. Revised Statutes of Ontario 1990, Chapter O.1.

.1 Ontario Regulation 490/09. *Designated Substances.*

.2 Ontario Regulation 278/05. *Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations*.

.10 Ontario Ministry of Labour. 2011. *Lead on Construction Projects*.

.11 Ontario Ministry of Labour 2011. *Silica on Construction Projects.*

1.2 RELATED SECTIONS

.1 02 81 00 Hazardous Building Materials General Requirements

.2 02 82 00.1 Asbestos Abatement – Type 1 (Minimum Precautions)

.3 02 82 00.2 Asbestos Abatement – Type 2 (Intermediate Precautions)

.4 02 82 00.3 Asbestos Abatement – Type 3 (Maximum Precautions)

.5 02 83 11 Lead and Other Paint Coatings – Level 2A Intermediate Worker Precautions

.6 02 84 00 Removal of PCB Containing Equipment

.7 02 90 00 Removal of Equipment Containing Mercury

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Prior to commencing construction activities submit an Environmental Protection Plan to include the following:

.1 Spill Response Plan.

.2 Hazardous Materials Abatement and Management Plan.

.3 Waste Management and Disposal Plan.

.4 Pollution Prevention Plan.

.3 Record of Abatement and as-built drawings identifying abatement completed.

.4 Submit other data, information and documentation upon request by the Queen's University Representative and as stipulated elsewhere in this section.

1.4 DESIGNATED SUBSTANCES

.1 Designated Substances and Hazardous Materials are outlined in Section 02 81 00 – Hazardous Building Materials General Requirements.

.2 In accordance with Section 30 of Ontario's *Occupational Health and Safety Act*, following is a list of designated substances present at the project site:

.1 Asbestos-containing materials are present throughout the building.

.1 See Section 02 81 00 Hazardous Building Materials General Requirements for specific materials.

.2 Disturbance to asbestos-containing materials shall be conducted in accordance with Ontario Regulation 278/05 and Canada Labour Code – Canada Occupational Health and Safety Regulations SOR/86-304 (COHSR), and in accordance with,

.1 Section 02 82 00.1 Asbestos Abatement – Type 1 (Minimum Precautions);

.2 Section 02 82 00.2 Asbestos Abatement – Type 2 (Intermediate Precautions); and,

.3 Section 02 82 00.3 Asbestos Abatement – Type 3 (Maximum Precautions).

.3 Lead is present in all painted surfaces throughout the building.

.1 Disturbances to lead painted surfaces shall be conducted in accordance with the Ministry of Labour Guideline "*Lead on Construction Projects*" (2011).

.2 Based on previous results of Toxicity characteristic leaching procedure (TCLP) metals analysis of surface coatings within the renovation area, surface coatings are considered non-hazardous and will be transported and disposed of as regular waste.

.4 Silica is present in all concrete materials throughout the project site.

.1 Disturbance of materials containing silica shall be conducted in accordance with the Ministry of Labour Guidelines "*Silica on Construction Projects*" (2011).

.5 Mercury Containing Lamps and Thermostats:

.1 Mercury may be present within lighting lamps and bulbs, thermostats, thermometers, manometers and mechanical controls throughout the building.

.1 Disturbance of mercury-containing lamps shall be conducted in accordance with Environment and Climate Change Canada's "*Code of Practice for the Environmentally Sound Management of End-of-Life Lamps Containing Mercury"* (2017).

.2 Lighting tubes contain mercury, must not be released to the environment. Therefore, the tubes must not be broken.

.3 All mercury containing thermostats, lighting lamps and bulbs handled and disposed in accordance with O.Reg. 490/09 (as amended) and O. Reg. 347/09 (as amended).

.6 Inform all workers and sub trades of the presence of designated substances and hazardous materials identified in the contract documents.

.7 Immediately notify the Queen's University Representative of potential asbestos containing material (ACM) discovered during the work and not apparent from the drawings, specifications, or reports pertaining to the Work. Do not disturb such material.

.8 For additional reference information, refer to report titled:

.1 *Designated Substance and Hazardous Materials Survey, Building N-107 Leadership Building – Lecture Training, 108 Arras Road, Garrison Petawawa, ON* prepared by XCG, dated October 19, 2018.

.2 *Project Specific Abatement Specifications – Targeted Sampling Building N-107, 108 Arras Road, Garrison Petawawa, Ontario* prepared by WSP E&I Canada Limited, dated November 9, 2022.

1.5 GENERAL

.1 Comply with all federal, provincial, and municipal regulatory requirements and guidelines for environmental protection and natural resource conservation, including in section 1.0 References, noted above.

.2 The Work site is subject to inspection by the Queen's University Representative, without prior notice.

.3 Failure to comply with environmental requirements may result in a stop work order or assessment of damages commensurate with repair of damage.

.4 All references to payment referred to in OPSS references are to be disregarded and do not apply to this contract.

.5 The Contractor will be unable to request extra funding to meet environmental requirements that are within the contract.

.6 It is the Contractor's responsibility to be aware of environmental requirements and the best management practices and pollution control measures necessary to meet them.

.7 Blasting is not permitted on Queen's University property.

.8 Fires and burning of rubbish are not permitted on Queen's University property.

1.6 SPILL PREVENTION AND RESPONSE PLAN

.1 A spill or release is an accidental discharge of a pollutant (solid, liquid or gas) into the environment. After a spill or release, always ensure human health and safety is protected above all else.

.2 Submit to the Queen's University Representative a project-specific Spill Prevention and Response (SPR) Plan prior to work on-site.

.1 The SPR shall include environmental response measures necessary to prevent and to mitigate a pollutant release on University property.

.2 The SPR is to include: roles and responsibilities, contact information, spill notification procedure, emergency spill response measures, project and site-specific clean up measures for spills, waste disposal, restoration activities, and reporting requirements.

.3 Identify storage locations of materials or wastes that may require emergency spill response. Identify spill control kit inventory and location(s).

.4 SPR shall identify equipment fuelling location, methodology and control measures. Refueling operations shall be conducted within a secondary containment area. Refuel equipment no closer than 30 metres from water bodies.

.3 The SPR is to be modified and updated as necessary. On-going assessments shall be performed during the progress of work identifying and documenting new or potential spill hazards and measures not previously known and identified.

.4 Prior to starting work, provide to the Queen's University Representative an inventory of hazardous material to be brought to the site, including volume or mass, and Safety Data Sheets (SDS).

.5 A Pollution Incident Report shall be completed by the Contractor for all spill or release incidents.

.6 Emergency Response:

.1 With respect to liquid spills, provide enough on-site equipment to control for one hour a liquid spill of 110% of any material brought on to—or handled at—the site.

.2 The on-site spill control kit required to include absorbent pads, absorbent granular, nitrile gloves, garbage bags and/or pails with lids, and shovels, and applicable to the chemical used. A spill control kit shall be located wherever significant quantities of materials or wastes that may require emergency spill response are used or stored.

.3 In the event of a spill, invoke Contractor's SPR Plan and make immediate notifications.

.4 In the event of a spill into the natural environment, do everything practicable to prevent, eliminate, and ameliorate adverse effects, and to restore the natural environment.

.5 Emergency response planning is to include measures to escalate the response in the event of an emergency that exceeds on-site equipment capabilities.

.7 Display an information placard on all such material and equipment containing liquid products that will be located overnight or longer on Queen's University property.

.1 Information placards to include: Contractor's name and address, contact person, emergency telephone numbers, and liquid contents.

.2 Post the information placard either on the exterior of the container, or on the dashboard of the vehicle, where applicable.

1.7 HAZARDOUS MATERIALS ABATEMENT AND MANAGEMENT PLAN

.1 Establish and submit to the Queen's University Representative a Hazardous Materials Abatement and Management (HMAM) Plan prior to work on-site.

.2 The HMAM Plan will address the details of how designated substance(s) and hazardous material(s) will be abated and managed.

.1 Identify all municipal, provincial and federal permits and notifications required to complete the Work.

.2 Detail the approach to the execution of abatement work, including the equipment, tools, materials and actions to be employed for each type of hazardous material.

.3 A Layout Drawing identifying existing conditions with location of proposed enclosure(s), barricades and/or warning signs to restrict access, waste and personal decontamination facilities, and proposed location of waste bin.

.4 Proposed schedule accounting for day(s) projected for enclosure set up, abatement work, cleaning and lockdown, and enclosure tear down.

.5 Emergency procedures to be followed in the event of: fire, breach of the enclosure, injury or accident within the enclosure, detection of airborne asbestos fibers outside the enclosure, spilling asbestos debris en-route to the waste bin.

.3 Contractor shall provide Queen's University Representative a minimum of 48-hours notice prior to request for pre-contamination inspections, post abatement visual inspections and inspections prior to lockdown application (including both Moderate and High Risk Abatement activities as defined of COHSR).

.1 Scheduling with the environmental consultant to be coordinated through the Queen's University Representative.

.4 Contractor shall allow a minimum of 48-hours to receive results from Queen's University Representative for all visual inspections and clearance air testing results prior to enclosure tear-down (including both Moderate and High Risk Abatement activities as defined of COHSR).

.1 Inform all workers and sub trades of the presence of designated substances and hazardous materials identified in the contract documents.

.2 Immediately notify the Queen's University Representative of potentially containing asbestos material discovered during the work and not apparent from the drawings, specifications, or reports pertaining to the Work. Do not disturb such material.

.3 Fire alarm suspension can be coordinated on week days between 7:30am and 3:30pm daily. Notification to Queen's University Representative, via submission of completed Request for Fire Alarm Shut Down form, is required a minimum of 5 days in advance of temporary fire alarm shut down

.4 Written notification to Queen's University Representative required a minimum of 5 days prior to request to disable the mechanical ventilation system servicing the work area.

1.8 WASTE MANAGEMENT AND DISPOSAL PLAN

.1 Submit a Waste Management and Disposal (WMD) Plan to the Queen's University Representative before construction work begins at the site.

.2 The WMD Plan is to encompass:

.1 Regular waste,

.2 Construction waste,

.3 Hazardous materials used in the course of the work, and

.4 Hazardous materials and designated substance waste.

.3 The Plan is to comply with legislation, best practices, and with the requirements of the specifications.

.4 Provide evidence in the WMD Plan that all proposed temporary storage procedures, transport methods, and disposal sites are licensed where applicable.

.1 Include copies of licenses.

.5 The WMD Plan is to include handling, storage, transportation, disposal, and emergency response. Specific minimum requirements to be addressed are listed below.

.6 <u>Handling:</u>

.1 Ensure that staff are properly trained and equipped, in accordance with regulatory requirements.

.2 Minimize handling and exposure to hazardous materials. Use control measures such as PPE and best practice procedures to address potential risks.

.3 All waste products will be placed in suitable containers and labeled clearly.

.1 Waste products are to be segregated by commodity and placed in separate containers based on class.

.2 Similar waste products are not to be mixed together without prior approval from the Queen's University Representative.

.7 <u>Storage:</u>

.1 Identify location(s) on site where wastes and hazardous materials wastes will be stored.

.2 Store all petroleum, oil, lubricants, and other hazardous materials within secondary containment, or in an appropriate metal clad storage building with containment.

.3 Store incompatible materials separated to prevent reaction.

.4 Access to hazardous waste storage areas must be controlled through appropriate physical barriers and limited to authorized personnel.

.5 Site is to be kept neat and orderly at all times.

.8 Transportation:

.1 Transportation of hazardous material must be in accordance with the *Transportation of Dangerous Goods Act*, by a licensed hauler, and in approved containers.

.2 Hazardous Materials Waste shall **not** be released from a work site to a carrier that is not registered as a carrier for the specific Hazardous Materials Waste, nor shall it be released for delivery to a consignee that is not registered as a receiver for the specific Hazardous Materials Waste.

.9 Disposal:

.1 Identify the proposed waste receiver facilities and the anticipated waste shipment frequency for all wastes.

.2 Based on previous results of Toxicity characteristic leaching procedure (TCLP) metals analysis of surface coatings within the renovation area, surface coatings are considered non-hazardous and can be disposed and transported in accordance with O. Reg. 347.

.3 Dispose of all materials that are removed as asbestos-containing materials as asbestos waste.

.10 Transport and Disposal of Hazardous Waste and Designated Substances:

.1 Provide Queen's University Representative written notification of intent to transport of hazardous materials or designated substances off site, including but not limited to hazardous and liquid industrial waste (i.e. oils, solvents, waste fuels, used spill clean-up materials) or designated substance waste (i.e. asbestos, leachate toxic lead paint, mercury vapour in fluorescent light tubes).

.2 For shipments that require a waste generator number pursuant to O. Reg. 347, the Base waste generator number is required prior to removal offsite and will be provided by the Queen's University Representative.

.3 Submit the following to the Queen's University Representative for review 5 days prior to transport:

.1 Description and approximate quantity of waste material, including substrate if applicable.

.2 Waste carriers' business name, address, contact information, and Ministry of Environment, Conservation and Parks (MECP) Certificate of Approval(s) listing the hazardous materials approved for transport.

.3 Contractor proposed date and time for hazardous waste material shipment.

.4 Hazardous waste receivers name, address, contact information, and MECP Certificate of Approval(s) listing the hazardous materials approved for their receiving site.

.5 Correspondence from the approved hazardous waste receiver, indicating agreement and intent to accept the specified hazardous materials waste on specified date.

.4 Coordinate with the Queen's University Representative so that the Base Hazardous Materials Officer or designate is present at the time of shipment to review, sign and document hazardous waste transport from the Base.

.5 Submit the following to the Queen's University Representative for review within 48 hours following transport from the Base:

.1 Landfill weigh scale receipt/ticket for the disposal of waste.

.11 Special Wastes:

.1 Smoke Detectors:

.1 Undamaged and intact commercial Canadian Standards Association (CSA) and Underwriters Laboratories (UL) approved smoke detectors containing less than 185 kilo-Becquerel's of Americium-241 may be disposed of using local waste collection systems.

.2 *Photoelectric* smoke detectors are **not** subject to this special procedure.

.3 *Ionization chamber smoke detectors* (ICSDs) contain radioactive sources, and **are** subject to this special procedure.

.4 If surplus ICSDs are not to be re-used, remove the ICSDs from walls, ceilings, etc., without breakage, and, dispose of ICSDs at an approved landfill

.2 Polychlorinated Biphenyls (PCBs):

.1 Before beginning work, confirm or refute that fluorescent light ballasts within the renovation area are PCB containing. Submit written procedures to Queen's University Representative for review. Do not begin work on PCB ballasts material until Queen's University has reviewed the written procedures.

.2 Fluorescent light ballasts considered to contain polychlorinated biphenyls (PCBs) are to be packaged and disposed of at a PCB storage facility off Base.

.3 Label containers with black and white serialized, "ATTENTION PCB" labels, in accordance with Environment and Climate Change Canada Manual for Spills of Hazardous Materials.

.12 Do not bury rubbish or waste materials on Queen's University Property.

.13 Do not dispose of waste into any waterways, storm or sanitary sewers, drainage system, or onto land.

.14 Divert unused asphalt material from landfill to be reused offsite or recycled.

.15 All solid and liquid hazardous waste material generated by work are to be taken off Base and disposed of in a lawful manner and at appropriately accredited facilities.

.16 All expenses incurred for the handling, storage, analysis, transport and disposal/recycling of all wastes will be incurred by the Contractor.

1.9 POLLUTION PREVENTION PLAN

.1 Prevent material from sandblasting, saw-cutting, sanding and other operations from contaminating air beyond application area, by providing temporary enclosures.

.2 Use new or well-maintained heavy equipment and machinery, preferably fitted with muffler/exhaust system baffles, engine covers.

.3 Comply with operating specifications for heavy equipment and machinery.

.4 Control emissions from equipment and plant to conform with federal, provincial, and municipal requirements.

.5 Products and Materials:

.1 Use products and materials that are as free as possible of noxious or toxic volatile emissions or emissions of irritating or toxic particles, so that the interior air of the completed building is as pollution-free as possible. For example, products emitting benzene, mercury, lead, or other known toxic compounds are not acceptable.

.2 Where odourless products are not available, choose products where possible so that odours are minimized. Set ventilation levels during the construction period sufficiently high to encourage the off-gassing of materials to their minimum levels prior to occupancy of the building, where possible.

.3 Choose products for installation within the air-handling and distribution systems to minimize the introduction of pollutants into the fresh air supply to the building.

END OF SECTION

1.1 STORAGE SHEDS

.1 Provide adequate weather tight sheds with raised floors, for storage of materials, tools and equipment which are subject to damage by weather.

1.2 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.3 SCAFFOLDING

.1 Construct and maintain scaffolding in rigid, secure and safe manner.

.2 Erect scaffolding independent of walls. Remove promptly when no longer required.

1.4 REMOVAL OF TEMPORARY FACILITIES

.1 Remove temporary facilities from site when directed by Queen's University Representative.

END OF SECTION

1.1 GENERAL

.1 Use new material and equipment unless otherwise specified.

1.2 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.2 Notify the Queen’s University Representative in writing of any conflict between these specifications and manufacturer's instructions. The Queen’s University Representative will designate which document is to be followed.

1.3 DELIVERY AND STORAGE

.1 Deliver, store and maintain packaged material and equipment with manufacturer's seals and labels intact.

.2 Prevent damage, adulteration and soiling of material and equipment during delivery, handling and storage. Immediately remove rejected material and equipment from site.

.3 Store material and equipment in accordance with supplier instructions.

.4 Touch-up damaged factory finished surfaces to the Queen’s University Representative's satisfaction. Use primer or enamel to match original. Do not paint over name plates.

.5 The Contractor will provide and maintain suitable facilities for storing and protecting materials, tools and equipment required to carry out the work of this contract. Type and location of such facilities will be subject to the Queen’s University Representative's approval.

1.4 ACCEPTABILITY OF MATERIALS

.1 Contractors will base bids on materials specified and will not allow in tenders for substitution of materials. Where the specified materials are not available and will put the project schedule at risk, requests for substitution of materials will be referred to the Queen’s University, prior to the tender closing date, and supported by such manufacturer's test data, samples, and installation manuals as may be required to carry out an assessment of substitutes. In no event will the substitute deviate substantially from the originally specified material.

1.5 CONFORMANCE

.1 Where material or equipment is specified by standard or performance specification, and upon the request of the Queen’s University Representative, obtain from manufacturer an independent testing laboratory report, stating the material or equipment meets or exceeds specified requirements.

1.6 TRADE NAMES

.1 Where trade names are used in this specification, they are not necessarily restrictive unless specifically noted. The acceptance of materials other than those specified will be determined by the Queen’s University Representative, in accordance with paragraph 1.4.1 of this Section.

END OF SECTION

1.1 SUBMITTALS

.1 Submit to Queen's University Representative copies of the following documents, including updates issued:

.1 Health and Safety Program as indicated in paragraph 1.9, prior to commencement of work on the work site.

.2 Reports or directions issued by authorities having jurisdiction, immediately upon issuance from that authority.

.3 Accident or Incident Reports, within 24 hrs of occurrence.

.2 Submit other data, information and documentation upon request by the Queen's University Representative as stipulated elsewhere in this section.

1.2 COMPLIANCE REQUIREMENTS

.1 Comply with the latest edition of the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act.

.2 Observe and enforce construction safety measures required by:

.1 National Building Code of Canada (latest edition).

.2 Provincial Worker's Compensation Board.

.3 Municipal statutes and ordinances.

.3 In event of conflict between any provisions of above authorities the most stringent provision shall apply.

.4 Provide and maintain Worker's Compensation Board coverage for all employees for the duration of the contract. Prior to commencement of the work, at the time of Interim Completion and prior to final payment, provide to the Queen's University Representative a letter (certificate) of Clearance from the Workers' Compensation Board indicating that the Contractor's account is in good standing.

1.3 RESPONSIBILITY

.1 The Contractor is responsible for safety of persons and property on the work site and for protection of university employees, students, and the general public circulating adjacent to work site operations to extent that they may be affected by conduct of work.

.2 The Contractor is to enforce compliance by workers and other persons granted access to work site with safety requirements of Contract Documents, applicable federal, provincial, and local statues, regulations, and ordinances, and with the Contractor's Health and Safety Program.

.3 Should an unforeseen or peculiar safety related hazard or condition become evident during performance of work, immediately take measures to rectify the situation and prevent damage or harm. Advise the Queen's University Representative verbally and in writing of the hazard or condition.

1.4 SITE CONTROL AND ACCESS

.1 Control all work site access points and work site activities. Delineate and isolate the work site from adjacent and surrounding areas by use of appropriate means to maintain control of all work site access points.

.1 The site, including construction trailers and material storage compounds, will be delineated between the public way and the project with a 1.8 meters steel construction fence. The erection of construction fence will be with metal posts no further than 2.4 metres apart and have chain link or welded steel mesh, and a solid steel rail for both top and bottom. Provide two lockable truck entrance gates and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys. Maintain fence in good repair.

.2 Make provisions for granting permission to access onto work site to all persons who require access. Procedures for granting permission to access are to be in accordance with the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act and the Contractor's Health and Safety Program.

.3 Ensure persons granted access to the work site are in possession of and wear the minimum personal protective equipment (PPE) designated by the Contractor's Health and Safety Program. Ensure persons granted access to the work site are provided with, trained in the use of, and wear, appropriate PPE that are required above and beyond the designated minimums previously noted and as specifically related to the work site activity that they are involved in. Be responsible for the efficacy of the PPE that is provided above and beyond the designated minimums.

.4 Control of the work site access and activities remain the responsibility of the Contractor as detailed within this specification section.

.1 Erect signage at access points and at other strategic locations around the work site clearly identifying the work site area(s) as being "off-limits" to non-authorized persons. Signage must be professionally made with well understood graphic symbols and is not to be used as advertising but for the specific use as related to site safety and key contact information. The size of the signage is expected to be 0.6 metres in height by 1.2m in length to clearly identify the requirements.

.1 Information to be provided on the signage is as follows:
Project Name/Description:
Contractor Company Name:
Project Superintendent's Name/Phone No.:
Queen's University Point of Contact Name/Phone No.:

.5 Secure the work site at all times to protect against un-authorized access.

1.5 FILING OF NOTICE

.1 File Notice of Project and any other required Notices with the Provincial Authorities prior to commencement of the work. Provide the Queen's University Representative with a copy of the filed Notice(s) prior to commencement of the work.

1.6 PERMITS

.1 Obtain permits, licenses and compliance certificates at appropriate times and frequencies as required by the authorities having jurisdiction.

.2 Post all permits, licenses and compliance certificates on work site and provide copies to the Queen's University Representative.

1.7 PROJECT/SITE CONDITIONS

.1 The following are the known hazardous substances and/or hazardous conditions at the work site which shall be considered as health or environmental hazards and shall be properly managed should they be encountered as part of the work:

.1 Contractor is to be advised that Asbestos has been identified in the project. Refer to Asbestos Abatement section for minimum Precautions.

.2 Contractor is to be advised that Lead has been identified in the project. Please refer to the Lead remediation section for minimum precautions.

.3 Contractor is to be advised that Silica has been identified in the project. Please refer to the Silica remediation section for minimum precautions.

.4 Contractor is to be advised that Mercury has been identified in the project. Please refer to the Mercury remediation section for minimum precautions.

.5 Contractor is to be advised that locations within the work area are designated confined spaces and that they must follow the Provincial Confined Space Regulations for construction projects.

.6 Contractors are required to be aware of the known hazardous substances and/or hazardous conditions and are to include in their tender price all work associated in working with, in and around the hazards.

.2 The above lists shall not be construed as being complete and inclusive of all safety and health hazards encountered as a result of Contractor's operations during the course of work. Include above items into the hazard assessment program specified herein.

1.8 MEETINGS

.1 Prior to commencement of work attend a pre-commencement meeting conducted by Queen's University Representative. Ensure minimum attendance by Contractor's site superintendent. Queen's University Representative will advise of time, date and location of the meeting.

.2 Conduct site specific occupational health and safety meetings as required by the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act.

.3 Record and post minutes of all meetings in plain view on the work site. Make copies available to Queen's University Representative upon request.

1.9 HEALTH AND SAFETY PROGRAM

.1 Contractors are required under Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act to have in place a Health and Safety Program. Compliance requirements for the content, detail and implementation of the program resides with the provincial authority. For the purpose of this contract the Health and Safety Program shall include a site-specific Health and Safety Plan that acknowledges, assesses and addresses the hazardous substances and/or hazardous conditions known and identified in paragraph 1.7 above, and on-going hazard assessments performed during the progress of work identifying and documenting new or potential health risks and safety hazards not previously known and identified.

.2 Provide one copy of the Health and Safety Program to the Queen's University Representative prior to commencement of work on the work site. The copy provided to the Queen's University Representative is for the purpose of review against the contract requirements related to the known hazardous substances and/or hazardous conditions.

The review is not to be construed to imply approval by the Queen's University Representative that the program is complete, accurate and legislatively compliant with the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act, and shall not relieve the Contractor of their legal obligations under such legislation.

1.10 ACCIDENT REPORTING

.1 Investigate and report incidents and accidents as required by Ontario Occupational Safety and Health Act, and the Regulations made pursuant to the Act.

.2 For the purpose of this contract immediately investigate and provide a report to the Queen's University Representative on incidents and accidents that involve:

.1 A resulting injury that may or may not require medical aid but involves lost time at work by the injured person(s).

.2 Exposure to toxic chemicals or substances.

.3 Property damage.

.4 Interruption to adjacent and/or integral infrastructure operations with potential loss implications.

.3 In the investigation and reporting of incidents and accidents, the Contractor is required to respond in a timely fashion to correct the action that was deemed to have caused the incident and/or accident and advise in writing on the action taken to prevent a re-occurrence of the incident and/or accident.

1.11 RECORDS ON SITE

.1 Maintain on site a copy of the safety documentation as specified in this section and any other safety related reports and documents issued to or received from the authorities having jurisdiction.

.2 Upon request, make copies available to the Queen's University Representative.

1.12 TRAFFIC CONTROL

.1 The Contractor shall provide a traffic management plan to the Queen's University Representative ten (10) working days prior to the start of construction showing the proposed traffic control at various stages of their operations. The traffic control plan shall be in the form of drawings and written description to indicate how the Contractor intents to control traffic through and around the work zone, based on the following criteria:

.1 Maintain one lane of traffic in all directions, with a minimum lane width of 3.5m during the period of 0800 to 1700 hours.

.2 The use of flag persons or temporary traffic signals to control traffic flow to a single lane will only be allowed based on the approval of the Queen's University Representative.

.3 The plan shall be in accordance with Ontario Traffic Manual (OTM) Book 7 – January 2014, Temporary Conditions.

END OF SECTION

1.1 GENERAL

.1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

.2 Prevent accumulation of wastes which create hazardous conditions.

1.2 MATERIALS

.1 Use only cleaning materials recommended by manufacturer for surface to be cleaned, and as recommended by cleaning material manufacturer.

1.3 CLEANING DURING CONSTRUCTION

.1 On a daily basis, maintain premises, including roofs, free from debris and waste materials.

.2 Remove waste materials and rubbish from site.

END OF SECTION

1.1 MANUAL

.1 An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual sections of Divisions 02 – 49.

.2 Submit complete "Operation and Maintenance (O&M) Manuals" to the Queen’s University Representative prior to application for Interim Certificate of Completion of project. The cost of the O&M Manuals will be shown as a separate item in the Cost Breakdown referred to in Section 01 05 00, paragraph 1.6.1.

1.2 GENERAL

.1 Assemble, coordinate, bind and index required data in Operation and Maintenance Manual.

.2 Submit two (2) paper copies and one electronic copy on DVD-RW in English.

.3 Organize data into same numerical order as contract specifications.

.4 Material: label each section with tabs protected with celluloid covers fastened to hard paper dividing sheets.

.5 Type lists and notes.

.6 Drawings, diagrams and manufacturer's literature must be legible.

.7 Where multiple items are shown on manufacture's literature mark out all items not included in the contract.

1.3 BINDERS

.1 Binders: vinyl, hard covered, 3 "D" ring, loose leaf, sized for 216 x 280 mm paper, with spine pocket.

.2 Identify contents of each binder on spine.

1.4 CONTENTS

.1 Binder :

- .1 Cover sheet containing:
  - .1 Date submitted.
  - .2 Project title, location and project number.
  - .3 Names and addresses of contractor, and all sub-contractors.
- .2 Table of contents.
- .3 List of maintenance materials.
- .4 List of special tools.
- .5 Warranties, guarantees.
- .6 Copies of approvals, and certificates.
- .7 Provide data as specified in individual sections of Divisions 02 to 49.
  - .1 List of equipment including service depot.
  - .2 Nameplate information including equipment number, make, size, capacity, model number and serial number.

.3 Parts list.

.4 Installation details.

.5 Operating instructions.

.6 Maintenance instructions for equipment.

.7 Maintenance instructions for finishes.

.2 Shop drawings:

.1 Bind separately one complete set of reviewed final shop drawings and product data.

END OF SECTION

1.1 RECORD DRAWINGS

.1 Queen's University Representative will provide two sets of white prints for record drawing purposes.

.2 Maintain project record drawings and record accurately deviations from contract documents.

.3 During construction, mark changes, in red ink, on one set of white prints.

.4 Record following information:

- .1 Field changes of dimensions and details.
- .2 Depths of various elements of foundation in relation to ground floor level.
- .3 Horizontal and vertical location of external, underground and aerial utilities referenced to exterior grading level.
- .4 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
- .5 Changes made by Change Order or Field Order.

.5 Record primary connections to Queen's University utilities on one set of white prints as the work is being completed, and make these prints available to the Queen's University Representative on demand.

.6 The record drawings will include a notation referencing building and services to a known geodetic benchmark.

.7 At completion of project and prior to final inspection, neatly transfer change notations to the second set of white prints and submit both sets to the Queen's University Representative.

.8 Submit both sets of Project Record Documents including a copy on DVD-RW to the Queen's University Representative prior to application for Interim Certificate of Completion of project. The cost of these documents shall be shown as a separate item in the Cost Breakdown referred to in Section 01 05 00.

.9 The contractor will be responsible for submitting red line drawings only to the consultant.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section includes the following:

.1 Demolition and removal of selected portions of interior building components and finishes.

.2 Repair procedures for selective demolition operations.

.2 This section does not include the following:

.1 Removal of hazardous materials or asbestos abatement.

.2 Demolition of structural elements.

.3 Mechanical or electrical equipment, except as required to make minor modifications to allow the work to be completed.

.3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this project; Contractor is required to develop these details further by submitting a demolition plan prepared by a professional engineer employed by the Contractor.

1.2 RELATED REQUIREMENTS

.1 Section 09 21 16 - Gypsum Board Assemblies

.2 Section 09 30 13 - Ceramic Tiling

.3 Section 09 51 13 - Acoustical Panel Ceilings

.4 Section 09 60 00 - Flooring

.5 Section 22 05 05– Selective Demolition for Plumbing

.6 Section 23 05 05– Selective Demolition for HVAC

.7 Section 26 05 05– Selective Demolition for Electrical

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)

.1 ANSI A10.8-2019, Scaffolding Safety Requirements

.2 American Society for Testing and Materials (ASTM):

.1 ASTM C475/C475M-17, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board

.3 CSA Group (CSA)

.1 CSA S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), 2019

.2 Canadian Environmental Protection Act (CEPA), 2021

.1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations

.2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34

.4 Motor Vehicle Safety Act (MVSA), 1995

.5 Hazardous Materials Information Review Act, 1985

.5 National Fire Protection Association (NFPA)

.1 NFPA 241 2022, Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.4 DEFINITIONS

.1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.

.2 Remove and Salvage: Detach items from existing construction and deliver them to Queen's University Representative.

.3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

.4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

.5 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate with Queen's University Representative for the material ownership as follows:

.1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Queen's property, demolished materials shall become Contractor's property and shall be removed from Project site.

.2 Coordinate selective demolition work so that work of this Section adheres to aesthetic criteria established by the Drawings and specified dimensions with all elements in planes as drawn, maintaining their relationships with all other building elements.

.2 Pre-Demolition Meeting: Convene pre-installation meeting 1 week prior to beginning work of this Section, with Contractor and Queen's University in accordance with Division 01 to:

.1 Confirm extent of salvaged and demolished materials

.2 Review Contractor's demolition plan

.1 Verify existing site conditions adjacent to demolition work

.2 Coordination with other construction sub trades

.3 Ensure key personnel, subcontractor representatives, project manager, and site supervisor attend.

.4 Queen's University Representative will provide written and verbal notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

1.6 ACTION AND INFORMATION SUBMITTALS

.1 Provide the following submittals before starting any work of this Section:

.1 Schedule of Selective Demolition Activities:

.1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

.2 Coordinate with Queen's University Representative for ongoing site operations and limit the number of interruptions during regular business hours.

.3 Interruption of utility services.

.4 Coordination for shutoff, capping, and continuation of utility services.

.2 Demolition Plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of Authority Having Jurisdiction, and as follows:

.1 Proposed Noise Control, Dust Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Queen's University reserves the right to make modifications where proposed methods interfere with the Queen's University ongoing operation.

.2 Inventory: Submit a list of items that have been removed and salvaged after selective demolition is complete.

.3 Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

.4 Pre demolition Photographs: Submit photographs indicating existing conditions of adjoining construction and site improvements prior to starting Work. Include finish surfaces that may be misconstrued as damage caused by selective demolition operations.

.2 Informational Submittals: Provide the following submittals when requested by the Queen's University Representative:

.1 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including, but not limited to, lists of completed projects with project names and addresses, names, and addresses of architects and owners, for work of similar complexity and extent.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Perform work as follows; use most restrictive requirements where differences occur between the municipal, provincial and federal jurisdictions:

.1 Provincial and Federal Requirements: Perform work in accordance with governing environmental notification requirements and regulations of the Authority Having Jurisdiction.

.2 Municipal Requirements: Perform hauling and disposal operations in accordance with regulations of Authority Having Jurisdiction.

.2 Qualifications: Provide proof of qualifications when requested by Queen's University Representative :

.1 Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project:

.1 Conform to the provincial Occupational Health and Safety Act and Regulation.

.2 Conform to Workers' Compensation Board Regulations.

.3 Conform to City of Petawawa bylaws and regulations governing this type of work.

1.8 SITE CONDITIONS

.1 Hazardous Substances: Hazardous Substances were present in building to be selectively demolished. A report on the presence of Hazardous Substances is attached as an information document to this Section for review and use:

.1 Examine report to become aware of locations where hazardous materials are present.

.2 Do not disturb Hazardous Substances or items suspected of containing Hazardous Substances.

.2 Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities and as follows:

.1 Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

.3 Storage or sale of removed items or materials on site will not be permitted.

.4 Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

.5 Maintain fire protection facilities in service during selective demolition operations.

.6 All hazardous materials must be abated by a licensed abetment contractor prior to any demolition work.

Part 2 Products

2.1 TEMPORARY SUPPORT STRUCTURES

.1 Design temporary support structures required for demolition work as necessary for the project using a qualified professional engineer registered or licensed in province of the Work.

2.2 DESCRIPTION

.1 This section of the Work includes, but is not necessarily limited to, the following:

- .1 Demolition, removal completely from site, and disposal of all identified components, materials, equipment and debris
- .2 Selective demolition to allow new walls, bulkheads, ceilings and other materials to meet existing construction as indicated
- .3 All material from demolition shall be removed from site immediately with no salvage, selling, sorting or burning permitted on site
- .4 Retain items indicated on drawings for re use in new construction

2.3 DEBRIS

.1 Make all arrangements for transport and disposal of all demolished materials from the site.

2.4 EQUIPMENT

.1 Provide all equipment required for safe and proper demolition of the building interiors and exterior indicated.

2.5 REPAIR MATERIALS

.1 Use repair materials identical to existing materials:

- .1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
- .2 Use a material whose installed performance equals or surpasses that of existing material.
- .3 Comply with material and installation requirements specified in individual Specification Sections.

.2 Floor Patching and Levelling Compounds: Cement based, trowel able, self levelling compounds compatible with specified floor finishes; gypsum-based products are not acceptable for work of this Section.

2.6 EXISTING MATERIALS

.1 Items to be retained for re use in new construction include, but are not limited to the following:

- .1 Fixed Auditorium Seating
- .2 Classroom Ceiling components

.3 Roof Top Vents

.4 Vertical blind vanes, and curtains and tracks

.5 Confirm with Queen's University Representative any materials that appear to be in re usable condition prior to disposal.

.6 Confirm with Queen's University Representative any materials scheduled for re use that are not in re usable condition prior to installation.

Part 3 Execution

3.1 EXAMINATION

.1 Verify that utilities have been disconnected and capped.

.2 Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

.3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

.4 Engage a professional engineer to survey condition of building when removing elements that may result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during demolition operations.

.5 Perform surveys as the work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

.1 Coordinate existing services indicated to remain and protect them against damage during selective demolition operations in accordance with Division 01.

.2 Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.

.3 Coordinate with Mechanical and Electrical Divisions for shutting off, disconnecting, removing, and sealing or capping utilities.

.4 Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

.1 Identify and mark all equipment and materials identified to be retained by Queen's University or to be re used in subsequent construction. Separate and store items to be retained in an area away from area of demolition and protect from accidental disposal.

.2 Post warning signs on electrical lines and equipment that must remain energized to serve other areas during period of demolition.

.3 Confirm that all electrical and telephone service lines entering the building are not disconnected.

.4 Do not disrupt active or energized utilities crossing the demolition site.

.5 Provide and maintain barricades, warning signs, protection for workmen and the public during the full extent of the Work. Read drawings carefully to ascertain extent of protection required.

.6 Mark all materials required to be re used, store in a safe place until ready for re installation.

.7 Adjust all junction boxes, receptacles and switch boxes flush with new wall construction where additional layers to existing construction are indicated.

.8 Remove permanent marker lines used or found on exposed surfaces and at surfaces indicated for subsequent finish materials. Mechanically remove permanent marker lines and associated substrates where permanent marker lines occur and patch surface. Sealing or priming over permanent marker lines is not acceptable.

3.4 CONCRETE SLAB REINFORCING

.1 Locate location of reinforcing steel in concrete slabs prior to cutting or coring using non-destructive, non ionizing radio frequency locators.

.2 Core concrete slabs to avoid reinforcing steel, electrical conduit or water pipes; adjust core location and coordinate with Engineer where slab features interfere with core drilling.

.3 Notify the Queen's University Representative immediately for further instructions where coring or cutting will damage existing slab features.

3.5 DEMOLITION

.1 Demolish and dismantle work in a neat and orderly manner and in strict accordance with all regulations.

.2 At end of each day's work, leave Work in safe condition so that no part is in danger of toppling or falling.

.3 Demolish in a manner to minimize dusting and to prevent migration of dust.

.4 Selling or burning of materials on the site is not permitted.

.5 Demolish existing resilient flooring and adhesive remnants as follows:

.1 Demolish existing resilient floor finishes, remove and dispose of off site.

.2 Remove adhesive to the greatest extent possible using scrapping tools and as follows:

.1 Do not use solvent based cleaners to remove adhesive remnants.

.2 Lightly shot blast or grind floor using machine designed for purpose to remove adhesive remnants.

.3 Vacuum floor ready for application of skim coating.

.4 Repair all slab depressions and damage with cementitious patching compound.

.5 Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials.

.3 Floor substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through resilient flooring materials and carpets.

.6 Demolish completely all ceiling panels as indicated.

3.6 CLEANING

.1 Clean in accordance with Section 01 74 13 - Cleaning. Keep area clean at the end of each day.

.2 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures. Label stockpiles, indicating material type and quantity.

.3 Separate and stockpile materials in neat and orderly fashion in location and as directed by the Queen's University Representative for alternate disposal. Stockpile materials in accordance with applicable fire and safety regulations.

.4 Remove stockpiles of like materials by alternate disposal option once collection of materials is complete.

.5 Divert excess materials from landfill to site approved by Queen's University Representative.

.6 Promptly as the Work progresses, and on completion, clean up and remove from the site all rubbish and surplus material. Remove rubbish resulting from demolition work daily.

.7 Maintain access to exits clean and free of obstruction during removal of debris.

.8 Keep surrounding and adjoining roads, lanes, sidewalks, municipal rights of way clean and free of dirt, soil or debris that may be a hazard to vehicles or persons.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 09 91 23 – Interior Painting

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM A 53/A 53M-20, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A307-21 , Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 CSA Group

.1 CSA G40.20-13 /G40.21-13(R2018) , General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA G164-18 , Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA S16:19 , Design of Steel Structures.

.4 CSA W48-18 , Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).

.5 CSA W59-18 , Welded Steel Construction (Metal Arc Welding) [Metric] .

.3 Green Seal Environmental Standards (GS)

.1 GS-11-2021 , Paints, Coatings, Stains and Sealers.

1.3 DESIGN CRITERIA

.1 Design hand railings, balustrades, guards, all connections to support minimum horizontal live load 0.75 kN/m (51.39 lbs/ft) or a concentrated load of 1.0 kN (224.8 lbs).

.2 Design hand railings, balustrades, guards, all connections to support minimum vertical live load 1.5 kN/m (102.78 lbs/ft).

.3 Design metal balustrades, railings and connections to NBC vertical and horizontal live load requirements.

.4 Detail railings to NAAMM Metal Stairs Manual fifth Edition 1992, NAAMM Commercial quality.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 23.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for pipe, sections, bolts, plates, and tubing and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS SDS in accordance with Division 01.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.5 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W.

.2 Structural steel rolled sections, plates: to CAN/CSA-G40.21, Grade 300W.

.3 Structural steel hollow sections: to CAN/CSA-G40.21, Grade 350W, Class C.

.4 Steel pipe: to ASTM A53/A53M standard weight , black finish.

.5 Welding materials: to CSA W59.

.6 Welding electrodes: to CSA W48 Series.

.7 Bolts and anchor bolts: to ASTM A307.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Exposed welds continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 SHOP PAINTING

.1 Primer: VOC limit 250 g/L maximum to GS-11.

.2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Paint when temperature minimum 7 degrees C.

.4 Clean surfaces to be field welded; do not paint.

2.4 PIPE RAILINGS

.1 Steel pipe railings, posts: nominal outside diameters indicated, formed to shapes and sizes as indicated, fully welded.

.2 Mounting base plates: minimum 6 mm thick mounting plates, sizes indicated, required, drilled for anchor bolts to concrete, welded construction.

.3 Sleeves: sized to accept rail posts.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for metal fabrications installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Consultant.

.2 Inform the Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions remedied and after receipt of written approval to proceed from the Consultant.

3.2 ERECTION - GENERAL

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to the Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CSA S16 and weld field connection as indicated.

.7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:

.1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 PIPE RAILINGS

.1 Install pipe railings as indicated to existing stairs.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 13.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 31 13 – Asphalt Shingle.

.2 Section 07 92 00 – Joint Sealants.

.3 Section 09 21 16 - Gypsum Board Assemblies.

.4 Section 09 22 16 – Non-Structural Metal Framing.

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM D1761-20, Standard Test Methods for Mechanical Fasteners in Wood.

.2 CSA Group (CSA)

.1 CSA B111-1974(R2003) , Wire Nails, Spikes and Staples.

.2 CSA O121-17, Douglas Fir Plywood.

.3 CSA O141:05(R2019), Softwood Lumber.

.4 CSA O151-17, Canadian Softwood Plywood.

.3 National Research Council Canada (NRC).

.1 National Building Code of Canada, latest edition.

.4 National Lumber Grades Authority (NLGA).

.1 Standard Grading Rules for Canadian Lumber 2017(R2019).

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 23 - Shop Drawings Product Data and Samples.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

.1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instruction. Replace defective or damaged materials with new.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 MATERIALS

.1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:

.1 CAN/CSA-O141.

.2 NLGA Standard Grading Rules for Canadian Lumber.

.3 CAN/CSA-Z809 or FSC or SFI certified.

.2 Furring, blocking, nailing strips, grounds, rough bucks, [cants,] curbs, fascia backing and sleepers:

.1 S2S is acceptable for

.2 Board sizes: "Standard" or better grade.

.3 Dimension sizes: "Standard" light framing or better grade.

.4 Post and timbers sizes: "Standard" or better grade.

.3 Panel Materials:

.1 Douglas fir plywood: to CSA O121, standard construction.

.2 Canadian softwood plywood: to CSA O151, standard construction.

.3 Fire retardant Canadian Softwood Plywood to CSA O151.

.4 Use pressure treated lumber materials when in contact with concrete, window framing or roof related work.

.5 Electrical equipment mounting boards: Douglas fir plywood, square edge 15.9 mm thick to CSA O121, standard construction. Treat plywood by pressure impregnation with fire-retardant chemicals in accordance with CSA-O80.27. Following treatment, kiln-dry material to maximum moisture content of 15%. Surface Burning classification to CAN/ULC S102. Flame Spread: 25 to ASTM E84. Each sheet of fire-retardant treated plywood to bear ULC label indicating classification.

.1 Fasteners for Fire Retardant Treated Plywood: Hot-Dipped zinc coated galvanized steel, stainless steel, silicon bronze or copper. Provide corrosion resistant fasteners as approved by lumber or plywood manufacturer. Minimum Hot Dip galvanized to ASTM A153/A153M. Hardware to ASTM A653/A653M, Class G185 galvanized.

2.2 ACCESSORIES

.1 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.2 Nails, spikes and staples: to ASTM F1667.

.3 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.

.4 Surface applied fire-retardant coating: meeting NFPA 703. Field applied single or multiple component, VOC free, colourless coating. Free of PDBE's, non-toxic, non combustible. Interior / exterior pyrolytic penetrating formulation. Proprietary product, containing polymers that create a weathertight bond to the molecular structure of wood. Purpose made for surface application to interior or exterior exposed wood surfaces to increase the natural Fire resistant properties. Permanent life expectancy when applied to interior wood. Meeting the following:

.1 To ASTM E84: "Class A" Flame Spread Rating of 25 or less and Smoke Developed Classification of 250 or less.

.2 To CAN/ULC S102. Flame Spread Rating of 25 or less and Smoke developed Classification of 200 or less.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Consultant.

.2 Inform the Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 PREPARATION

.1 Treat surfaces of material with wood preservative, before installation.

.2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and 1 minute soak on plywood.

3.3 INSTALLATION

.1 Comply with requirements of National Building Code of Canada (NBC), supplemented by the following paragraphs.

.2 Construct continuous members from pieces of longest practical length.

.3 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.

.4 Align and plumb faces of furring and blocking to tolerance of 1:600.

.5 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.6 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.

.7 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.8 Countersink bolts where necessary to provide clearance for other work.

.9 Install mechanical fasteners and secure members as required to obtain rigid and secure attachment. Apply continuous bead of adhesive in accordance with manufacturer's instructions where necessary and where fasteners alone are not sufficient.

.10 Fire Retardant Lumber and Plywood: Treat field cuts on members in accordance with manufacturer's written instructions. End cuts and drilling is permitted. Do NOT rip or otherwise mill treated lumber materials.

.11 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.

3.4 APPLICATION OF FIRE RETARDANT COATINGS

.1 Apply Fire Retardant Coatings in accordance with Manufacturer's written instructions. Apply in multiple coats as required to obtain specified Fire Ratings.

.2 Clean and prepare surfaces to obtain clear, clean, dry surfaces, free from oil, dust, dirt, grease and loose particles.

.3 Apply by brush, roller or airless spray to obtain 100% coverage.

.4 Apply 2 coats to achieve a minimum dry film thickness of 8 mils

3.5 CLEANING

.1 Clean in accordance with Section 01 74 13. Leave Work area clean at end of each day.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 10 00 - Rough Carpentry.

.2 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E814-13a (2017), Standard Test Method for Fire Tests of Penetration Firestop Systems.

.2 ASTM E2174-20a, Standard Practice for On-Site Inspection of Installed Fire Stops.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 National Building Code of Canada (NBC), latest edition.

.4 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S115-2018, Standard Method of Fire Tests of Firestop Systems.

1.3 DEFINITIONS

.1 Provide submittals in accordance with Section 01 33 23 - Shop Drawings Product Data and Samples.

.2 Product Data: Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria and limitations.

.3 Shop Drawings:

.1 Submit System Design listings, indicating ULC design number and including illustrations, applicable to each firestop configuration. Provide schedule indicating material to be used, building elements to be protected, hourly rating and appropriate references.

.2 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.

.4 Submit copies of WHMIS MSDS - Material Safety Data Sheets.

.5 Samples: Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.

1.4 PERFORMANCE CRITERIA

.1 Penetrations: Provide and install firestopping systems produced to resist the spread of fire, and the passage of smoke and other gases according to requirements indicated, including but not limited to the following:

.2 Firestop penetrations passing through fire resistance rated wall and floor assemblies and other locations as indicated on the drawings.

.3 Provide and install complete penetration firestopping systems that have been tested and approved by third party testing agency.

.4 Fire-Resistive Joints: Provide joint systems with fire-resistance ratings indicated, but not less than the fire-resistance rating of the construction in which the joint occurs.

.5 For firestopping exposed to view, traffic, moisture, and physical damage, provide appropriate firestop systems for these conditions.

1.5 QUALITY ASSURANCE

.1 Work is to be undertaken by experienced Site Supervisor in their trade of material or system being used. The contractor shall provide a list of not less than five (5) successfully completed projects of similar scale and type upon Queen's University Representative's request.

.2 All workers including the site supervisor shall be certified by the manufacturer of the products and systems proposed for the Installation of this product. Proof of this certification will be required after award of the project.

.3 Firestop sub-contractor to be a member of the Firestop Contractors International Association (FCIA) and be in good standing with this association. Contractor to provide after award of the project, proof of their association of the FCIA.

.4 Notify Consultant when completed installations are ready for inspection prior to concealing or enclosing area containing fire stopping materials. Allow forty-eight (48) hours for site review.

.5 Do not cover up firestopping installations until receipt of written notice from the Consultant.

.6 All firestopping to be a single source and installed by one contractor.

.7 Firestop installation must meet requirements of ASTM E2174 and ASTM E2393 tested assemblies.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instruction. Replace defective or damaged materials with new.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 MATERIALS

.1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.

.1 Asbestos -free materials and systems capable of maintaining an effective barrier against flame, smoke, gases and hose steam in compliance with requirements of CAN/ULC-S115 and not to exceed opening sizes for which they are intended.

.2 Colours:

.1 Firestopping: Red

.2 Smoke Seal: Grey

.2 Service penetration assemblies: systems tested to CAN-ULC-S115.

.3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.

.4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.10 Sealants for vertical joints: non-sagging.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 VERIFICATION OF CONDITIONS

.1 Examine condition of voids to be filled to ensure suitability for firestop systems.

.2 Verify installation of service penetrations and adjacent construction has been completed.

3.3 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

.1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation [without interruption to vapour barrier] .

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.4 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

3.5 SEQUENCES OF OPERATION

.1 Proceed with installation only when submittals have been reviewed by the consultant.

.2 Install floor fire stopping before interior partition erections.

.3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.

.4 Mechanical pipe insulation: certified fire stop system component.

.1 Ensure pipe insulation installation precedes fire stopping.

3.6 INSPECTION

.1 Notify the consultant when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.7 INDEPENDENT THIRD PARTY INSPECTION

.1 Field quality assurance is monitored by independent inspection. Independent inspection and testing of firestopping may be carried out by testing laboratory approved by the consultant.

.2 Independent third party inspection agency shall perform random observation reviews during construction and prior to closing off concealed areas. Observations shall be based on ASTM E2174 Standard Practice for on-site inspection of Installed Firestop Systems

and ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers. Notify the consultant a minimum 48-hours prior to requesting review.

.3 Upon completion of construction and prior to requesting Substantial Performance Review, Firestopping Sub-Trade and Manufacturer's Representative shall inspect firestopping work, prepare a deficiency list, and submit list to the consultant. Firestop Sub-Trade shall repair deficiencies and re-inspect work to ensure that deficiencies have been completed.

.4 Firestop Sub-Trade shall request Substantial Performance review of work once work is completed, inspected and identified with assembly identification penetration plates.

.5 During Substantial Performance Review, the Firestop sub-trade shall be present.

3.8 SCHEDULE

.1 Fire stop and smoke seal at:

.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

.2 Edge of floor slabs at curtain wall and precast concrete panels.

.3 Top of fire-resistance rated masonry and gypsum board partitions.

.4 Intersection of fire-resistance rated masonry and gypsum board partitions.

.5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

.7 Openings and sleeves installed for future use through fire separations.

.8 Around mechanical and electrical assemblies penetrating fire separations.

.9 Rigid ducts: greater than 129 cm^2: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.9 CLEANING

.1 Clean in accordance with Section 01 74 13. Keep area clean at the end of each day.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 08 11 00 – Metal Doors and Frames.

.2 Section 08 80 00 – Glazing.

.3 Section 09 21 16 – Gypsum Board Assemblies.

.4 Section 09 30 13 – Ceramic Tiling.

.5 Section 09 91 23 – Interior Painting

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM C919-19 , Standard Practice for Use of Sealants in Acoustical Applications.

.2 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-19.24-M90 , Multi-component, Chemical Curing Sealing Compound.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit product data in accordance with Section 01 33 23.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria and limitations.

.2 Manufacturer's product to describe: Caulking compound, Primers, Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets.

.4 Prior to commencement of the work, submit, for each type of sealant, a certificate signed by the sealant manufacturer which states:

.1 Surface preparation requirements.

.2 Priming and application procedures.

.3 Verification that sealant materials are selected for use from those specified.

.4 Verification that sealants are suitable for their locality, purposes intended and joint designs.

.5 Verification that sealants are compatible with other materials and products with which they come in contact, including but not limited to sealants provided under other Sections, and finishes.

.6 Verification that sealants will not stain the substrates or finished products.

.7 Verification that sealant is suitable for temperature and humidity conditions at the time of application.

1.4 QUALITY ASSURANCE

.1 The work of this Section shall be executed by someone whose primary business is in the application of caulking and sealants, using tradesmen skilled and trained in the techniques of caulking, and who are completely familiar with the published recommendations of the manufacturer of the caulking material being used.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instruction. Replace defective or damaged materials with new.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.6 SITE CONDITIONS

.1 Ambient Conditions:

.1 Proceed with installation of joint sealants only when:

.1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.

.2 Joint substrates are dry.

.3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Joint-Width Conditions:

.1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:

.1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Safety Data Sheets (SDS) acceptable to Health Canada.

Part 2 Products

2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

.3 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Urethane Sealant:

- .1 Multi component, chemically cured polyurethane, gun grade.
- .2 Classification:
  - .1 ASTM C-920, Type M, Grade NS, Class 50, use T, NT, M, A and O.
  - .2 CAN/CSA 19.24-M90 Type 11, Class B.
- .3 Colour: As selected by the Consultant from manufacturer's standard colours.
- .4 Use: for finished, interior, exterior areas in control joints, concrete, tile, and floors.

.2 Silicone Sealant:

- .1 Low modulus, high performance, one part moisture curing sealant.
- .2 Classification:
  - .1 ASTM C920, Type S, Grade NS, Class 100/50 use NT, M, G, A, and O.
  - .2 CAN/CGSB 19.13-M-87.
- .3 Colour: As selected by the Consultant from manufacturer's standard colours.
- .4 Use: for exterior, interior use on concrete, masonry, metals, glass, porcelain, control joints, and expansion joints.

.3 Latex Sealant:

- .1 Pure acrylic sealant, fast setting pliable seal, minimum shrinkage.
- .2 Classification:
  - .1 ASTM C834 Type OP
  - .2 CAN/CGSB 19 GP-17M
- .3 Colour: As selected by the Consultant from manufacturer's standard colours.
- .4 Use: for interior use in dry areas around windows, door frames, interior caulking to gypsum board, masonry, metals

.4 Mildew Resistant:

- .1 One-part, high modulus silicone, movement range to ±25%.
- .2 Classification:
  - .1 CAN/CGSB 19.22-M89

.3 Colour: As selected by the Consultant from manufacturer's standard colours.

.4 Use: for interior use in wet areas around plumbing fixtures, vanity tops, other counter surfaces.

.5 Acoustic Sealant:

.1 One component non-skimming, non-hardening synthetic rubber to meet the requirements of CAN/CGSB-19.0-M77.

.2 Maximum VOC content: 250 g/L (less water).

.3 ASTM-C919-08.

.4 Use: for sealing interior concealed joint to reduce air-born sound.

2.3 ACCESSORIES

.1 Primer: Type recommended by the sealant manufacturer and compatible with joint forming materials.

.2 Joint Cleaner: Non-corrosive and non-staining type recommended by sealant manufacturer and compatible with joint forming materials.

.3 Non-gassing Polyolefin Backer Rod: designed for use with cold-applied joint sealants.

.1 Comply with ASTM C1330.

.2 Size required for joint design to allow for 25% compression.

.4 Closed-Cell Polyethylene or Open Cell Polyurethane, Backer Rod: backer rod designed for use with cold-applied joint sealants for on-grade or below-grade applications.

.1 Comply with ASTM C1330.

.2 Size required for joint design to allow for 25% compression.

.5 Joint Filler: closed-cell polyethylene joint filler designed for use in cold joints, construction joints, or isolation joints wider than 1/4". Size required for joint design.

.6 Bond Breaker: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Consultant.

.2 Inform the Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

.1 Sealant:

.1 Apply sealant in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing:

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 13.

.1 Leave Work area clean at end of each day.

.2 Clean adjacent surfaces immediately.

.3 Remove excess and droppings, using recommended cleaners as work progresses.

.4 Remove masking tape after initial set of sealant.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by joint sealants installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 07 92 00 – Joint Sealants

.2 Section 08 71 00 – Door Hardware

.3 Section 09 21 16 – Gypsum Board Assemblies

.4 Section 09 22 16 – Non-Structural Metal Framing

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A653/A653M-17, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors.

.3 Canadian Standards Association (CSA International)

.1 CSA-G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA W59-18, Welded Steel Construction (Metal Arc Welding).

.4 Canadian Steel Door Manufacturers' Association (CSDMA)

.1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.

.2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 2009.

.5 National Fire Protection Association (NFPA)

.1 NFPA 80-2019, Standard for Fire Doors and Fire Windows.

.2 NFPA 252-2017, Standard Methods of Fire Tests of Door Assemblies.

.6 Underwriters' Laboratories of Canada (ULC)

.1 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.

.2 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.3 DESIGN REQUIREMENTS

.1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 NFPA 252 for ratings specified or indicated.

.2 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, ASTM E152, NFPA 252 and listed by nationally recognized agency having factory inspection services.

1.4 QUALITY ASSURANCE

.1 Manufacture fire door and frame components and assemblies to ULC/ULI/Warnock Hersey/Factory Mutual requirements.

.2 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to Authorities Having Jurisdiction, and as follows:

.1 Steel Fire Rated Doors and Frames: Labelled and listed by organization accredited by Standards Council of Canada for ratings specified or indicated.

.2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:

.1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by agency to individual manufacturers.

.2 Fabricate rated doors, frames, and screens to labelling authority standard.

.3 Affix appropriate label to each opening requiring indicating a labelling requirement.

1.5 SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 23 - Shop Drawings Product Data and Samples.

.2 Provide product data. Submit manufacturer's standard product literature on doors, frames and accessories.

.3 Provide shop drawings:

.1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, arrangement of hardware fire rating and finishes.

.2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings, reinforcing and fire rating finishes.

.3 .3 Location of hardware and rough-in of electrical conduit.

.4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

.5 Submit installation instructions.

1.6 QUALITY ASSURANCE

.1 Manufacture fire door and frame components and assemblies to ULC/ULI/Warnock Hersey/Factory Mutual requirements.

.2 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to Authorities Having Jurisdiction, and as follows:

.1 Steel Fire Rated Doors and Frames: Labelled and listed by organization accredited by Standards Council of Canada for ratings specified or indicated.

.2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:

.1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by agency to individual manufacturers.

.2 Fabricate rated doors, frames, and screens to labelling authority standard.

.3 Affix appropriate label to each opening requiring indicating a labelling requirement.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instruction. Replace defective or damaged materials with new.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 MATERIALS

.1 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDFMA Table 1 - Thickness for Component Parts.

.2 Reinforcement channel: to CAN/CSA-G40.21, Type 44W, coating designation to ASTM A653M.

2.2 DOOR CORE MATERIALS

.1 Honeycomb construction (interior):

.1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m3 minimum sanded to required thickness.

2.3 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.2 Polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

.3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PRIMER

.1 Touch-up prime CAN/CGSB-1.181. Maximum VOC limit 150 g/L to GC-11 for non-flat paint/primer.

2.5 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.

.2 Interior top and bottom caps: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

.4 Metallic paste filler: to manufacturer's standard.

.5 Fire labels: metal riveted.

.6 Sealant: As per Section 07 92 00 – Joint Sealants.

.7 Glazing: as per Section 08 80 50 – Glazing.

2.6 DOOR FRAMES FABRICATION

.1 Fabricate frames in accordance with CSDMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated.

.3 Interior frames: 1.6mm knocked-down type construction.

.4 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.5 Protect mortised cutouts with steel guard boxes.

.6 Prepare frame for door silencers, 3 for single door, 2 at head for double door.

.7 Manufacturer's nameplates on frames and screens are not permitted.

.8 Conceal fastenings except where exposed fastenings are indicated.

.9 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

.10 Insulate exterior frame components with polyurethane insulation.

2.7 DOOR FRAME ANCHORAGE

.1 Provide anchorage to floor and wall construction. Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.2 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

.3 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

.4 Conceal fastenings except where exposed fastenings are indicated.

2.8 FRAMES: KNOCKED-DOWN TYPE

.1 Ship knocked-down type frames unassembled.

.2 Provide frames with mechanical joints which inter-lock securely and provide functionally satisfactory performance when assembled and installed in accordance with CSDMA Recommended Installation Guide for Steel Doors and Frames.

.3 Securely attach floor anchors to inside of each jamb profile

2.9 DOOR FABRICATION

.1 Minimum door thickness: 45 mm.

.2 Interior doors: honeycomb construction.

.3 Fabricate flush steel doors, swing type. Door face sheets: Min 1.6mm (16 ga).

.1 Fabricate doors with vertical edges mechanically inter-locked and welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish with no visible edge seams.

.2 Provide inverted, recessed, flush, spot welded steel channel caps to top and bottom of doors. Spot welded in place.

.3 Weld hardware reinforcement plates in place.

.4 Provide cut-outs for openings. Reinforce perimeter of openings as required.

.5 Prepare doors to receive glazed panels as indicated. Provide removable stops.

.4 Prepare doors to receive hardware as specified in Section 08 71 00 - Door Hardware.

.1 Blank, reinforce, drill doors and tap for mortised, templated hardware. Prepare for electronic hardware.

.2 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.3 Reinforce doors where required, for surface mounted hardware.

2.10 HOLLOW STEEL CONSTRUCTION

.1 Form face sheets for interior doors from 1.6mm sheet steel.

.2 Reinforce doors with vertical stiffeners, securely welded to each face sheets at 150 mm on centre maximum.

.3 Fill voids between stiffeners of exterior doors with polyurethane core.

Part 3 Execution

3.1 EXAMINATION

.1 Prior to installation, remove temporary shipping spreaders.

.2 Prior to installation, the area of floor on which the frame is to be installed, and within the path of the door swing, shall be checked and corrected for flatness.

.3 Door and frame product shall be checked for correct size, swing, rating and opening number.

.4 The supplier shall be advised of any discrepancies prior to installation.

3.2 INSTALLATION

.1 Compliance: comply with supplier's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

.2 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.3 Install doors and frames to CSDMA Installation Guide.

.4 Frame Installation

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide temporary vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Allow for deflection of structure loads are not transmitted to frames.

.5 Apply sealant to perimeter of frames between frame and adjacent material.

.6 Adjust to provide a tight fit at contact points.

.7 Adjust for smooth operation and weathertight and secure enclosure.

.8 No site alterations to the factory fabricated units will be permitted.

.9 Installation tolerances of installed frame for squareness, alignment, twist and plumbness are to be no more than ± 1.5 mm in compliance with HMMA 841.

.5 Door Installation

.6 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.

.7 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

.1 Hinge side: 1.0 mm.

.2 Latch side and head: 1.5 mm.

.3 Finished floor, top of carpet, non-combustible sill and thresholds: 13 mm.

.8 Adjust operable parts for correct function.

3.3 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation. Fill exposed frame anchors surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.4 FINISH PAINTING

.1 Prepare metal frames to receive site application of primer and finish paint coatings as specified in Section 09 91 13 – Interior Painting.

.2 Field apply primer and finish paint coats to doors and frames as specified in Section 09 91 13 – Interior Painting. Apply final finish coat free of scratches or other blemishes.

3.5 CLEANING

.1 Cleaning: clean in accordance with Section 01 74 13. Leave Work area clean at end of each day.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Provide wood doors as noted in Door and Frame Schedule and as indicated.

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, including installation instructions, MSDS sheets, specifications and data sheets in accordance with Division 01.

.2 Indicate door core materials and construction; veneer species, type and characteristics.

.2 Shop Drawings:

.1 Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria.

.3 Manufacturer's Instructions:

.1 Indicate special installation instructions.

.2 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.4 Samples:

.1 Submit Samples in accordance with Division 01.

.2 Submit two (2) 150 mm x 150 mm stained wood veneer Samples with clear finish coats of each colour/finish specified.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

.1 Provide fire labeled frame products for those openings requiring fire protection ratings, as scheduled. Test products in strict conformance with ULC 104, or NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store materials in compliance with Division 01.

.2 Comply with manufacturer's recommendations for handling, storage and protection during installation.

.3 Label packages to include material name, production date and/or product code.

.4 Package, deliver and store doors in accordance with AWMAC Quality Standards.

.5 Storage and Protection:

.1 Protect doors from dampness. Doors to be wrapped and protected with packaging material. Arrange for delivery after Work causing abnormal humidity has been completed.

.2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.

.3 Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.5 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten years' experience.

1.6 QUALITY CONTROL

.1 Perform Work in accordance with AWMAC Quality Standards, Premium Grade.

.2 Obtain doors from single source.

1.7 SEQUENCING AND PHASING

.1 Coordinate the Work with door opening construction, door frame and door hardware installation.

1.8 WARRANTY

.1 Provide limited life time warranty on door construction from manufacturer.

Part 2 Products

2.1 FLUSH WOOD DOORS CONSTRUCTION

.1 Door Faces:

.1 3 mm Cherry wood veneer, 5-ply plywood plain sliced, uniform cherry, stain grade finish to AWMAC Grade AA face veneer, factory stained and clear coated.

.2 Door Core:

.1 Particle core: bonded and sanded solid particle board doors.

.2 Density: 448 -512 kg/m3 (28-32 lb/ft3)

.3 44 mm thick

.4 No added Urea-Formaldehyde (Type 1) adhesive

.3 Rails and Styles:

.1 Minimum 25 mm bonded hardwood, both inner and outer bands.
.2 Manufactured to ASTM D5456
.3 Finish on hardwood to match door faces.
.4 Total width stile: 105 mm, total width rail: 84 mm
.5 Lifetime anti-warping warranty

.4 STC Rating: Coordinate with Door Hardware for assembly STC rating.

.5 Factory Finish:
.1 Colour and sheen to be selected by Consultant from full colour range.

.6 Acceptable Products:
.1 Baillargeon/Masonite
.2 Boccam
.3 Lambton

2.2 FIRE RATED FLUSH WOOD DOORS – NOT USED

.1 45/60 Minute FRR Door with Agrifibre Core:
.1 Door Faces:
.1 3mm wood veneer, 3-ply plywood plain sliced, uniform Cherry, stain grade finish to AWMAC Grade AA face veneer,
.2 factory stained and clear coated.
.2 Acceptable Products:
.1 Baillargeon / Masonite Doors,
.2 Boccam Doors,
.3 Lambton Doors

2.3 ACCESSORIES

.1 Glass and Glazing: Types as scheduled; to Section 08 80 00 Glazing.

.2 Glazing beads: rolled steel, mitered corners; prepared for countersink style tamper proof screws. Factory painted; colour by Consultant.

Part 3 Execution

3.1 EXAMINATION

.1 Verify that opening sizes and tolerances are acceptable.

.2 Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 PREPARATION OF SUBSTRATE

.1 Door frames to be plumb and true before doors are installed. Make good any unacceptable frames.

3.3 INTERFACE WITH OTHER SYSTEMS

.1 Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware.

.2 Provide solid blocking for through bolted hardware.

.3 Provide lock blocks at lock edge and top of door for closer and for hardware reinforcement.

.4 Factory Preparation for Light Openings and Louvers: Cut and trim openings through doors to comply with NFPA 80 requirements where indicated; maintain door manufacturer's warranty.

.5 Coordinate installation of glass and glazing.

.6 Provide edge clearances in accordance with AWMAC standards.

3.4 INSTALLATION

.1 Install fire rated and non-rated doors in accordance with AWMAC Quality Standard and NFPA 80 requirements.

.2 Machine cut for hardware.

.3 Coordinate installation of doors with installation of steel frames and door hardware.

.4 Install doors and hardware in accordance with manufacturer's printed instructions.

.5 Conform to AWMAC requirements for fit and clearance tolerances, and maximum diagonal distortion.

3.5 PROTECTION

.1 Protect wood door finish during door hardware installation.

.2 Protect wood door from damage from accidental damage from moving items and finishing Work being done at job completion.

3.6 ADJUSTMENT

.1 Re-adjust doors just prior to completion of building to function freely and properly.

.2 Adjust door for smooth and balanced door movement.

.3 Adjust closer for full closure.

3.7 CLEANING

.1 Perform cleaning to remove accumulated construction dust and debris.

.2 Remove traces of primer, caulking; clean doors and frames.

.3 On completion of installation, remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 08 11 00 – Metal Doors and Frames.

.2 Section 08 14 16 – Flush Wood Doors and Frames.

.3 Division 26 for power to door operator.

1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)

.1 ANSI/BHMA A156.1-2021, American National Standard for Butts and Hinges.

.2 ANSI/BHMA A156.2-2017, Bored and Preassembled Locks and Latches.

.3 ANSI/BHMA A156.3-2020, Exit Devices.

.4 ANSI/BHMA A156.4-2019, Door Controls - Closers.

.5 ANSI/BHMA A156.5-2020, Standard for Cylinders and Input Devices for Locks.

.6 ANSI/BHMA A156.6-2021, Architectural Door Trim.

.7 ANSI/BHMA A156.8-2021, Door Controls - Overhead Stops and Holders.

.8 ANSI/BHMA A156.10-2017, Power Operated Pedestrian Doors.

.9 ANSI/BHMA A156.12-2018, Interconnected Locks and Latches.

.10 ANSI/BHMA A156.13-2017, Mortise Locks and Latches Series 1000.

.11 ANSI/BHMA A156.14-2019, Sliding and Folding Door Hardware.

.12 ANSI/BHMA A156.15-2021, Release Devices - Closer Holder, Electromagnetic and Electromechanical.

.13 ANSI/BHMA A156.16-2018, Auxiliary Hardware.

.14 ANSI/BHMA A156.17-2019, Self-closing Hinges and Pivots.

.15 ANSI/BHMA A156.18-2020, Materials and Finishes.

.16 ANSI/BHMA A156.19-2019, Power Assist and Low Energy Power - Operated Doors.

.17 ANSI/BHMA A156.20-2021, Strap and Tee Hinges and Hasps.

.2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)

.1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 23.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.

.4 After approval samples will be returned for incorporation in Work.

.4 Hardware List:

.1 Submit contract hardware list.

.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

.5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Division 01 .

.2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:

.1 Supply maintenance materials in accordance with Section 01 78 23.

.2 Tools:

.1 Supply 2 sets of wrenches for exit hardware, door closers, and locksets.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements:

.1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.4 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect door hardware from nicks, scratches, and blemishes.

.3 Protect prefinished surfaces with wrapping.

.4 Replace defective or damaged materials with new.

Part 2 Products

2.1 HARDWARE ITEMS

.1 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

.1 Butts and hinges:

.1 Butts and hinges: to ANSI/BHMA A156.1, Grade 1, designated by letters SL and numeral identifiers, followed by size and finish, listed in Hardware Schedule.

.2 Exit devices: to ANSI/BHMA A156.3, Grade 1, Type 1.

.1 Auxiliary items: door co-ordinator, type 21, for pairs of doors with overlapping astragals.

.3 Door Closers and Accessories:

.1 Door controls (closers): to ANSI/BHMA A156.4, Grade 1.

.2 Overhead Stops: to ANSI/BHMA A156.8-2005, Grade 1.

.3 Door co-ordinator: surface for pairs of doors with overlapping astragal.

.4 Door Operators:

.1 Power-operated pedestrian doors: to ANSI/BHMA A156.10.

.2 Power assist and low energy power operated doors: to ANSI/BHMA A156.19.

.5 Thresholds: 152mm mill finish, extruded aluminum surface, serrated , with thermal break door seal insert]

.6 Barrier Free Pneumatic Door Operator:

.1 Heavy duty pneumatically assisted door closer, capable of multi-door operation, complete with actuators, control boxes, pneumatic tubing and compressed air source.

.2 Self contained control box/compressor combination for independent operation of two door leaves.

.3 Control boxes: complete with electric strike relay.

.4 Mount operators on either push or pull sides of doors as required to place them inside rooms.

.5 Actuation of operators by push button.

.6 Electrical box and actuator: Hardwired low voltage actuator with stainless steel 114 mm round plate, engraved blue filled with handicap symbol. Box 51 mm

wide x 102 mm high x 50 mm deep single gang electrical box, flush mounted in wall, locations indicated.

.7 Supply switched line voltage to control box. Locate switch adjacent to box.

.8 Supply low voltage wiring to each actuator and 6 mm diameter air tubing to each operator.

.9 Mount control box in location as directed by Queen’s University Representative.

2.3 FASTENINGS

.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.3 Exposed fastening devices to match finish of hardware.

.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.5 Use fasteners compatible with material through which they pass.

2.4 KEYING

.1 Doors, padlocks and cabinet locks to be keyed alike to existing master keyed as directed by Queen’s University representative. Prepare detailed keying schedule in conjunction with Queen’s University Representative.

.2 Supply keys in duplicate for every lock in this Contract.

.3 Supply 3 master keys for each master key or grand master key group.

.4 Stamp keying code numbers on keys and cylinders.

.5 Supply construction cores.

.6 Hand over permanent cores and keys to Queen’s University Representative.

Part 3 Execution

3.1 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.3 Supply manufacturers' instructions for proper installation of each hardware component.

.4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).

.5 Where door stop contacts door pulls, mount stop to strike bottom of pull.

.6 Install key control cabinet.

.7 Use only manufacturer's supplied fasteners.

.1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

.8 Remove construction cores when directed by Queen's University Representative.

.1 Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING

.1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.

.2 Lubricate hardware, operating equipment and other moving parts.

.3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 13.

.1 Leave Work area clean at end of each day.

.2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.

.3 Remove protective material from hardware items where present.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.

3.4 DEMONSTRATION

.1 Maintenance Staff Briefing:

.1 Brief maintenance staff regarding:

.1 Proper care, cleaning, and general maintenance of projects complete hardware.

.2 Description, use, handling, and storage of keys.

.3 Use, application and storage of wrenches for door closers, exit hardware and locksets.

.2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by door hardware installation.

3.6 SCHEDULE

.1 Hardware Group #1 (confirm swing on Door Schedule)

3	Standard Hinge	Ives 5BB1HW 4 1/2" x 4" 652 NRP	652
1	Classroom Lockset	Schlage L9070 P6 03B 626	626
1		Medeco Cylinder by Queen's University	
1	Surface Closer	LCN 4040XP H 689 44	689
1	Kick Plate	Ives 8400 C32D B-CS 8 x 36	C32D
1	Wall Door Stop	Ives WS406/407CVX C32D	C32D
1	Gasketing	Draftseal DSS99D20	D
1	Surface Auto Door Bottom K.N. Crowder CT-52F-CA x 38"		CA

.2 Hardware Group #2 (confirm swing on Door Schedule)

6	Standard Hinge	Ives 5BB1HW 4 1/2" x 4" 652 NRP	652
1	Manual Flush Bolt	Ives FB458 C26D	C26D
		Top Bolt Only	
1	Storeroom Lockset	Schlage L9080 P6 03B 626	626
1		Medeco Cylinder by Queen's University	
2	Surface Closer	LCN 1461 HCUSH 689 FPC 44	689
2	Kick Plate	Ives 8400 C32D B-CS 8 x 36	C32D
1	Gasketing	Draftseal DSS99D20	D
2	Surface Auto Door Bottom K.N. Crowder CT-52F-CA x 38"		CA
1	Astragal (2 pieces)	K.N. Crowder W-25 x 84"	

.3 Hardware Group #3 (confirm swing on Door Schedule)

3	Standard Hinge	Ives 5BB1HW 4 1/2" x 4" 652 NRP	652
1	Storeroom Lockset	Schlage L9080 P6 03B 626	626
1		Medeco Cylinder by Queen's University	
1	Surface Closer	LCN 4040XP H 689 44	689
1	Kick Plate	Ives 8400 C32D B-CS 8 x 36	C32D
1	Wall Door Stop	Ives WS406/407CVX C32D	C32D

.4 Hardware Group #4 (confirm swing on Door Schedule)

3	Standard Hinge	Ives 5BB1HW 4 1/2" x 4" 652 NRP	652
1	Power Transfer	Von Duprin EPT-10-689	689
1	Classroom Lockset	Schlage L9070 P6 03B 626	626
1		Medeco Cylinder by Queen's University	
1	Electric Strike	HES 1006CLB-630	630
1	Bridge Rectifier	HES 2005M3	
1	Door Operator	Hunter HA-8 x PULL	CL
2	Actuator	Camden CM-35N	630
1	Wall Door Stop	Ives WS406/407CVX C32D	C32D
1	Kick Plate	Ives 8400 C32D B-CS 12 x 36	C32D
1	Gasketing	Draftseal DSS99D20	D
1	Surface Auto Door Bottom K.N. Crowder CT-52F-CA x 38"		CA
1	Power Supply Schlage PS902 900-2RS		
1		Card Reader (refer to project cost allowances)	
1		Door Contact (refer to project cost allowances)	

MODE OF OPERATION:
- DOOR ALWAYS LOCKED
- PRESENT CREDENTIAL TO MOMENTARALY UNLOCK DOOR OR POWER UP OUTSIDE ACTUATOR.
- INSIDE ACTUATOR ALWAYS POWERED-UP TO EGRESS.
- WHEN REQUIRED, ELECTRIC STRIKE CAN REMAIN 'UNLOCK' BY ACCESS CONTROL SCHEDULE
- ELECTRIC STRIKE POWERED BY POWER SUPPLY
- ACCESS CONTROL CONNECTED TO DRY INPUT RELAY OF POWER SUPPLY

.5 Hardware Group #5 (confirm swing on Door Schedule)

6	Standard Hinge	Ives 5BB1HW 4 1/2" x 4" 652 NRP	652
1	Power Transfer	Von Duprin EPT-10-689	689
1	Classroom Lockset	Schlage L9070 P6 03B 626	626
2		Medeco Cylinder by Queen's University	
1	Door Operator	Hunter HA-8 x PUSH	CL
2	Actuator	Camden CM-35N	630

1 Surface Closer	LCN 4040XP XLONG 689 44	689
	Top Jamb Mount	
1 Mounting Plate	LCN 4040XP-18TJ 689	689
2 Overhead Door Stop	Glynn-Johnson 104S C32D	C32D
2 Kick Plate	Ives 8400 C32D B-CS 12 x 36	C32D
1 Gasketing	Draftseal DSS99D20	D
2 Surface Auto Door Bottom	K.N. Crowder CT-52F-CA x 38"	CA
1 Astragal (2 pieces)	K.N. Crowder W-25 x 84"	

.6 Hardware Group #6 (Reserved)

.7 Hardware Group #7 (confirm swing on Door Schedule)

3	Standard Hinge	Ives 5BB1HW 4 1/2" x 4" 652 NRP	652
1	Power Transfer	Von Duprin EPT-10-689	689
1	Storeroom Lockset	Schlage L9080 P6 03B 626 XL11-422	626
1		Medeco Cylinder by Queen's University	
1	Electric Strike	HES 1006CLB-F-630	630
1	Door Operator	Hunter HA-8 x PULL	CL
1	Door Sensor	Entrex OA-Edge 1 Installed on pull side	
1	Overhead Door Stop	Glynn-Johnson 104S C32D ADJ	C32D
1	Kick Plate	Ives 8400 C32D B-CS 12 x 36	C32D
1	Gasketing	Draftseal DSS99D20	D
1	Surface Auto Door Bottom	K.N. Crowder CT-52F-CA x 38"	CA
1	Washroom Package	Camden CW-WC13XSM	
1	Emergency Call Kit	Camden CX-WEC10	
1	Power supply	Camden CX-33-PS	

MODE OF OPERATION:
- ALWAYS UNLOCK UNLESS PUSH TO LOCK ACTUATOR IS ACTIVATED
- ON ACTIVATION OF PUSH TO LOCK, OCCUPENCY LIGHT TURN RED AND OUTSIDE ACTUATOR POWERS DOWN
- USE OF EMERGENCY CALL ACTIVATES VISUAL AND AUDIBLE ALARM AND UNLOCK DOOR FOR ASSISTANCE
- TO EXIT, USE THE INSIDE ACTUATOR OR LOCKSET LEVER
- ELECTRIC STRIKE & WASHROOM PACKAGE POWERED BY POWER SUPPLY

- ENSURE THAT THE WASHROOM LOCKING DEVICE THAT CONNECTS TO THE POWER DOOR OPERATOR LOCK BUTTON DOES NOT HAVE A TIMER AUTOMATICALLY SET TO UNLOCK THE ROOM.
- NO TIMER IS PREFERRED. IF A TIMER IS SET TO UNLOCK THE DOOR LOCK AT 30 MINUTES, FOR EXAMPLE, A SIGN NEEDS TO BE POSTED TO INDICATE THAT THE DOOR WILL UNLOCK AUTOMATICALLY AFTER 30 MINUTES ONCE THE LOCK BUTTON IS PRESSED. THIS SIGNAGE, INCLUDING GRADE 1 BRAILLE CONVEYING THIS MESSAGE, WILL NEED TO BE POSTED JUST ABOVE THE DOOR LOCK BUTTON.

.8 Hardware Group #8 (confirm swing on Door Schedule)

1. Eclisse Single Pocket Door 1000 x 2100 for stud wall, glazed door with key lock from ECLISSE North America, LLC
2. Hardware finish – Satin Chrome

.9 Hardware Group #9 (confirm swing on Door Schedule)

3	Standard Hinge	Ives 5BB1HW 4 1/2" x 4" 652 NRP	652
1	Power Transfer	Von Duprin EPT-10-689	689
1	Storeroom Lockset	Schlage L9080 P6 03B 626 XL11-422	626
1		Medeco Cylinder by Queen's University	
1	Electric Strike	HES 1006CLB-630	630
1	Bridge Rectifier	HES 2005M3	
1	Door Operator	Hunter HA-8 x PULL	CL
2	Actuator	Camden CM-35N	630
1	Kick Plate	Ives 8400 C32D B-CS 12 x 36	C32D
1	Wall Door Stop	Ives WS406/407CVX C32D	C32D
1	Gasketing	Draftseal DSS99D20	D
1	Surface Auto Door Bottom	K.N. Crowder CT-52F-CA x 38"	CA

.10 Hardware Group #10 (frames different than Hardware Group #9, confirm swing on Door Schedule)

3	Standard Hinge	Ives 5BB1HW 4 1/2" x 4" 652 NRP	652
1	Power Transfer	Von Duprin EPT-10-689	689

1	Storeroom Lockset	Schlage L9080 P6 03B 626 XL11-422	626
1		Medeco Cylinder by Queen's University	
1	Electric Strike	HES 1006CLB-630	630
1	Bridge Rectifier	HES 2005M3	
1	Door Operator	Hunter HA-8 x PULL	CL
2	Actuator	Camden CM-35N	630
1	Kick Plate	Ives 8400 C32D B-CS 12 x 36	C32D
1	Wall Door Stop	Ives WS406/407CVX C32D	C32D
1	Gasketing	Draftseal DSS99D20	D
1	Surface Auto Door Bottom	K.N. Crowder CT-52F-CA x 38"	CA

.11 Hardware Group #11 (confirm swing on Door Schedule)

3	Standard Hinge	Ives 5BB1HW 4 1/2" x 4" 652 NRP	652
1	Lockset	Schlage B571 Deadbolt Occupancy IND X Thumbturn	626
1	Surface Closer	LCN 4040XP H 689 44	689
1	Kick Plate	Ives 8400 C32D B-CS 8 x 36	C32D
1	Wall Door Stop	Ives WS406/407CVX C32D	C32D
1	Entrance Handle	Schlage Dego Entrance Handle 325mm	626

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 92 10 - Joint Sealing.

.2 Section 08 14 16 – Flush Wood Doors.

.3 Section 10 28 00 – Toilet and Bath Accessories.

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM C542-05(2017) , Standard Specification for Lock-Strip Gaskets.

.2 ASTM D790-17 , Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

.3 ASTM D1003-21 , Standard Test Method for Haze and Luminous Transmittance of Plastics.

.4 ASTM D1929-20, Standard Test Method for Determining Ignition Temperature of Plastics.

.5 ASTM D2240-15(2021) , Standard Test Method for Rubber Property - Durometer Hardness.

.6 ASTM E84-21a, Standard Test Method for Surface Burning Characteristics of Building Materials.

.7 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.8 ASTM F1233-08(2019) , Standard Test Method for Security Glazing Materials and Systems.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-12.1-2017 , Safety Glazing.

.2 CAN/CGSB-12.2-M91(R2017) , Flat, Clear Sheet Glass.

.3 CAN/CGSB-12.3-M91(R2017) , Flat, Clear Float Glass.

.4 CAN/CGSB-12.4-M91(R2017) , Heat Absorbing Glass.

.5 CAN/CGSB-12.8-2017, Insulating Glass Units.

.3 Underwriters Laboratories (UL)

.1 UL 2761, Sustainability for Sealants and Caulking Compounds.

.4 Glass Association of North American (GANA)

.1 GANA Glazing Manual - 2008 .

.2 GANA Laminated Glazing Reference Manual - 2009 .

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2017 , Adhesives and Sealants Applications.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with the Consultant in accordance with Division 01 to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's written installation instructions and warranty requirements.

.2 Arrange for site visit with Queen’s University Representative prior to start of Work to examine existing site conditions adjacent to demolition Work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 23.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings indicating window assembly.

.4 Samples: Submit duplicate 300 x 300 mm size samples of patterned glass and window film applied to specified materials.

.5 Manufacturer's Instructions: Submit manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Provide maintenance data including cleaning instructions and maintenance data for incorporation into manual specified in Division 01.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect glazing and frames from nicks, scratches, and blemishes.

.3 Protect prefinished aluminum surfaces with wrapping.

.4 Replace defective or damaged materials with new.

1.7 AMBIENT CONDITIONS

.1 Ambient Requirements:

.1 Install glazing when ambient temperature is 10 degrees C minimum. Maintain ventilated environment for 24 hours after application.

.2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

Part 2 Products

2.1 MATERIALS

.1 Design Criteria:

.1 Ensure continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:

.1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

.2 Limit glass deflection to 1/200 with full recovery of glazing materials.

.3 Meet the applicable standard listed below.

.1 Label each glass lite in accordance with applicable CGSB Standard.

.2 Flat Glass:

.1 Float glass: to CAN/CGSB-12.3.

.2 Safety glass: to CAN/CGSB-12.1, Type 2-tempered.

.3 Acid etched glass: 6.0 mm thick. Fabricated from clear float glass.

.1 Visible light transmittance: 91%.

.2 Reflectance 1: 7%.

.3 Reflectance 2: 9%.

.4 Daylight Diffusion:

.1 Total Luminous transmittance: 82.5%.

.2 Diffuse transmittance: 75.09 %.

.3 Haze: 90.73%.

.4 Mirrors: to CAN/CGSB-12.5, Type 1A; One-piece, dimensions as indicated in Section 10 28 00 x 6mm thickness.

.5 Insulating glass unit: to CAN/CGSB-12.8.

.6 Low emissivity (LOW E) glass, glass type as specified in glazing schedule.

.1 Metallic coating: soft, sputtered.

.2 Properties (based upon two 6 mm lites clear glass, argon fill, Low-E coating on 2nd surface).

.3 Light transmittance: 69% ± 1%.

.4 Shading co-efficient: 0.45 ± 0.01.

.5 Solar heat gain coefficient: 0.39 ± 0.01.

.6 U-Value: (night time/winter): 0.24 ± 0.01.

.3 Sealant:

.1 Acrylic sealant: to CAN/CSGB 19-GP-5M, gun grade, colour to be selected by the Consultant.

2.2 ACCESSORIES

.1 Setting blocks: neoprene, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.

.2 Glazing tape:

.1 Preformed butyl compound, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; colour to match to frame.

.3 Primer, sealers, cleaners: to manufacturer's standard.

.4 Mirror attachment accessories:

.1 Mirror frames: see Section 10 28 00.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.

.1 Verify that openings for glazing are correctly sized and within tolerance.

.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

.3 Visually inspect substrate in presence of the Consultant.

.4 Inform the Consultant of unacceptable conditions immediately upon discovery.

.5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 PREPARATION

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION: EXTERIOR - DRY METHOD

.1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Perform work in accordance with GANA Glazing Manual for glazing installation methods.

.3 Cut glazing tape to length; install on glazing light. Seal corners by butting tape and sealing junctions with sealant.

.4 Place setting blocks at 1/3 points, with edge block maximum 150 mm from corners.

.5 Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

.6 Install removable stops without displacing glazing tape. Exert pressure for full continuous contact.

.7 Trim protruding tape edge.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 13 .

.1 Leave Work area clean at end of each day.

.1 Remove traces of primer, caulking.

.2 Remove glazing materials from finish surfaces.

.3 Remove labels.

.4 Clean glass and mirrors using approved non-abrasive cleaner in accordance with manufacturer's instructions.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 After installation, mark each light with an "X" by using removable plastic tape or paste.

.1 Do not mark heat absorbing or reflective glass units.

.3 Repair damage to adjacent materials caused by glazing installation.

3.6 SCHEDULE

.1 Supply glass for the following, installation under respective sections:

.1 Flush wood doors and frames:

.1 Safety glass: to CAN/CGSB-12.1, Type 2-tempered, 6 mm thick clear.

.2 Mirrors: Refer to drawings and Section 10 28 00 for sheet mirror sizes and locations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 07 92 00 – Joint Sealants

.2 09 22 16 – Non-Structural Metal Framing

.3 09 30 13 – Ceramic Tiling

.4 09 91 23 – Interior Painting

1.2 REFERENCE STANDARDS

.1 Aluminum Association (AA)

.1 AA DAF 45-03(R2009) , Designation System for Aluminum Finishes.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM C423-23. Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

.2 ASTM C475/C475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.3 ASTM C514-04(2020) , Standard Specification for Nails for the Application of Gypsum Board.

.4 ASTM C557-03(2017) , Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.

.5 ASTM C840-20 , Standard Specification for Application and Finishing of Gypsum Board.

.6 ASTM C954-18 , Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

.7 ASTM C1002-20, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.8 ASTM C1047-19, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.9 ASTM C1177/C1177M-17 , Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.10 ASTM C1178/C1178M-18 , Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.

.11 ASTM C1280-18, Standard Specification for Application of Gypsum Sheathing.

.12 ASTM C1396/C1396M-17, Standard Specification for Gypsum board.

.3 Association of the Wall and Ceilings Industries International (AWCI)

.1 AWCI Levels of Gypsum Board Finish-GA-214-2015.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 23.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit gypsum board assembly drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Indicate components such as fastener type, dimensions, spacing and locations at gypsum board edges, ends and in field of board as well as installation methods. Components and work to confirm to ASTM C 840 standard specification for application and finishing of gypsum board.

.3 Indicate type of joint compound, and number of joint compound layers.

.4 Indicate number and location of electrical boxes for wall and ceiling.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address and applicable standard designation.

.3 Exercise care in unloading gypsum board materials shipment to prevent damage.

.4 Storage and Handling Requirements in accordance with ASTM C 840–16:

.1 Store gypsum board assemblies materials level flat in dry location indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.

.3 Protect gypsum board from direct exposure to rain, snow, sunlight, or other excessive weather conditions.

.4 Protect ready mix joint compounds from freezing, exposure to extreme heat and direct sunlight.

.5 Protect from weather, elements and damage from construction operations.

.6 Handle gypsum boards to prevent damage to edges, ends or surfaces.

.7 Replace defective or damaged materials with new.

1.5 AMBIENT CONDITIONS

.1 Maintain temperature 10 °C minimum, 21 °C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.

.2 Apply board and joint treatment to dry, clean, frost free surfaces.

.3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 Products

2.1 MATERIALS

.1 Standard board: to ASTM C1396/C1396M–14 regular, Type X, 15.9mm thick , 1200 mm wide x maximum practical length, ends square cut, edges squared cut, edges bevelled.

.2 Water-resistant board: to ASTM C1396/C1396M—14 Type X, 15.9 mm thick regular, 1200 mm wide x maximum practical length, ends square cut, edges squared cut, edges bevelled.

.3 Metal furring runners, hangers, tie wires, inserts, and anchors: to : to CSA A82.30-M1980, 1.27 mm galvanized, soft annealed steel wire ties, 1 1/2" cold rolled steel channel runners, 4.75 mm diameter, zinc coated, mild steel pencil rod hangers, 19 mm U-bar shaped 0.56mm galvanized steel, knurled face furring channels.

.4 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.5 Steel drill screws: to ASTM C1002-14.

.6 Steel drill screws for application of gypsum board into heavier gauge steel studs: to ASTM C954.

.7 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated by electrolytic process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.8 Sealants: in accordance with Section 07 92 00- Joint Sealants .

.9 Polyethylene: to CAN/CGSB-51.34, Type 2.

.10 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.

.11 Foam gasket: continuous polyethylene foam strip gasket from full length roll 6 mm thick x 89 or 140 mm wide to suit stud dimensions. Designed to inhibit air and moisture penetration with RSI rating of 0.87 per 25 mm.

.12 Joint compound: to ASTM C475, asbestos-free.

.13 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.14 Acoustic insulation: mineral wool batts, minimum density 40 kg/m3, material achieving NRC 1.05 at 75 mm thickness when measured to ASTM C423.

.15 Acoustic putty for partitions: Class A fire resistant with flame spread rate of 15 or less to CAN/ULC - S102, minimum tensile strength 900 kPa. Apply in accordance with board manufacturer installation directions.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assembly's installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Consultant.

.2 Inform the Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 ERECTION

.1 Do application and finishing of gypsum board to ASTM C840-16 except where specified otherwise.

.2 Do application of gypsum sheathing to ASTM C1280-13a.

.3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840-16 except where specified otherwise.

.4 Below bottom tracks install foam gasket, continuous with no gaps. Install additional gasket or bead of sealant to gaps where surface imperfections result in ono-contact between the slab and the foam. Install sufficient fasteners to ensure continuous gasket contact and compression.

.5 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.6 Install work level to tolerance of 1:1200.

.7 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers and grilles.

.8 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

.9 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.10 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

.11 Install wall furring for gypsum board wall finishes to ASTM C840–16, except where specified otherwise.

.12 Furr openings and around built-in equipment, cabinets, and access panels.

.13 Furr duct shafts, beams, columns, pipes, and exposed services where indicated.

3.3 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.

.2 Apply single layer gypsum board to furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.

.3 Apply water-resistant gypsum board where wall tiles to be applied adjacent to slop sinks janitors closets. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

.4 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes and ducts.

.5 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

.6 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.7 Install gypsum board with face side out.

.8 Do not install damaged or damp boards.

.9 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre] .

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.5 Construct control joints of [two back-to-back casing beads] [preformed units] set in gypsum board facing and supported independently on both sides of joint.

.6 Provide continuous polyethylene dust barrier behind and across control joints.

.7 Locate control joints at changes in substrate construction and at approximate 15 m spacing on ceilings or 10m spacing on long corridor runs.

.8 Install control joints straight and true.

.9 Ensure that screws or nails are properly applied in process of attaching gypsum board to framing without damaging of gypsum board edges and ends.

.10 Splice corners and intersections together and secure to each member with 3 screws.

.11 Install access doors to electrical and mechanical fixtures specified in respective sections.

.1 Rigidly secure frames to furring or framing systems.

.12 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.13 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:

.1 Levels of finish:

.1 Level 2: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.

.2 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

.14 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.15 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, invisible after surface finish is completed.

.16 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.17 Completed installation smooth, level or plumb, free from waves and other defects and ready for surface finish.

.18 Mix joint compound slightly thinner than for joint taping.

.19 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.

.20 Allow skim coat to dry completely.

.21 Remove ridges by light sanding or wiping with damp cloth.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 13.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies' installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 10 00 - Rough Carpentry

.2 Section 08 14 16 - Flush Wood Doors

.3 Section 09 21 16 - Gypsum Board Assemblies

1.2 REFERENCE STANDARDS

.1 ASTM International, (ASTM)

.1 ASTM C645-18, Specification for Non-structural Steel Framing Members.

.2 ASTM C754-20, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide Submittals in accordance with Section 01 33 23 - Shop Drawings Product Data and Samples.

.2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for metal framing and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

.1 Submit certified test reports showing compliance with specified performance characteristics and physical properties. Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instruction. Replace defective or damaged materials with new.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 MATERIALS

.1 Non-load bearing channel stud framing: to ASTM C645, galvanized sheet steel:

.1 25 gauge thick unless otherwise noted or as required by site conditions and specified performance criteria.

.2 20 gauge required around opening at all glazed, specialty door openings.

.3 Knock-out service holes at 460 mm O.C.

.4 Top tracks with 50mm extended legs.

.5 Stud size as noted on drawings.

.2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 50 mm flange height.

.3 Foam gasket: continuous polyethylene foam strip gasket from full length roll 6 mm thick x 89 or 140 mm wide to suit stud dimensions. Designed to inhibit air and moisture penetration with RSI rating of 0.87 per 25 mm.

.4 Metal channel stiffener: size to suit framing, 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.

.5 Furring, framing and accessories: ASTM C645

.6 Blocking and/or plywood: refer to Section 06 10 00 – Rough Carpentry.

.7 Sheet metal backing: 16ga as indicated.

Part 3 Execution

3.1 ERECTION

.1 Erect partitions in accordance with framing requirements of ASTM C754.

.2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.

.3 Install damp proof course under stud shoe tracks of partitions on slabs on grade.

.4 Below bottom tracks install foam gasket, continuous with no gaps. Install additional gasket or bead of sealant to gaps where surface imperfections result in ono-contact between the slab and the foam. Install sufficient fasteners to ensure continuous gasket contact and compression.

.5 Place studs vertically at 400 mm oc unless indicated otherwise, and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs at 1200 mm oc as required to provide rigid installation to manufacturer's instructions.

.6 Install studs tight to concrete or concrete masonry unit walls where sound insulated partitions meet these walls.

.7 Erect metal studding to tolerance of 1:1000.

.8 Attach studs to bottom track only for walls extending to underside of structure using screws. Attach studs to bottom and ceiling track for walls not extending to underside of structure.

.9 Co-ordinate simultaneous erection of studs with installation of service lines. Align web openings when erecting studs.

.10 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

.11 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified.

.1 Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.

.12 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs.

.1 Secure track to studs at each end, in accordance with manufacturer's instructions.

.2 Install intermediate studs above and below openings in same manner and spacing as wall studs.

.13 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

.14 Provide wood backing or blocking or 38 mm stud or furring channel secured between studs for attachment of cabinets, monitors, fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars, attached to steel stud partitions. Type of backing or blocking to suit weight of wall mounted item..

.15 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.16 Extend partitions to ceiling height except where noted otherwise on drawings.

.17 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.

.18 Install continuous insulating strips to isolate studs from uninsulated surfaces.

.19 Install [two continuous beads of acoustical sealant] [insulating strip] under studs and tracks around perimeter of sound control partitions.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 13.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.

3.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by non-structural metal framing application.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 07 92 00 – Joint Sealants

1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)

.1 ANSI/CTI A108/A118/A36.1-2005, Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-.13, A118.1-.10, ANSI A136.1).

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM C144-18, Specification for Aggregate for Masonry Mortar.

.2 ASTM C207-18, Specification for Hydrated Lime for Masonry Purposes.

.3 ASTM C847-18, Specification for Metal Lath.

.4 ASTM C979/C979M-16, Specification for Pigments for Integrally Coloured Concrete.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 71-GP-22M-78(AMEND.) , Adhesive, Organic, for Installation of Ceramic Wall Tile.

.2 CAN/CGSB-75.1-M88, Tile, Ceramic.

.3 CAN/CGSB-25.20-95, Surface Sealer for Floors.

.4 CSA Group (CSA)

.1 CSA A123.3-05(R2015), Asphalt Saturated Organic Roofing Felt.

.2 CAN/CSA-A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-17, Adhesives and Sealants Applications.

.6 Terrazzo Tile and Marble Association of Canada (TTMAC)

.1 Tile Specification Guide 09 30 00 (2019-2021), Tile Installation Manual.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 23.

.2 Provide product data in accordance with Section 01 33 23.

.1 Include manufacturer's information on:

.1 Ceramic tile, marked to show each type, size, and shape required.

.2 Cementitious backer unit.

.3 Dry-set cement mortar and grout.

.4 Divider strip.

.5 Elastomeric membrane and bond coat.

.6 Reinforcing tape.

.7 Levelling compound.

.8 Latex cement mortar and grout.

.9 Commercial cement grout.

.10 Organic adhesive.

.11 Slip resistant tile.

.12 Waterproofing isolation membrane.

.13 Fasteners.

.3 Provide samples in accordance with Section 01 33 23.

.1 Base tile: submit 300 x 300 mm sample panels of each colour, texture, size, and pattern of tile.

.2 Floor tile: submit 300 x 300 mm sample panels of each colour, texture, size, and pattern of tile.

.3 Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, colour, and size.

1.4 QUALITY ASSURANCE

.1 Quality Assurance Submittals:

.1 Manufacturer's Instructions: manufacturer's installation instructions.

.2 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with Division 01.

.2 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Division 01.

1.6 AMBIENT CONDITIONS

.1 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 degrees C for 48 hours before, during, and 48 hours after, installation.

.2 Do not install tiles at temperatures less than 12 degrees C or above 38 degrees C.

.3 Do not apply epoxy mortar and grouts at temperatures below 15 degrees C or above 25 degrees C.

Part 2 Products

2.1 WALL AND FLOOR TILE

.1 Porcelain tile: to CAN/CGSB-75.1, Type 3, Class MR, with a matt finish and V2 colour variation surface, and edge trim to suit application.

.1 Performance Requirements:

.1 Water Absorption: ISO 10545-3 - < 0.5%.
.2 Dynamic Coefficient of Friction: ANSI A137.1 - ≥0.42
.3 Slip Resistance: DIN 51130 – R-9
.4 Breaking Strength: ISO 10545-4 - >1300N

.2 Floor Tile (TL-1):
.1 Olympia Tile, Regal Series, Charcoal BLK.
.2 Size: Match existing.
.3 Location: Atrium (match existing dark tile) and elevator area (new).

.3 Floor Tile (TL -2):
.1 Reserved

.4 Floor Tile (TL -3):
.1 Ciot – XRock Grigio (G) Nat.
.2 Size: 12" X 24"
.3 Location: Washrooms

.5 Wall Tile (TL -4):
.1 Ciot – Soho Beige Matte
.2 Size: 4" x 16"
.3 Location: Washrooms

.6 Floor Tile (TL -5):
.1 Ciot - Marte – Grigio Marostica
.2 Size: 12" X 24"
.3 Location: Janitor Room

.7 Wall Tile (TL -6):
.1 Ciot - Marte – Thassos
.2 Size: 12" X 24"
.3 Location: Janitor Room

2.2 TRIM SHAPES

.1 Conform to applicable requirements of adjoining floor and wall tile.

.2 Use trim shapes sizes conforming to size of adjoining field wall tile, including existing spaces, unless specified otherwise.

2.3 MORTAR AND ADHESIVE MATERIALS

.1 Cement: to CSA-A5, type 10.

.2 Sand: to ASTM C144, passing 16 mesh.

.3 Hydrated lime: to ASTM C207, Type N.

.4 Latex additive: formulated for use in cement mortar and thin set bond coat.

.5 Water: potable and free of minerals and chemicals which are detrimental to mortar and grout mixes.

2.4 BOND COAT

.1 Primer: as recommended by the epoxy bond coat manufacturer.

.2 Epoxy bond coat: non-toxic, non-flammable, non-hazardous during storage, mixing, application, and when cured. To produce shock and chemical resistant mortars having the following physical characteristics:

.1 Compressive Strength: 246 kg/cm^2.

.2 Bond Strength: 53 kg/cm^2.

.3 Water Absorption: 4.0% Max.

.4 Ozone Resistance, 200 hours @ 200 ppm: no loss of strength.

.5 Smoke Contribution Factor: 0.

.6 Flame Contribution Factor: 0.

.7 Finished mortar and grout to be resistant to urine, dilute acid, dilute alkali, sugar, brine and food waste products, petroleum distillates, oil and aromatic solvents.

2.5 GROUT

.1 Colouring Pigments:

.1 Pure mineral pigments, limeproof and nonfading, complying with ASTM C979.

.2 Colouring pigments to be added to grout by manufacturer.

.3 Job coloured grout are not acceptable.

.4 Use in Commercial Cement Grout, Dry-Set Grout, and Latex Cement Grout.

.2 Latex Cement Grout: to ANSI A118.6, fast curing, high early strength, polymer-modified, stain resistant, sanded mix for floors, unsanded mix for walls and floors with polished tiles commercial tile grout.

.3 Note: Grout to match tile colour.

2.6 ACCESSORIES

.1 Divider strips:

.1 Laminated strips, core 32 x 3 mm black neoprene, outsides (both sides) brass 32 x 1.29 mm complete with anchors, both sides spaced at 150 mm on centre.

.2 Metal lath: to ASTM C847 galvanized finish, 10 mm rib at 2.17kg/m^2.

.3 Transition Strips: purpose made metal extrusion; zinc type.

.4 Sealant: in accordance with Section 07 92 00.

.5 Floor sealer and protective coating: to tile and grout manufacturers recommendations and to CAN/CGSB-25.20, Type 1.

2.7 PATCHING AND LEVELLING COMPOUND

.1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.

.2 Have not less than the following physical properties:

.1 Compressive strength - 25 MPa.

.2 Tensile strength - 7 MPa.

.3 Flexural strength - 7 MPa.

.4 Density - 1.9.

.3 Capable of being applied in layers up to 50 mm thick, being brought to feather edge, and being trowelled to smooth finish.

.4 Ready for use in 48 hours after application.

2.8 CLEANING COMPOUNDS

.1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.

.2 Materials containing acid or caustic material are not acceptable.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 WORKMANSHIP

.1 Do tile work in accordance with TTMAC Tile Installation Manual 2006/2007, "Ceramic Tile", except where specified otherwise.

.2 Apply tile to clean and sound surfaces.

.3 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.

.4 Maximum surface tolerance 1:800.

.5 Make joints between tile uniform and approximately 1.5 mm wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.

.6 Lay out tiles so perimeter tiles are minimum 1/2 size.

.7 Sound tiles after setting and replace hollow-sounding units to obtain full bond.

.8 Make internal angles square, external angles rounded .

.9 Use round edged tiles at termination of wall tile panels, except where panel abuts projecting surface or differing plane.

.10 Install divider strips at junction of tile flooring and dissimilar materials.

.11 Allow minimum 24 hours after installation of tiles, before grouting.

.12 Clean installed tile surfaces after installation and grouting cured.

3.3 WALL TILE

.1 Install in accordance with TTMAC detail 323RW-Tile Installed Over Existing Tile Interior Walls Only.

3.4 FLOOR TILE

.1 Install in accordance with TTMAC detail 324RF – Tile Installed Over Existing Tile Interior Floors Only.

3.5 FLOOR SEALER AND PROTECTIVE COATING

.1 Apply in accordance with manufacturer's instructions.

3.6 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 13.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 09 21 16 - Gypsum Board Assemblies

.2 Section 09 22 16 - Non-Structural Metal Framing

.3 Section 23 30 00 - HVAC Air Distribution: Air inlets and outlets to be coordinated with ceiling work.

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

.2 ASTM E580/E580M-20, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

.3 ASTM C635/C635M-17, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

.4 ASTM C636/C636M-19, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

.5 ASTM E1264-19, Standard Classification for Acoustical Ceiling Products.

.6 ASTM E1414/E1414M-21a, Standard Test Method for Sound Attenuation between Rooms Sharing a Common Ceiling Plenum.

.7 ASTM E1477-98a(2017)e1 , Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.

.8 ASTM F1667-21 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 COORDINATION

.1 Do not begin erection of ceiling suspension system until work above ceiling has been inspected by the Consultant.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit samples in accordance with Section 01 33 23.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for acoustical suspension, acoustic panels, acoustic tiles , and system accessories. Include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit reflected ceiling plans for special grid patterns as indicated.

.2 Indicate lay-out ,[insert and hanger spacing and fastening details , splicing method for main and cross runners, location of access splines, access door dimensions, and locations and accessories.

.4 Samples:

.1 Submit duplicate full size 150 mm x 150 mm samples of each type of acoustical unit.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Division 01.

.2 Submit operation and maintenance data for acoustical suspension for incorporation into manual.

.3 Submit final certificate from design professional responsible for delegated detail design of ceiling indicating conformity with accepted shop drawings.

1.6 MAINTENANCE MATERIALS

.1 Provide extra acoustical units in accordance with Division 01.

.2 Provide acoustical units amounting to 2 % of gross ceiling area for each pattern and type of acoustical panel , suspension system and trim required for project, minimum 1 complete factory-sealed package of each.

.3 Ensure extra materials are from same production run as installed materials.

.4 Deliver extra materials for each type of acoustical unit in original unopened packages clearly identified, including colour and texture.

.5 Deliver to Queen’s University Representative, upon completion of the work of this section.

1.7 CERTIFICATIONS

.1 Fire-resistance rated suspension system: certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements. Include certification of sustainable requirements.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials flat, indoors, off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect acoustical ceiling panels suspension grid components from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Store extra materials required for maintenance, where directed by Queen's University Representative.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Permit wet work to dry before beginning to install.

.2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20 % before and during installation.

.3 Store materials in work area 48 hours prior to installation.

Part 2 Products

2.1 ACOUSTICAL CEILING SUSPENSION

.1 Intermediate duty system: non- rated system to ASTM C636.

.2 Basic materials for suspension system: commercial quality cold rolled steel, hot-dipped galvanized. Exposed surfaces prefinished in manufacturer's standard corrosion resistant enamel paint finish.

.3 Two directional exposed tee bar grid to match existing:

.1 Main tees: 24mm rolled cap on exposed face, double web, rectangular bulb, 38 mm deep minimum, cross tee holes 152 mm o.c., integral, reversible splices.

.2 Cross tees: 24mm rolled cap on exposed face, rectangular bulb, 32 mm deep minimum, extended web positive interlock to main tee web, lower flange extended, and offset to provide flush intersection.

.3 Edge mouldings: manufacturer's standard to match exposed grid components, uniform width, complete with back up plates.

.4 Finish: shop painted satin sheen white.

.4 Hanger wire: galvanized soft annealed steel wire, pre-stretched; yield stress load at least three times the design load but not less than 12-gauge

.5 Accessories: splices, clips, wire ties and retainers to complement suspension system components, as recommended by system manufacturer.

2.2 ACOUSTICAL CEILING PANELS

.1 Type 1: Acoustic tile, to ASTM C635. Basis of design: Rockfon Sonar.

.1 Edge type: Square Tegular Narrow to match existing.

.2 Size: 610mm x 610mm x 15 mm thick

.3 Light reflectance: LR1

.4 Colour: white

.5 Fire Performance: Class A

.6 STC 35 – 39

.7 NRC 0.70 – 0.95

Part 3 Execution

3.1 EXAMINATION

.1 Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for acoustical ceiling tile and track installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Consultant.

.2 Inform the Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 INTERFACE WITH OTHER WORK

.1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

3.3 SUSPENSION SYSTEM INSTALLATION

.1 Comply with manufacturer's written installation instructions and recommendations, including product technical bulletins, product carton installation instructions, and data sheets.

.2 Install suspension system in accordance with ASTM C636, manufacturer's written instructions and as supplemented in this section.

.3 Locate system according to reflected plan.

.4 Finished ceiling system to be square with adjoining walls and level within 1:1000.

.5 Install suspension system in accordance with ASTM C636, manufacturer's written instructions and as supplemented in this section.

.6 Locate system according to reflected plan.

.7 Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

.8 Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

.9 Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6" of each corner; or support components independently.

.10 Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

.11 Form expansion joints to accommodate plus or minus 1" movement. Maintain visual closure.

3.4 ACOUSTICAL CEILING PANEL INSTALLATION

.1 Install acoustic units in accordance with ASTM C635 and manufacturer's written instructions.

.2 Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.

.3 Install units after above ceiling work is complete.

.4 Cutting Acoustic Units:

.1 Cut to fit irregular grid and perimeter edge trim.

.2 Cut square reveal edges to field cut units.

.3 Seal edges of cut fibreglass tiles with clear tape.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 13.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.

.1 Touch up scratches, abrasions, voids and other defects in painted surfaces.

END OF SECTION

1 General

1.01 WORK INCLUDED

.1 Surface preparation prior to application of floor finishes.

.2 Resilient floor finishes

.3 Synthetic finishes

.4 Special flooring

.5 Flooring accessories

1.02 DESIGN REQUIREMENTS

.1 Provide flooring system with a waterproof membrane applied to the substrate in rooms with floor drains.

.2 For homogeneous vinyl sheet, linoleum sheet, and epoxy quartz flooring systems provide integral flash cove wall base by extending flooring up the wall using materials and accessories recommended and approved by the flooring manufacturer.

1.03 SUBMITTALS

.1 Sustainable Design: Provide submittals to confirm compliance with the requirements specified in Section 01 33 23.

.2 Samples

.1 Submit two (2) samples, 300 mm x 300 mm in size illustrating colour and pattern for each floor material for each colour specified.

.2 Submit two (2) 300 mm long samples of base and termination trim material for each colour specified.

1.04 QUALITY ASSURANCE

.1 Manufacturer representative shall be present at all construction phases to ensure adequate quality control on the installation.

1.05 MAINTENANCE

.1 Deliver 3% of each type and colour of different floor tiles, wall tiles, carpet tiles, rolled carpet, and ceiling tiles to Owner, for maintenance use.

1.06 WARRANTY

.1 Resilient sheet flooring with heat welded seams shall be guaranteed to be free of defects and not to wear through the colour/pattern for a period of 5 years for labour and Materials.

.2 All special flooring shall be guaranteed against all defects including cracking, crazing, surface deterioration or any other defects detrimental to the appearance or strength of the finishes, for a period of 3 years for Labour and Materials

2 Products

2.01 FLOORING FILLINGS

.1 Crack filler and repair mortar:

.1 Two-component multi-purpose, non-shrink, solvent-free and moisture- insensitive epoxy and binder.

.2 Suggested product: "Planibond EBA" by Mapei.

.2 Patching compound, over existing finishes (up to 3mm):

.1 A fast-setting mix of Portland cement blended with inner fillers and synthetic dry polymer resins for conditioning concrete and patching and filling of minor cracks cracks and depressions over properly prepared wood underlayments, vinyl or cermaic tiles.

.2 Suggested product: "Plani/Patch" with "Plani/Patch Plus" by Mapei.

.3 Modified cementitious mortar for concrete repairs and slopes (for toppings of 1.5mm to 40mm):

.1 A self-levelling & tapered blend of Portland cement and other hydraulic cements; for interior use only.

.2 Suggested product: "Ardex K13" by Ardex.

.4 Modified cementitious mortar for concrete fill (for toppings of 10mm to 100mm):

.1 One-component, shrinkage crack free, fast-setting and drying polymer-modified cementitious mortar consisting of special hydraulic binders, selected aggregates, special additives and polymeric resin, for interior or exterior use.

.2 Suggested product: "Mapecem 100" by Mapei.

.5 Epoxy based grout for concrete repairs and slopes fast drying:

.1 A three-component, fast-setting, trowelable, epoxy based grout designed for permanent horizontal repairs to concrete foundations, decks, floors and structural surfaces, with high strength and excellent chemical resistance, for interior use.

.2 Suggested product: "Stonset TG5" by Stonhard.

.6 Levelling and repairing compound, high compressive:

.1 A high compressive strength cementitious, rapid hardening premixed self-levelling underlayment compound for levelling and repairing substrate up to 12 mm (½") in depth, with compressive strength attaining more than 29.5 MPa and linear shrinkage not more than 0.05% after 28 days cure.

.2 Suggested product: "Ultra/Plan" by Mapei.

.7 Modified cementitious mortar for concrete repair, high resistance, low permeable (for toppings of 6mm to 50mm):

.1 A preblended two-component, shrinkage crack free, fast-setting polymer-modified cementitious mortar consisting of high strength hydraulic binders, selected aggregates, and special additives; high wear resistant, for interior and exterior use.

.2 Suggested product: "Mapecem 202" by Mapei.

2.02 RESILIENT FINISHES

.1 Vinyl Tile (RS): 100% homogeneous solid resin resilient tile, 3.2 mm (0.126") thick, with colour and pattern extending through the full thickness of the tile.

Luxury Vinyl Tile (LVT): High Performance Luxury Vinyl Tile (Class III Printed Vinyl Tile) with 4.5mm (0.177") thick, with a 22 mil wear layer.

.1 RS

1. Manufacture: Patcraft
2. Collection: Collection
3. Style: #1508V Admix,
4. Size: 18" x 36"
5. Format: Tile
6. Colour: #00110 Moon Shell
7. Location: As noted on the drawings.

.2 Contact: Shaw/Patcraft, Deanne Duncan, Tel.: 613 294 0000, e-mail: deanne.duncan@shawinc.com

.3 LVT

1. Manufacture: Interface
2. Collection: Level Set
3. Style: Natural Woodgrains
4. Size: 25cm x 1m (9.845 in x 39.38)
5. Installation: Ashlar
6. Format: Tile
7. Colour: A00209 Mahogany
8. Location: As noted on the drawings.

.4 Contact: Interface, Julia Cullinan, Tel: 613-402-1278, email: julia.cullinan@interface.com

2.03 SYNTHETIC FINISHES

Carpet Tile (Flex-Aire Modular® Cushion) & Rolled Carpet (Powerbond® Cushion): Hybrid resilient carpet, with the durability of hard-surface flooring with the comfort and cushion of carpet. Complete with chemically welded seams. Made of synthetic material, the backing is 0.156" (4.0mm) thick.

Note: the specified carpet tile and rolled carpet can be placed side by side with no transition.

.1 CRP-1

1. Manufacture: Tarket
2. Collection: Twill 11527
3. Colour: Black Hearth 57208
4. Format: As noted on the drawings.
   - .1 Format A: Carpet Tile (Flex-Aire Modular® Cushion)
     - .1 Size: 36 "x 18"
     - .2 Installation: Vertical Ashlar (refer to plan for direction)
   - .2 Format B: Rolled Carpet (Powerbond® Cushion)

.2 CRP-2

1. Manufacture: Tarket
2. Collection: Twill 11527
3. Colour: Deep Brindle 57205
4. Format: As noted on the drawings.

.1 Format A: Carpet Tile (Flex-Aire Modular® Cushion)

.1 Size: 36 "x 18"

.2 Installation: Vertical Ashlar (refer to plan for direction)

.1 Format B: Rolled Carpet (Powerbond® Cushion)

5. CRP-3

.1 Manufacture: Tarket

.2 Collection: Aida Cloth G0052

.3 Format: Carpet Tile

.4 Size: 36 "x 18"

.5 Installation: Vertical Ashlar (refer to plan for direction)

.6 Colour: Deep Brindle 57205

6. Contact: Julie Charron, Account Executive, Tel.: +1 613 292 9727, e-mail: Julie.Charron@tarkett.com

2.04 ACCESSORIES

.1 Underlayer Waterproof Membrane:

.1 For interior use, a Waterproof & Crack Isolation Membrane, for use below bond coat, under all ceramic tile and stone installation where a waterproof surface is required. Exceeds ANSI A118.10 and ANSI A118.12 standards.

.2 Suggested product: "WP-900", with "WP980 fabric", by Flextile Ltd.

.3 Reinforcing mesh: 50 x 50 x 1.6 x 1.6 mm galvanized steel wire

.4 mesh, welded fabric design, in flat sheets.

.2 Divider strips:

.1 Zinc: 2mm x depth, complete with anchors, both sides spaced at 150 mm on centre.

.3 Prefabricated Movement Joints:

.1 purpose made, having a Shore A Hardness not less than 60 and elasticity of plus or minus 40 percent when used in accordance to TTMAC Detail 301EJ.

.4 Trims and Edging:

.1 Conform to applicable requirements of adjoining floor and wall tile.

.2 Use trim shapes sizes conforming to size of adjoining field wall tile, including existing spaces, unless specified otherwise.

.3 Straight Edge and Transition Strips: Use "Schluter" type trim shapes sizes conforming to size of adjoining field wall tile, including existing spaces, unless specified otherwise. Use trims for transitions between floor types, inside corners, outside corners and edges.

1. TR-1: Trim at floor transition between Porcelain Floor Tile TL and LVT, Vinyl Composite Tile or safety flooring or sheet vinyl: Schluter Reno-U-12mm-AE Finish. Trim to be installed prior to installation of LVT, Vinyl Composite Tile or safety flooring or sheet vinyl Floor

2. TR-2: Trim at floor transition between Porcelain Floor Tile TL and Terrazzo: Schluter Reno-U-12mm-AE Finish

3. Trim at control joints in ceramic tile flooring. Schluter Dilex-AKSN-125-G Grey at maximum 6m o.c.

4. Trim at outside corners of ceramic tile: Schluter-Quadec-AE.

5. Note: No transition required between flooring of the same type.

.5 Wall Base:

Note: All new areas requiring wall base to match adjacent wall base type and finish.

.1 BA-1: Porcelain Tile

1. 4" H cut tile base to match floor tile.
2. Trim: Refer to tile specifications.
3. Location: Where new floor tile is specified.

   Note: Where wall tile is specified, no 4" base is required (use cove base trim only).

.2 BA-2: Rubber Base

1. Manufacture: Tarkett
2. Product: For areas with resilient flooring use 'TightLock for Resilient Flooring', for areas with carpet use 'TightLock for Carpet'.
3. Size: 4" High
4. Colour: To match existing rubber base colour.
5. Location: As noted on plans.

.3 BA-3: Wood Base

1. Description: Wood base with reveal at top and bottom. Wood type and stain to match existing wood bases.
2. Size: 4" High
3. Location: As noted on plans.

3 Execution

3.01 PREPARATION

.1 Prepare floor using grinding, Blastrac system, acid etching (as a last resort), or by other means, to remove all surface gloss and laitance and produce a level surface, as recom- mended by the manufacturer. Do not use sand shot blasting without Facilities approval.

.2 Scarify narrow cracks to 12.7 mm (1/2), then fill depressions and cracks, as well as holes, and other defects and crevices in the substrate with appropriate types of mortar.

.3 Do not fill saw-cuts, expansion and construction joints with mortar or grout.

.4 Remove all surface contamination by washing with an appropriate cleaner such as "TSP" (Trisodium Phosphate). Rinse thoroughly and allow drying. Do not use hydrocarbon solvents for cleaning. Existing peeled or checked paint should be scraped and sanded to a sound surface. Glossy surfaces should be sanded dull. Stains from water, smoke, ink, pencil, grease, etc. should be sealed with the appropriate primer/sealer.

.5 For extreme conditions, prepare existing painted metal surfaces as per The Society for Protective Coatings (SSPC-SP1 & SSPC-SP6) solvent & commercial blast cleaning specifications, to remove existing or cracked paint, rust or other contaminants and render surface rough.

3.02 INSTALLATION

.1 Install sheet flooring to manufacturer's written instructions.

.2 No wax or other floor finish shall be applied on pre-protected Linoleum surfaces and other non-waxed resilient products.

.3 If recommended by the flooring manufacturer, only Owner approved sub-contractor shall be used for waxing.

.4 Sheet Flooring:

- .1 Spread only enough adhesive to permit installation of materials before initial set.
- .2 Set flooring in place, press with heavy roller to attain full adhesion.
- .3 Lay flooring with joints and seams to produce minimum number of seams.
- .4 Double cut sheet at seams and provide continuously heat welded seal.
- .5 Terminate flooring at centreline of door openings where adjacent floor finish is dissimilar.
- .6 Install edge strips at unprotected or exposed edges, and where flooring terminates.
- .7 Turn up flooring to form base. Back floor and wall junction with cant strip. Provide cap strip to terminate base.
- .8 Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- .9 At movable partitions install flooring under partitions without interrupting floor pattern.

.5 Resilient Tile Flooring:

- .1 Mix tile from container to ensure shade variations are consistent when tile is placed.
- .2 Spread only enough adhesive to permit installation of materials before initial set.
- .3 Set flooring in place, press with heavy roller to attain full adhesion.
- .4 Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern. Fit joints tightly.
- .5 If special or several floor tile patterns are intended, schedule these pattern types in a schedule at the end of this section and edit the following paragraph accordingly.
- .6 Allow minimum 1/2 full size tile width at room or area perimeter.
- .7 Terminate flooring at centreline of door openings where adjacent floor finish is dissimilar.
- .8 Install edge strips at unprotected or exposed edges, and where flooring terminates.
- .9 Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- .10 At movable partitions install flooring under partitions without interrupting floor pattern.

.6 Base:

- .1 Fit joints tight and vertical. Maintain minimum measurement of 450 mm between joints.
- .2 Mitre saw internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premoulded units.
- .3 Install base on solid backing. Bond tight to wall and floor surfaces.
- .4 Scribe and fit to door frames and other interruptions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 05 50 00 – Metal Fabrications

.2 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCE STANDARDS

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (SDS).

.2 Master Painters Institute (MPI)

- .1 The Master Painters Institute (MPI)/Architectural Painting Specification Manual (ASM) - current edition.
- .2 Standard GPS-1-12, MPI Green Performance Standard.
- .3 Standard GPS-2-12, MPI Green Performance Standard.

.3 SCAQMD Rule #1113-A2011, Voc and Chemical Component Limits.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide in accordance with Section 01 33 23.

.2 Product Data:

- .1 Provide manufacturer's instructions, printed product literature and data sheets for paint and paint products and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit WHMIS SDS – Material Safety Data Sheet.
- .3 Confirm products to be used are in MPI's approved product list.

.3 Samples:

- .1 Submit duplicate 200 x 300mm swatches of each paint, stain, clear coating, special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on the following substrate materials:
- .2 13mm gypsum board for finishes over gypsum board and other smooth surfaces.
- .3 When approved, samples shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.
- .4 Submit full range of available colours where colour availability is restricted.
- .5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 QUALITY ASSURANCE

.1 Mock-ups:

.1 Construct mock-ups in accordance with Division 01.

.2 Mock-ups to include complete interior spaces including walls painted with field colour and at least two accent colours for verification of the selected accent colour.

.3 Locate mock-up where directed by Queen's University Representative or the Consultant before proceeding with work.

.4 Allow 48 hours for inspection of mock-up by Queen's University Representative or the Consultant.

.5 When accepted, mock-up will demonstrate minimum standard of quality and materials for work of this Section.

.6 Mock-up may remain as part of finished work.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.1 Labels: to indicate:

.1 Type of paint or coating.

.2 Compliance with applicable standard.

.3 Colour number in accordance with established colour schedule.

1.6 SITE CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10 °C for twenty-four (24) hours before, during and after paint application until paint has cured sufficiently.

.2 Where required, provide continuous ventilation for seven (7) days after completion of application of paint.

.3 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.4 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted.

.2 Temperature, Humidity Levels:

.1 Interior Painting: Perform no painting when ambient air and substrate temperatures are below 50°F (10°C.) for interior or exterior work.

.2 Maximum moisture content of Substrates:

.1 12% concrete and masonry, clay and concrete brick or block.

.2 15% for wood.

.3 12% for plaster and gypsum board.

.4 5.5% for walls specified to have vinyl wall covering finish.

.3 Test concrete, masonry and plaster surfaces for alkalinity as required.

.4 Concrete and masonry surfaces must be installed at least 28 days prior to painting and decorating work and must be visually dry on both sides.

.3 Surface and Environmental Conditions: Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

.4 Additional Interior Application Requirements: Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

.5 Provide paint products meeting MPI Green Performance Standard GPS-01 ratings based on VOC EPA Method 24 content levels.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Environmental Performance Requirements:

.1 Provide paint products meeting MPI "Environmentally Friendly" E2 or E1 ratings based on VOC (EPA Method 24) content levels.

2.2 MATERIALS

.1 Supply paint materials for paint systems from single manufacturer.

.2 Conform to latest MPI requirements for painting work including preparation and priming.

.3 Materials in accordance with MPI - Architectural Painting Specification Manual "Approved Product" listing.

.1 Use MPI listed materials having E3 or E2 rating where indoor air quality requirements exist.

.2 Primer: VOC limit 100 g/L maximum to SCAQMD Rule 1113.

.3 Paint: VOC limit 100 g/L maximum to SCAQMD Rule 1113.

.4 Colours: Submit proposed Colour Schedule to the Consultant. Base colour schedule on selection of 5 base colours and 3 accent colours.

.5 Mixing and tinting:

.1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from the Consultant for tinting of painting materials.

.2 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.

.3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.

.4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.3 GLOSS/SHEEN RATINGS

.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss @ 60 degrees	Sheen @ 85 degrees	
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

.2 Gloss level ratings of painted surfaces as indicated.

2.4 INTERIOR PAINTING SYSTEMS

.1 Concrete vertical surfaces: including horizontal soffits:

.1 INT 3.1C - High performance architectural latex (over W.B. alkali-resistant primer) Gloss Level 5 finish.

.2 Concrete horizontal surfaces: floors and stairs:

.1 INT 3.2C - Epoxy finish semi-gloss.

.3 Metal Fabrications: frames, railings, misc. steel.

.1 INT 5.1R - High performance architectural latex, Gloss Level 3 (over W.B. galvanized primer) finish.

.4 Dressed lumber: including doors, door frames, casings, mouldings:

.1 INT 6.3A - High performance architectural latex, Glass Level 5 (over latex primer) finish.

.5 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:

.1 INT 9.2B - High performance architectural latex, Gloss Level 3 (over latex primer/sealer) finish.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable to be painted in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Consultant.

.2 Inform the Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

.2 Verify existing substrates are suitably prepared to be painted. Report to the Consultant unsatisfactory conditions before proceeding with work.

.3 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test".

.4 Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.4 PREPARATION

.1 Perform preparation and operations for exterior painting in accordance with MPI Maintenance Repainting Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

.3 Clean and prepare exterior surfaces to be repainted in accordance with MPI Maintenance Repainting Manual requirements. Refer to the MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and surface debris by vacuuming, wiping with dry, clean cloths or compressed air.

.2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

.4 Allow surfaces to drain completely and allow to dry thoroughly.

.5 Use water-based cleaners in place of organic solvents where surfaces will be repainted using water based paints.

.6 Many water-based paints cannot be removed with water once dried. Minimize use of kerosene or such organic solvents to clean up water-based paints.

.4 Clean metal surfaces to be repainted by removing rust, dirt, oil, grease and foreign substances in accordance with MPI requirements. Remove such contaminates from surfaces, pockets and corners to be repainted by brushing with clean brushes, blowing with clean dry compressed air, or brushing/vacuum cleaning as required.

.5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before priming and between applications of remaining coats. Touch-up, spot prime, and apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.

.6 Do not apply paint until prepared surfaces have been accepted by the Consultant.

.7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000mm.

3.5 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by the Consultant.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Remove light fixtures, surface hardware on doors, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Store items and re-install after painting is completed.

.5 Move and cover exterior furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.6 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas.

3.6 APPLICATION

.1 Apply paint in accordance with MPI Painting Manual Custom Grade finish requirements.

.2 Brush and Roller Application:

.1 Apply paint in uniform layer using brush and/or roller type suitable for application.

.2 Work paint into cracks, crevices and corners.

.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.

.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.

.4 Brush out immediately all runs and sags.

.5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.

.5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

.9 Finish top, bottom, edges and cut-outs of doors after fitting as specified for door surfaces.

.10 Wood, drywall, concrete; if sprayed, must be back rolled.

3.7 SITE TOLERANCES

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 13.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.

3.9 PAINT FINISH LEGEND

.1 PT-1:

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW9166, Drift of Mist.

.3 Location: Main – throughout unless noted otherwise

.2 PT-2:

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW7649, Silverplate.

.3 Location: Accent (lighter grey).

.3 PT-3:

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW7069, Iron Ore.

.3 Location: Accent (dark grey) - **Reserved.**

.4 PT-4 (Mock-up Option A):

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW9133, Jasper Stone

.3 Location: Accent (green/ blue) - as noted + wood slat accent.

.5 PT-4 (Mock-up Option B):

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW9062, Bluebird Feather

.3 Location: Accent (blue) - as noted + wood slat accent.

.6 PT-4 (Mock-up Option C):

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW7604, Dorian Gray

.3 Location: Accent (medium warm grey) - as noted

.7 PT-5:

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW6514, Respite

.3 Location: Accent (blue) - **Reserved.**

.8 PT-6:

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW7604, Smokey Blue.

.3 Location: Accent (darker blue) - as noted + wood slat accent.

.9 PT-7:

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW6662, Summer Day.

.3 Location: Accent (yellow) - wood slat accent.

.10 PT-8:

.1 Manufacture: Sherwin Williams.

.2 Colour: #SW6628, Robust Orange.

.3 Location: Accent (orange/red) - wood slat accent.

.11 PT-9:

.1 Manufacture: Sherwin Williams.

.2 Colour: White - To match existing drywall ceiling colour.

.3 Location: Drywall Ceilings

.12 PT-10:

.1 Manufacture: Sherwin Williams.

.2 Colour: Light Grey - To match existing metal door/frame colour.

.3 Location: New Metal Doors and Frames

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM B456-17, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

.2 ASTM A653/A653M-20 , Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 ASTM A924/A924M-20 , Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

.2 CSA Group (CSA)

.1 CAN/CSA-B651-18, Accessible Design for the Built Environment.

.2 CAN/CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 23.

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.

.4 Samples:

.1 Submit samples in accordance with Division 01.

.2 Samples will be returned for inclusion into work.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Division 01.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Tools:

.1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories in accordance with requirements specified in Division 01.

.2 Deliver special tools to Queen’s University Representative.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect toilet and bathroom accessories from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating.

.2 Stainless steel sheet metal: to ASTM A167, Type 304, with No. 4 Finish.

.3 Stainless steel tubing: Type 304, commercial grade, seamless welded, minimum 1.2 mm wall thickness.

.4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 COMPONENTS

.1 Toilet tissue dispenser (TPD): double roll type, surface mounted, chrome plated steel frame, capacity of 500 double ply roll, roll under spring tension for controlled delivery. Product: 56TR Tork Jumbo Twin Bath Dispenser 8" Smoke/Gray, Bunzl Code: 141004551. Supplied by Queen’s University Operations and installed by the Contractor.

.2 Towel dispenser (PTD): surface mounted wall unit, approximately 300 mm wide, 231 mm deep, suitable for dispensing roll paper towels. Product: Designer® Push Bar Roll Towel Dispenser, Bunzl Code: 17900195. Supplied by Queen’s University Operations and installed by the Contractor.

.3 Waste Receptacle (WB): 378 x 378 x 756mm stainless steel bin equipped with vinyl bumper strip and rubber feet. Suggested product: Queen’s University standard product.

.4 Soap dispenser (SD): liquid push-in valve 158 mm spout, self contained 1.26 L tank, tamper proof filler lock, surface mounted. Product: GOJO® ADX-12™ Push-Style Dispenser for GOJO® Foam Soap. Bunzl Code: 354088841. Supplied by Queen’s University Operations and installed by the Contractor.

.5 Feminine napkin disposal bin (SND): stainless steel, surface unit, continuous hinged door, self closing, embossed with universally accepted symbol , removable stainless steel receptacles fitted with spring clip for deodorizer block. Suggested product: Queen's University standard product.

.6 L-Shape Grab Bar (GB-1): 760mm x 760mm, 38mm diameter with 1.2 mm wall tubing of stainless steel, 80mm diameter wall flanges, concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grips. Grab bar material and anchorage to withstand downward pull of 2.2 kN.

.7 Straight Grab bars (GB-2): length as indicated in drawing, 38mm diameter with 1.2 mm wall tubing of stainless steel, 80 mm diameter wall flanges, concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grips. Grab bar material and anchorage to withstand downward pull of 2.2 kN. Suggested products: B-5806.99, by Bobrick.

.8 Standard Mirror (MIR-1): 460 mm wide x 760 mm one piece min. 1.2mm stainless steel channel frame, vandal resistant concealed mounting, 6 mm glass with shock resistant primary back, and full galvanized back panel.

.9 Full Length Mirror (MIR-2): 610 mm wide x 1829 mm one piece min. 1.2mm stainless steel channel frame, vandal resistant concealed mounting, 6 mm glass with shock resistant primary back, and full galvanized back panel.

.10 (MIR-3): 1600 mm wide x 2560 mm one piece min., vandal resistant concealed mounting, 6 mm glass with shock resistant primary back.

.11 Heavy duty shelf (SHF): Brushed stainless steel, 22 gauge, 100mm x 450mm. Suggested product: "950-4x18", by Frost

.12 Individual Hook (CH): Stainless steel with bumper, integral with partition. Single or double head. Suggested product: "01-9402", by Sunglow.

.13 Wall-Mounted Swing-Up Grab Bar (GB-3): Hinged offset rail, stainless steel, (810mm x 150mm offset), c/w free standing post (for retrofit projects). Suggested products: "B-4998(.99 for peened gripping surface)", by Bobrick.

.14 Toilet Backrest (TB): Brushed stainless steel tube & 16mm solid plastic laminate Backrest. Suggested product: "1028", by Frost.

.15 Adult change table, surface mounted (ADCT): Provide engineered blocking and associated supports, compliant with QFADS, OBC, and AODA. Suggested product: "Pressalit Care 1000" by Max-Ability.

.16 Baby Change Station (BCS): 200bs capacity, compliant with QFADS, OBC, and AODA, and with appropriate blocking and anchoring. Suggested product: "KB300-SS Horizontal Surface-Mounted with Stainless Steel Veneer" by Koala Care.

2.3 FABRICATION

.1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.

.2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.

.3 Brake form sheet metal work with 1.5 mm radius bends.

.4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.

.5 Back paint components where contact is made with building finishes to prevent electrolysis.

.6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CAN/CSA-G164.

.7 Shop assemble components and package complete with anchors and fittings.

.8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details, and instructions for building in anchors and inserts.

.9 Provide steel anchor plates and components for installation on studding and building framing.

2.4 FINISHES

.1 Manufacturer's or brand names on face of units not acceptable.

Part 3 Execution

3.1 INSTALLATION

.1 Install and secure accessories rigidly in place as follows:

.1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.

.2 Hollow masonry units, existing plaster or drywall: use toggle bolts drilled into cell or wall cavity.

.3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.

.4 Toilet and shower compartments: use male to female through bolts.

.2 Install grab bars on built-in anchors provided by bar manufacturer.

.3 Use tamper proof screws/bolts for fasteners.

.4 Fill units with necessary supplies shortly before final acceptance of building.

3.2 ADJUSTING

.1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.

.2 Lubricate moving parts to operate smoothly and fit accurately.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 13.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 13.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by toilet and bathroom accessories installation.

END OF SECTION

1 GENERAL

1.01 REFERENCES

.1 Division 00 and Division 01 apply to and are a part of this Section.

1.02 APPLICATION

.1 This Section specifies requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Divisions 00 or 01, conditions of Division 00 or 01 to take precedence, as confirmed with Owner and reviewed with Consultant prior to Bid submission.

.2 Be responsible for advising product vendors of requirements of this Section.

1.03 DEFINITIONS

.1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.

.2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.

.3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.

.4 "provision" or "provide" (and tenses of "provide") – means supply and install complete.

.5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify and certify.

.6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery and administer supply of products; distribute to areas; and include manufacturer's supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties and manufacturers' assistance to Contractor.

.7 "delete" or "remove" (and tenses of "delete" or "remove") – means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Owner and reviewed with Consultant.

.8 "barrier-free" – means when applied to a building and its facilities, that building and its facilities can be approached, entered and used by persons with physical or sensory disabilities in accordance with requirements of local governing building code.

.9 "BAS" – means building automation system; "BMS" – means building management system; "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same.

.10 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.

.11 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.

.12 "Mechanical Divisions" – typically, refers to Divisions 20, 21, 22, 23, 25 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.

.13 "Electrical Divisions" – typically, refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.

.14 "Consultant" – means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Owner to act for Owner in a professional capacity in relation to the Work.

.15 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.

.16 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

1.04 DOCUMENTS

.1 Documents for bidding include but are not limited to issued Drawings, Specifications and Addenda.

.2 Specification is typically generally arranged in coordination with guidelines of CSI/CSC 50 Division MasterFormat.

.3 Drawings and Specifications are portions of Contract Documents and identify labour, products and services necessary for performance of work and form a basis for determining pricing. They are intended to be cooperative. Perform work that is shown, specified, or reasonably implied on the drawings but not mentioned in Specification, or vice-versa, as though fully covered by both.

.4 Review Drawings and Specifications in conjunction with documents of other Divisions and, where applicable, Code Consultant's report.

.5 Unless otherwise specifically noted in Specifications and/or on Drawings, Sections of Mechanical Divisions are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and Sections are to be read as a whole.

.6 Drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of building is to be taken on site. Do not scale Drawings, and do not use Drawings for prefabrication work.

.7 Drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, offsets, fittings, transformations and similar products required as a result of obstructions and other architectural and/or structural details but not shown on Drawings.

.8 Locations of equipment and materials shown may be altered, when reviewed by Consultant, to meet requirements of equipment and/or materials, other equipment or systems being installed, and of building, all at no additional cost to Contract.

.9 Specification does not generally indicate specific number of items or amounts of material required. Specification is intended to provide product data and installation requirements. Refer to schedules, Drawings (layouts, riser diagrams, schematics, details) and Specification to provide correct quantities. Singular may be read as plural and vice versa.

.10 Starter/motor control centre (MCC)/variable frequency drive (VFD) schedule drawings are both mechanical and electrical, and apply to work of Mechanical Divisions and Electrical Divisions. Be responsible for reviewing starter, MCC, VFD, and motor specification requirements prior to Bid submission. Confirm and coordinate exact scope of work and responsibility of work between Mechanical Divisions and Electrical Divisions.

.11 Drawings and Specifications have been prepared solely for use by party with whom Consultant has entered into a contract and there are no representations of any kind made by Consultant to any other party.

.12 In the case of discrepancies between the drawings and specifications, documents will govern in order specified in "General Conditions", however, when scale and date of drawings are same, or where discrepancy exists within specification, most costly arrangement will take precedence.

1.05 METRIC AND IMPERIAL MEASUREMENTS

.1 Generally, both metric and imperial units of measurement are given in Sections of Specification governed by this section. Measurement conversions may be generally "soft" and rounded off. Confirm exact measurements based on application. Where measurements are related to installation and onsite applications, confirm issued document measurements with applicable local code requirements, and/or as applicable, make accurate measurements onsite. Where significant discrepancies are found, immediately notify Consultant for direction.

1.06 EXAMINATION OF DOCUMENTS AND SITE

.1 Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work, and include for such conditions in Bid Price.

.2 Report to Consultant, prior to Bid Submittal, any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.

.3 Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

1.07 WORK STANDARDS

.1 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.

.2 Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Owner and reviewed with Consultant.

.3 Supplementary mandatory specification and requirements to be used in conjunction with project include but are not limited to following:

.1 Air-Conditioning, Heating and Refrigeration Institute (AHRI);

.2 Air Movement and Control Association (AMCA);

.3 American Iron and Steel Institute (AISI);

.4 American National Standards Institute (ANSI);

.5 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);

.6 American Society of Mechanical Engineers (ASME);

.7 American Society of Testing and Materials (ASTM);

.8 American Water Works Association (AWWA);

.9 Associated Air Balance Council (AABC);

.10 Building Industry Consulting Services, International (BICSI);

.11 Canadian Gas Association (CGA);

.12 Canadian General Standards Board (CGSB);

.13 Canadian Standards Association (CSA);

.14 Electrical and Electronic Manufacturers Association of Canada (EEMAC);

.15 Electrical Safety Authority (ESA);

.16 Electronic Industries Association (EIA);

.17 Factory Mutual Systems (FM);

.18 Illuminating Engineering Society (IES);

.19 Institute of Electrical and Electronic Engineers (IEEE);

.20 International Standards Organization (ISO);

.21 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS);

.22 National Building Code of Canada (NBC);

.23 National Electrical Manufacturers Association (NEMA);

.24 National Environmental Balancing Bureau (NEBB);

.25 National Fire Protection Association (NFPA);

.26 National Standards of Canada;

.27 NSF International;

.28 Occupational Health and Safety Act (OHSA);

.29 Ontario Building Code (OBC);

.30 Ontario Electrical Safety Code (OESC);

.31 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);

.32 Technical Standards and Safety Authority (TSSA);

.33 Thermal Insulation Association of Canada (TIAC);

.34 Underwriters' Laboratories of Canada (ULC);

.35 Workplace Hazardous Materials Information System (WHMIS);

.36 Safety Data Sheets by product manufacturers;

.37 local utility inspection permits;

.38 Codes, standards, and regulations of local governing authorities having jurisdiction;

.39 additional codes and standards listed in Trade Sections;

.40 Owner's standards.

.4 Provide applicable requirements for barrier free access in accordance with latest edition of local governing building code.

.5 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted to appropriate authorities. Be responsible for costs associated with these submittals.

.6 Unless otherwise specified, install equipment in accordance with equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions. Notify Consultant in writing of conflicts between Contract Documents and manufacturer's instructions.

.7 Work is to be performed by journeyperson tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on site supervision of experienced journeyperson tradesman. Journeyperson to apprentice ratio is not to exceed ratio determined by the Board as stated in Ontario College of Trades and Apprenticeship Act or local equivalent governing body in Place of the Work.

.8 Journeyperson tradesmen are to have a copy of valid trade certificates available at site for review with Consultant at any time.

.9 Experienced and qualified superintendent is to be on-site at times when work is being performed.

.10 Protect existing areas above, below and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Owner and reviewed with Consultant. Maintain in operation existing services to these areas to allow Owner to continue use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, in coordination with Owner and Consultant. Include for required premium time work to meet these requirements.

.11 Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by Owner on a 24 hours basis or over various hours, coordinate hours of work with Owner on a regular basis to suit Owner's schedule. Execute work at times confirmed with and agreed to by Owner and reviewed with Consultant, so as not to inconvenience Owner's occupation or in any way hinder Owner's use of building. Include for required premium time work to meet these requirements.

.12 Coordinate work inspection reviews and approvals with governing inspection department to ensure construction schedule is not delayed. Be responsible for prompt notification of deficiencies to Consultant and submission of reports and certificates to Consultant.

.13 Properly protect equipment and materials on site from damage and defacement due to elements and work of trades, to satisfaction of Owner and reviewed with Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.

.14 Mechanical piping system work, including equipment, must comply with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products are to bear a CRN number.

.15 Electrical items associated with mechanical equipment are to be certified and bear stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

1.08 PERMITS, CERTIFICATES, APPROVALS AND FEES

.1 Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities. Obtain and pay for permits, certificates, and approvals required to complete Work.

.2 Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliant is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.

.3 Obtain and submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.

.4 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.

1.09 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

.1 Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.

.2 Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.

.3 Unless otherwise specified in Division 00 or 01, liability insurance requirements are as follows:

.1 coverage is to be a minimum of $1,000,000.00 CDN inclusive of any one occurrence;

.2 insurance policy is not to be cancelled or changed in any way without insurer giving Owner minimum thirty days written notice;

.3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the Place of the Work;

.4 retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above;

.5 evidence of the required liability insurance in such form as may be required is to be issued to Owner, Owner's Consultant, and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

1.10 WORKPLACE SAFETY

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials. Submit WHMIS SDS (Safety Data Sheets) for products where required, and maintain one copy at site in a visible and accessible location available to personnel.

.2 Comply with requirements of Occupational Health and Safety Act and other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces" and any other applicable Ministry of Labour requirements.

.3 If at any time during course of existing building work, hazardous materials other than those identified in Documents and pertaining to Project Scope of Work, are encountered or suspected that were not identified as being present and which specific instructions in handling of such materials were not given, cease work in area in question and immediately notify Consultant. Comply with local governing regulations with regards to working in areas suspected of containing hazardous materials. Do not resume work in affected area without approval from Owner and reviewed with Consultant.

1.11 PLANNING AND LAYOUT OF WORK

.1 Base installation layout, design, terminations, and supply of accessories, on Contract Documents with specific coordination with reviewed shop drawings.

.2 Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other as well as other obstructions. Generally, as coordinated prior to start of Work with each trade and with Owner and reviewed with Consultant, to suit specific project requirements, order of right of way for services to be as follows:

.1 piping requiring uniform pitch;

.2 piping 100 mm (4") dia. and larger;

.3 large ducts (main runs);

.4 cable tray and bus duct;

.5 conduit 100 mm (4") dia. and larger;

.6 piping less than 100 mm (4") dia.;

.7 smaller branch ductwork;

.8 conduit less than 100 mm (4") dia..

.3 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of work.

.4 Do not use Contract Drawing measurements for prefabrication and layout of piping, sheet metal work and such other work. Locations and routing are to generally be in accordance with Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for work of other trades. Accurately layout work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with Contract Drawings, notify Consultant prior to proceeding with work.

.5 Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or ¼"=1' 0") of work for coordination with each trade Contractor. Arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with plan drawings so that trades may make use of section drawings. Section drawings to indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, engineering drawings for this use. Contractors' interference drawings are to be distributed among other Trade Contractors. Submit drawings to Consultant for review. Failure of General Contractor to prepare and coordinate overall interface drawings of trades does not relieve respective Division Contractor of responsibility to ensure that work is properly planned and coordinated.

.6 Carry out alterations in arrangement of work that has been installed without proper coordination, study, and review, even if in accordance with Contract Documents, in order to conceal work behind finishes, or to allow installation of other work, without additional cost. In addition, make necessary alterations in other work required by such alterations, without additional cost.

.7 Locate shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings, for easy access for servicing and/or removal. Relocate products which do not meet this location requirement to accessible location, at no additional cost.

.8 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination.

.9 Where drawings indicate that acoustic tile ceiling is being suspended below structural ceiling, coordinate design of framework used to support suspended ceiling, diffusers, and other Divisions components that are mounted within or through ceiling. Do not mount devices to suspended ceiling. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.

1.12 PHASING

.1 Project partial occupancy permits to be required throughout project. Provide for each partial permit, required local governing authority certificate and any other testing/verification certificates for systems.

1.13 COORDINATION OF WORK

.1 Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include but not be limited to following:

.1 requirements for openings, sleeves, inserts and other hardware necessary for installation of work;

.2 concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;

.3 depth and routing of excavation required for work, and requirements for bedding and backfill;

.4 wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements.

.2 Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.

.3 Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building, subject to available space as confirmed with Owner and reviewed with Owner, and protected from elements.

.4 Ensure proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Comply with code requirements with regards to access space provision around equipment. In coordination with Owner and review with Consultant, relocate equipment which does not meet this requirement.

.5 Where work is to be integrated, or is to be installed in close proximity with work of other trades, coordinate work prior to and during installation.

1.14 PRODUCTS

.1 Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines. Failure to order products to allow manufacturers sufficient production/delivery time to meet project-scheduling timelines is an unacceptable reason to request for other suppliers or substitutions.

.2 Provide Canadian manufactured products wherever possible or required and when quality and performance is obtainable at a competitive price. Products are to be supplied from manufacturer's authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new.

.3 Products are to comply with applicable respective Canadian standards, and typically with Canadian Standards Association (CSA) approvals and/or Underwriters Laboratories of Canada (ULC) listings markings. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada ULC / cUL listed for use in Canada. Other certification organizations accredited by Standards Council of Canada to approve electrical equipment may be acceptable subject to approval from local governing electrical authority and review with Consultant. Applicable products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards enforced by local governing authorities.

.4 Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.

.5 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, base specified manufacturers are stated for any product specified by manufacturer's name and model number. Where acceptable manufacturers are listed, first name listed is base specified company. Bid Price may be based on products supplied by any of manufacturers' base specified or named as acceptable for particular product. If acceptable manufacturers are not stated for a particular product, base Bid Price on product supplied by base specified manufacturer.

.6 Documents have been prepared based on product available at time of Bidding. If, after award of Contract, and if successful manufacturer can no longer supply a product that meets base specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with base specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by Consultant and are considered as substitutions subject to a credit to Contract. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., include required changes. Such changes are to be submitted in detail to Consultant for review and consideration for acceptance. There will be no increase in Contract Price for revisions. Above conditions supplement and are not to supersede any specification conditions with regards to substitutions or failure to supply product as per issued documents.

.7 Listing of a product as "acceptable" does not imply automatic acceptance by Consultant and/or Owner. It is responsibility of Contractor to ensure that any price quotations received and submittals made are for products that meet or exceed specifications included herein.

.8 If products supplied by a manufacturer named as acceptable are used in lieu of base specified manufacturer, be responsible for ensuring that they are equivalent in performance and operating characteristics (including energy consumption if applicable) to base specified products. It is understood that any additional costs (i.e. for larger starters, larger feeders, additional spaces, etc.), and changes to associated or adjacent work resulting from provision of product supplied by a manufacturer other than base specified manufacturer, is included in Bid Price. In addition, in equipment spaces where equipment named as acceptable is used in lieu of base specified equipment and dimensions of such equipment differs from base specified equipment, prepare and submit for review accurately dimensioned layouts of rooms affected, identifying architectural and structural elements, systems and equipment to prove that equipment in room will fit properly meeting design intent. There will be no increase in Contract Price for revisions.

.9 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are approved by Owner and reviewed in writing by Consultant.

.10 If provided in contract bid form, indicate in Supplementary Mechanical Bid Form, names of manufacturers for proposed products to be supplied, and which were based specified or scheduled with a manufacturer's name. Names of proposed manufacturers on list must be one of names stated as acceptable for particular products, unless prior approval from Owner has been given for use of products by other manufacturers. Submit to Consultant for review as directed.

.11 When requested by Consultant, identify names of manufacturers for proposed products to be supplied, and which were based specified or scheduled with a manufacturer's name. Names of proposed manufacturers on list must be one of names stated as acceptable for products, unless prior approval from Owner has been given for use of products by other manufacturers. Submit to Consultant for review as directed.

.12 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of base specified product and is equivalent or better than base specified product. When requested by Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of Consultant. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of approved equal product. There must be no increase in Contract price due to Consultant's rejection of proposed equivalent product.

.13 Whenever use of product other than base specified product is being supplied, ensure corresponding certifications and product information (detailed catalogue and engineering data, fabrication information and performance characteristics) are submitted to Consultant for review. Failure of submission of these documents to Consultant in a timely manner to allow for review will result in base specified product to be supplied at Consultant's discretion, at no additional cost to Contract.

.14 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by Consultant if requested in writing with full product documentation submitted, a minimum of 10 working days prior to Bid closing date.

.15 Any proposed changes initiated by Contractor after award of Contract may be considered by Consultant at Consultant's discretion, with any additional costs for such changes if accepted by Owner and reviewed with Consultant, and costs for review, to be borne by Contractor.

.16 Whenever use of product other than based specified products or named as acceptable is being supplied, time for process of submission of other products and Consultant's review of products will not alter contract time or delay work schedule.

1.15 SHOP DRAWINGS

.1 At start-up meeting, review with Consultant products to be included in shop drawing submission. Prepare and submit list of products to Consultant for review.

.2 Submit electronic copies of shop drawings unless otherwise directed by Consultant. Coordinate exact requirements with Consultant.

.3 Submit for review, drawings showing detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to Consultant for review prior to ordering and delivery of product to site. Include minimally for preparation and submission of following, as applicable:

.1 product literature cuts;

.2 equipment data sheets;

.3 equipment dimension drawings;

.4 system block diagrams;

.5 sequence of operation;

.6 connection wiring schematic diagrams;

.7 functionality with integrated systems.

.4 Each shop drawing or product data sheet is to be properly identified with project name and product drawing or specification reference. Shop drawing or product data sheet dimensions are to match dimension type on drawings.

.5 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure this requirement is clearly indicated on submission.

.6 Ensure proposed products meet each requirement of Project. Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS". Include company name, submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned to be resubmitted.

.7 Consultant to review shop drawings and indicate review status by stamping shop drawing copies as follows:

.1 "REVIEWED" or "REVIEWED AS NOTED" (appropriately marked) – If Consultant's review of shop drawing is final, Consultant to stamp shop drawing;

.2 "RETURNED FOR CORRECTION" – If Consultant's review of shop drawing is not final, Consultant to stamp shop drawing as stated above, mark submission with comments, and return submission. Revise shop drawing in accordance with Consultant's notations and resubmit.

.8 Following is to be read in conjunction with wording on Consultant's shop drawing review stamp applied to each and every shop drawing or product data sheet submitted:

"THIS REVIEW BY CONSULTANT IS FOR SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH GENERAL DESIGN CONCEPT. THIS REVIEW DOES NOT MEAN THAT CONSULTANT APPROVES DETAILED DESIGN INHERENT IN SHOP DRAWINGS, RESPONSIBILITY FOR WHICH REMAINS WITH CONTRACTOR. CONSULTANT'S REVIEW DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR ERRORS OR OMISSIONS IN SHOP DRAWINGS OR OF CONTRACTOR'S RESPONSIBILITY FOR MEETING REQUIREMENTS OF CONTRACT DOCUMENTS. BE RESPONSIBLE FOR DIMENSIONS TO BE CONFIRMED AND CORRELATED AT JOB SITE, FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION AND INSTALLATION, AND FOR COORDINATION OF WORK OF SUB-TRADES."

.9 Submit each system and each major component as separate shop drawing submissions. Submit together, shop drawings for common devices such as devices of each system are to be submitted together.

.10 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.

.11 Do not order product until respective shop drawing review process has been properly reviewed with Consultant.

.12 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.

.13 Refer to specific requirements in other Sections.

.14 Applicable mechanical equipment has been selected to meet energy efficiency requirements of ANSI/ASHRAE/IES 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment are to indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.16 ENGINEERED SUBMITTALS

.1 Submittals for items required to be sealed by a professional engineer (engineered) are to be duly prepared, sealed, and signed under direct control and supervision of a qualified professional engineer licensed in jurisdiction of the work. Professional engineer is to conform to requirements specified in this Section in article entitled Requirements for Contractor Retained Engineers.

.2 Engineered submittals are to include, but not be limited to, following:

.1 complete CAD layout drawings indicating equipment, piping schematic, pipe routing and sizing, zones, devices, wiring schematics, and any other pertinent data;

.2 listing of design data used to determine system layout and sizing;

.3 complete copies of design calculations and listing of design data used in preparing calculations;

.4 list detailing standards, codes, regulations, etc. adhered to when designing system;

.5 items as noted in other Sections of the Specification.

.3 Professional engineer responsible for engineered submittals is to perform periodic field reviews, including review of associated mock-ups where applicable, at locations wherever work as described by engineered submittal is in progress, during fabrication and installation of such work, and submit a field review report after each visit. Submit field review reports to Consultant and authorities having jurisdiction as required.

.4 Field reviews are to be at intervals as necessary and appropriate to progress of work described by engineered submittal to allow engineer to be familiar with progress and quality of such work and to determine if work is proceeding in general conformity with Contract Documents including reviewed shop drawings and design calculations.

.5 Upon completion of work as described by engineered submittal, professional engineer responsible for preparation of engineered submittal and for performing periodic field reviews is to prepare and submit to Consultant and, if applicable, authorities having jurisdiction, a letter certifying that work has been supplied and installed in accordance with requirements of Contract Documents, authorities having jurisdiction and engineered submittal.

1.17 EQUIPMENT LOADS

.1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to Consultant, via shop drawing submissions, prior to construction.

.2 Where given choice of specific equipment, actual weight, location and method of support of equipment may differ from those assumed by Consultant for base design. Back-check equipment loads, location, and supports, and include necessary accommodations.

.3 Where supporting structure consists of structural steel framing, it is imperative that equipment loads, location, and method of support be confirmed prior to fabrication of structural steel. Review locations of equipment with Consultant prior to construction.

1.18 OPENINGS

.1 Supply opening sizes and locations to Consultant to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.

.2 No openings are permitted through completed structure without written approval from Owner and reviewed with Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to Consultant for review, well in advance of doing work.

.3 Prior to leaving site at end of each day, walk through areas of work and check for any openings, penetrations, holes, and/or voids created under scope of work of project, and ensure that any openings created under scope of work have been closed off, fire-stopped and smoke-sealed. Unless otherwise directed by Owner and reviewed with Consultant, do not leave any openings unprotected and unfinished overnight.

1.19 SCAFFOLDING, HOISTING AND RIGGING

.1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Owner and reviewed with Consultant.

.2 Use scaffolds in such a manner as to interfere as little as possible with work of other trades.

.3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Owner and reviewed with Consultant. No supports, clips, brackets or similar devices are to be welded, bolted or otherwise affixed to any finished member or surface without approval from Owner and review with Consultant.

.4 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.

1.20 CHANGES IN THE WORK

.1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity or type of work from that required by Contract Documents, prepare and submit to Consultant for review, a quotation detailing proposed cost for executing change or revision.

.2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.

.3 If overhead and profit percentages are not specified in Division 00 or 01, but allowable under Contract as reviewed with Consultant prior to contract signing, then allowable maximum percentages for overhead and profit are to be 5% for each.

.4 Unless otherwise specified in Divisions 00 or 01, following additional requirements apply to all quotations submitted:

.1 when change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work;

.2 material costs are not to exceed those published in local estimating price guides with additional reductions as follows:

.1 steel pipe: 50%;

.2 copper pipe: 45%;

.3 cast iron soil pipe: 45%;

.4 stainless steel pipe and fittings: 45%;

.5 welded fittings: 50%;

.6 grooved fittings: 30%

.7 threaded fittings: 40%;

.8 cast iron screwed fittings: 40%;

.9 copper fittings: 45%;

.10 cast iron MJ fittings: 35%;

.11 valves: 25%;

.12 insulation materials: 35%;

.13 all other materials: 20%.

.3 mechanical material labour unit costs are to be in accordance with Mechanical Contractors Association of America Labor Estimating Manual, less 25%;

.4 electrical material labour unit costs are to be in accordance with National Electrical Contractors Association Manual of Labor Units at normal level, less 25%;

.5 costs for journeyperson and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work;

.6 cost for site superintendent must not exceed 10% of total hours of labour estimated for change or revision, and change or revision must be such that site superintendent's involvement is necessary;

.7 costs for rental tools and/or equipment are not to exceed local rental costs;

.8 overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals;

.9 quotations, including those for deleted work, to include a figure for any required change to Contract time.

.5 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.

.6 Make requests for changes or revisions to work in writing to Consultant and, if accepted by Owner, Notice of Change to be issued.

.7 Do not execute any change or revision until written authorization for the change or revision has been obtained from Consultant.

1.21 PROGRESS PAYMENT BREAKDOWN

.1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.

.2 Payment breakdown is subject to Owner's approval and Consultant's review. Progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, system testing and verification, and project closeout submittals.

.3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as indicated on progress draw.

1.22 NOTICE FOR REQUIRED FIELD REVIEWS

.1 Whenever there is a requirement for Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 7 working days' notice in writing to Consultant.

.2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.

.3 Do not conceal work until Consultant advises that it may be concealed.

.4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses.

1.23 PRELIMINARY TESTING

.1 When directed by Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with Specification and governing Codes and Regulations, prior to Substantial Performance of the Work.

.2 When, in Consultant's opinion, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.

.3 These tests are not to be construed as evidence of acceptance of work, and it is agreed and understood that no claim for delays or damage will be made for injury or breakage to any part or parts of equipment or system due to test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.

.4 When, in Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from site and replace them with acceptable equipment and/or products, at no additional cost.

1.24 PROVISIONS FOR SYSTEMS/EQUIPMENT USED DURING CONSTRUCTION

.1 Permanent mechanical systems in building may be used for temporary heating or cooling during construction subject to following conditions:

.1 each entire system is complete, pressure tested, cleaned, and flushed out;

.2 specified water treatment system has been commissioned, and treatment is being continuously monitored;

.3 building has been closed in and areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes;

.4 there is no possibility of damage from any cause;

.5 supply ventilation systems are protected by 60% filters, which are to be inspected daily, and changed every 2 weeks, or more frequently as required;

.6 return air systems have approved construction filters over openings, inlets, and outlets;

.7 systems are operated in accordance with manufacturer's recommendations or instructions, and are monitored on a regular and frequent basis;

.8 warranties are not affected in any way;

.9 regular preventive and other manufacturer's recommended maintenance routines are performed;

.10 before application for Certificate of Substantial Performance, each entire system is to be refurbished, cleaned internally and externally, restored to "as-new" condition, and filters in air systems replaced;

.11 energy costs are to be paid by Contractor.

.2 Confirm with Consultant what equipment can be used during construction.

.3 Any system or piece of equipment that is specified to be provided under requirements of Documents and is required to be used during construction stages of work prior to issuing of Certificate of Substantial Performance of the Work, are to be provided with special interim maintenance and service to cover systems/equipment during time of use during construction period of project until project has been certified as substantially performed and such systems/equipment are turned over to Owner.

.4 During this period of construction, such systems/equipment to not become property of Owner or be Owner's responsibility for maintenance or service. Systems/equipment are to remain property of respective manufacturers/suppliers or Contractor, who are responsible for full maintenance and servicing of systems/equipment in order to maintain validity of warranties after turn over to Owner.

.5 Prior to application for a Certificate of Substantial Performance of the Work and turn over to Owner, such systems/equipment to be cleaned, restored to "new" condition, paint finishes "touched-up", filters cleaned or replaced, etc.

1.25 TEMPORARY SERVICES

.1 Coordinate with Prime Contractor, requirements for temporary services including but not limited to temporary heating, cooling and water. Unless otherwise noted, provide required services in compliance with requirements of local governing building code and local governing inspection authorities.

.2 Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

1.26 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

.1 Maintain equipment in accordance with manufacturer's instructions prior to start-up, testing and commissioning.

.2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.

.3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.

.4 All filters are to be new upon Substantial Performance of the Work. This is in addition to any spare filters specified.

1.27 CLEANING

.1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Owner and Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.

.2 Clean equipment and devices installed as part of this project.

1.28 RECORD AS-BUILT DRAWINGS

.1 Drawings for this project have been prepared on a CAD system using AutoCAD software of release version reviewed with Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from Consultant.

.2 As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date at all times, and ensure set is always available for periodic review. As-built set is also to include the following:

.1 dimensioned location of inaccessible concealed work;

.2 locations of control devices with identification for each;

.3 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;

.4 for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings;

.5 location of piping system air vents;

.6 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.

.3 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of Consultant.

.4 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant. Save drawings as AutoCAD files and in pdf format and such that each drawing is not x-referenced but as complete drawing.

.5 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with software release version reviewed with Consultant.

.6 For projects with phased turnover of project (refer to Division 01), review with Consultant completeness of as-built drawings prior to turn over of an area. Copies of hand drawn interim as-built drawings to be made available to Owner's maintenance personnel.

1.29 OPERATING AND MAINTENANCE MANUALS

.1 For each item of equipment for which a shop drawing is required (except for simple equipment), supply minimum 3, project specific, indexed copies of equipment manufacturers' operating and maintenance (O&M) manuals. Review exact quantity of manuals with Consultant. Consolidate each copy of data in an identified hard cover three "D" ring binder. Each binder to include:

.1 front cover: project name; wording – "Mechanical Systems Operating and Maintenance Manual"; and date;

.2 introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;

.3 equipment manufacturer's authorized contact person name, telephone number and company website;

.4 Table of Contents sheet, and corresponding index tab sheets;

.5 copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;

.6 operating data as follows:

.1 pressure test reports, and certificates issued by governing authorities;

.2 description of each system and its controls;

.3 control schematics for equipment/systems including building environmental controls;

.4 wiring and connection diagrams;

.5 if applicable, BAS architecture and required operating data;

.6 description of operation of each system at various loads together with reset schedules and seasonal variances;

.7 operation instruction for each system and each component;

.8 description of actions to be taken in event of emergencies and/or equipment failure;

.9 valve tag schedule, and flow diagrams to indicate valve locations.

.7 maintenance data as follows:

.1 operation and trouble-shooting instructions for each item of equipment and each system;

.2 schedules of tasks, frequency, tools required, and estimated task time;

.3 recommended maintenance practices and precautions including warnings of any maintenance practice that will damage or disfigure equipment/systems;

.4 complete parts lists with numbers.

.8 performance data as follows:

.1 equipment and system start-up data sheets;

.2 equipment performance verification test results, and final commissioning report;

.3 final testing, adjusting and balancing reports.

.9 copies of warranties;

.10 items requested specifically in Section Articles.

.2 Generally, binders are not to exceed 75 mm (3") thick and not to be more than 2/3 full.

.3 Operating and maintenance instructions are to relate to job specific equipment supplied under this project and related to Owner's building. Language used in manuals is to contain simple practical operating terms and language easy for in-house maintenance staff to understand how to operate and maintain each system.

.4 Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O&M Manual and submit to Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.

.5 Provide 2 digital copies of contents of operating and maintenance manuals and load onto separate USB type flash drives and submit to Consultant. Prepare digital copies using version of Adobe Acrobat Portable Document Format or equal as reviewed with Consultant and enhanced with bookmarks and internal document links.

1.30 COMMISSIONING

.1 After successful start-up and prior to Substantial Performance of the Work, commission the mechanical work. Commissioning work is the process of Contractor demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, as further described below.

.1 Retain services of a testing, adjusting, and balancing agency to perform testing and balancing of mechanical system air/fluid flows and capacities, prior to operational performance testing. Refer to Section entitled Testing, Adjusting and Balancing.

.2 Test, adjust and operate equipment and systems after start-up but before functional performance testing, to confirm operations are in accordance with requirements of Contract Documents. Verify modes and sequences of control and monitoring, interlocks, and responses to emergency conditions. Complete commissioning data sheets to document successful operational performance testing.

.3 Repeat successful operational performance testing with completed commissioning data sheet documentation in the presence of Consultant and Owner to validate and verify equipment and systems are complete in all respects, function correctly, and are ready for acceptance.

.4 Submit final commissioning data sheets, TAB reports as specified in Section entitled Testing, Adjusting and Balancing, project closeout documents, and other required submittals.

1.31 WARRANTY

.1 Unless otherwise specified in Divisions 00 and 01, warrant mechanical work to be in accordance with Contract Documents and free from defects for a period of 1 year from date of issue of a Certificate of Substantial Performance of the Work.

.2 Where equipment includes extended warranty period, e.g., 5 years, first year of warranty period is to be governed by terms and conditions of warranty in Contract Documents, and remaining years of warranty are to be direct from equipment manufacturer and/or supplier to Owner. Submit signed and dated copies of extended warranties to Consultant.

.3 Warranty to include parts, labour, travel costs and living expenses incurred by manufacturer's authorized technician to provide factory authorized on-site service.

.4 Repair and/or replace any defects that appear in Work within warranty period without additional expense to Owner. Be responsible for costs incurred in making defective work good, including repair or replacement of building finishes, other materials, and damage to other equipment. Ordinary wear and tear and damage caused wilfully or due to carelessness of Owner's staff or agents is exempted.

.5 Do not include Owner deductible amounts in warranties.

.6 Visit building during warranty period with Owner representatives. Owner to organize these visits. At these meetings, Owner representatives are to review performance of systems. If performance is satisfactory, then no further action needs to be taken. If unsatisfactory, then correct deficiencies, as directed by Owner representatives, to satisfaction of Owner's representatives. These site visits to occur:

.1 once during 1st month of building operation;

.2 once during 3rd month of building operation;

.3 once between 4th and 10th month in a season opposite to 1st and 3rd month visits.

1.32 PROJECT CLOSEOUT SUBMITTALS

.1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following:

.1 O&M Manuals;

.2 as-built record drawings and associated data;

.3 extended warranties for equipment as specified;

.4 operating test certificates, i.e. Sprinkler Test Certificate;

.5 final commissioning report and TAB report;

.6 identified keys for equipment and/or panels for which keys are required, and other items required to be submitted;

.7 other data or products specified.

.2 Refer to additional requirements in Division 01.

1.33 INSTRUCTIONS TO OWNER

.1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.

.2 Train Owner's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.

.3 Unless where specified otherwise in trade Sections, minimum requirements are for manufacturer/suppliers of each system and major equipment, to provide minimum two separate sessions each consisting of minimum 4 hours on site or in factory training (at Owner's choice), of Owner's designated personnel (for up to 6 people each session), on operation and maintenance procedures of system.

.4 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use O&M Manuals during training sessions. Training modules include but are not limited to:

.1 Operational Requirements and Criteria – equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;

.2 Troubleshooting – diagnostic instructions, test and inspection procedures;

.3 Documentation – equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;

.4 Maintenance – inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools;

.5 Repairs – diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.

.5 Before instructing Owner's designated personnel, submit to Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.

.6 Obtain in writing from Consultant list of Owner's representatives to receive instructions. Submit to Consultant prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:

.1 date instructions were given to Owner's staff;

.2 duration of instruction;

.3 names of persons instructed;

.4 other parties present (manufacturer's representative, consultants, etc.).

.7 Obtain signatures of Owner's staff to verify they properly understood system installation, operation and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings.

.8 Submit to Consultant, copy of electronic version of training materials loaded on USB flash drive. Include in operating and maintenance manuals submission.

1.34 FINAL INSPECTION

.1 Submit to Consultant, written request for final inspection of systems. Include written certification that:

.1 deficiencies noted during job inspections have been completed;

.2 field quality control procedures have been completed;

.3 systems have been tested and verified, balanced and adjusted, and are ready for operation;

.4 maintenance and operating data have been completed and submitted to, reviewed with Consultant and accepted by Owner;

.5 tags and nameplates are in place and equipment identifications have been completed;

.6 clean-up is complete;

.7 spare parts and replacement parts specified have been provided, as confirmed by Owner and reviewed with Consultant;

.8 as-built and record drawings have been completed and submitted to and reviewed with Consultant and accepted by Owner;

.9 Owner's staff has been instructed in operation and maintenance of systems;

.10 commissioning procedures have been completed.

2 PRODUCTS

2.01 NOT USED

3 EXECUTION

3.01 NOT USED

END OF SECTION

1 GENERAL

1.01 REFERENCE

.1 Division 00 and Division 01 apply to and are a part of each Mechanical Division Section.

1.02 APPLICATION

.1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Mechanical Divisions. It is intended as a supplement to each Section and is to be read accordingly.

1.03 SUBMITTALS

.1 Submit shop drawings/product data sheets for:

.1 pressure gauges and thermometers;

.2 electric motors (submit with equipment they are associated with).

.2 Submit weight loads for selected equipment (upon request).

.3 Submit copy of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations.

.4 Submit samples of materials and any other items as specified in Sections of Mechanical Divisions.

.5 Submit list of equipment identification nameplates indicating proposed wording and sizes.

.6 Submit list of pipe and duct identification colour coding and wording.

.7 Submit proposed valve tag chart and a list of proposed valve tag numbering and identification wording.

.8 Submit drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.

.9 As specified in Part 2 of this Section, submit spare belt set, tagged and identified, for each belt driven piece of equipment.

.10 Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

2 PRODUCTS

2.01 PIPE SLEEVES

.1 Galvanized Sheet Steel – Minimum #16 gauge galvanized steel with an integral flange at one end to secure sleeve to formwork construction.

.2 Polyethylene – Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.

.3 Waterproof Galvanized Steel Pipe – Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at sleeve midpoint.

.4 Galvanized Steel or Cast Iron Pipe – Schedule 40 mild galvanized steel, or Class 4000 cast iron.

2.02 FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in Section entitled Firestopping and Smoke Seal Systems and work is to be included as part of mechanical work.

2.03 PIPE ESCUTCHEON PLATES

.1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to building surface, each plate sized to completely cover pipe sleeve or building surface opening, and to fit tightly around pipe or pipe insulation.

2.04 PIPING HANGERS AND SUPPORTS

.1 Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to following requirements:

.1 unless otherwise specified, ferrous hanger and support products are to be electro-galvanized;

.2 hangers and supports for insulated piping are to be sized to fit around insulation and insulation jacket.

.2 Hangers and supports for horizontal suspended piping as follows:

.1 adjustable steel clevis hanger – MSS Type 1;

.2 adjustable swivel ring band hanger – MSS Type 10;

.3 adjustable roller hanger – MSS Types 41, 43, and/or 45, with MSS Type 39 steel protection saddle.

.3 Supports for horizontal pipe on vertical surfaces as follows:

.1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;

.2 heavy-duty steel pipe clip – MSS Type 26;

.3 single steel pipe hook – Myatt Fig. 156;

.4 epoxy coated steel pipe stays are not permitted.

.4 Floor supports for vertical risers as follows:

.1 copper tubing riser clamp – MSS Type 8;

.2 heavy-duty steel riser clamp – MSS Type 8.

.5 Supports for vertical piping on vertical surfaces as follows:

.1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;

.2 heavy-duty steel pipe bracket or soil pipe bracket – MSS Type 26;

.3 extension split pipe clamp – MSS Type 12;

.4 epoxy coated steel pipe stays are not permitted.

.6 For horizontal pipe on racks, Unistrut or approved equal galvanized steel pipe racks with pipe securing hardware as follows:

.1 standard galvanized steel U-bolts/clamps supplied by rack manufacturer;

.2 adjustable roller chair – MSS Type 44 with MSS Type 39 steel protection saddle.

.7 Special hangers and supports for various applications as follows:

.1 vibration isolated riser supports – black steel riser clamps as specified above, complete with neoprene–steel–neoprene sandwich type vibration isolation pads between clamp and floor;

.2 for groups of pipes having same slope – MSS Type 32 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or approved equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place;

.3 for sections of piping connected to vibration isolated equipment – hangers and supports as specified above but complete with MSS Type 48 spring cushions;

.4 for piping on existing roof – Portable Pipe Hangers (Canada) Inc. "PP" Series prefabricated portable pipe support system components to suit pipe, complete with required accessories including bases, galvanized structural steel frames, and galvanized steel pipe hangers and supports conforming to MSS SP-58;

.5 for piping on new roofs – Lexcor "Flash-Tite" or Thaler Roofing Specialties Products Inc. "MERS" Series insulated aluminum support risers with diameter, height, securement method and flashing to suit the application, channel type aluminum cross members, and galvanized steel pipe hangers and supports conforming to MSS SP-58, complete with required accessories;

.6 for glass drain and vent piping – special padded hangers supplied by pipe supplier;

.7 for plastic piping – generally as specified above but in accordance with pipe manufacturer's recommendations;

.8 for fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of NFPA Standard applicable to piping system;

.9 for bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact;

.10 for bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate pipe from clamp;

.11 insulation protection shields to and including 40 mm (1-½") dia. – MSS Type 40 galvanized steel shields with ribs to keep shield centred on hanger.

.8 Hanger rods are to be electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to suit loading in accordance with Table 3 in MSS SP-58, but in any case minimum 9.5 mm (3/8") diameter.

.9 Acceptable manufacturers are:

.1 E. Myatt & Co. Inc.;

.2 Anvil International Inc.;

.3 Empire Industries Inc.;

.4 Hunt Manufacturing Ltd.;

.5 Unistrut Canada Ltd.;

.6 Nibco Inc. "Tolco";

.7 Taylor Pipe Supports.

2.05 ACCESS DOORS

.1 Access doors to be provided under work of Division 08 by General Trades Contractor.

.2 Coordinate with Mechanical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services, where possible, be accessible from common access door. Coordinate work to ensure same common location access doors are not supplied by more than one Division.

.3 Size access doors to suit the concealed work for which they are supplied, and wherever possible they are to be of standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.

.4 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain fire separation integrity.

.5 Identify on reflected ceiling plans and wall elevation drawings, coordinated locations of proposed access door locations and submit to Consultant for review.

2.06 PRESSURE GAUGES AND THERMOMETERS

.1 Pressure gauges as follows:

.1 adjustable, glycerine filled, 100 mm or 115 mm (4" or 4-½") diameter and each accurate to within 1% of scale range;

.2 type 304 stainless steel case with relief valve and polished stainless steel bayonet;

.3 stainless steel rotary movement with stainless steel bushings and socket;

.4 clear acrylic window;

.5 dual scale white dial with a scale range such that working pressure of system is at approximate mid-point of scale;

.6 black pointer.

.2 Pressure gauge accessories and additional requirements as follows:

.1 bronze ball type shut-off valve is to be provided in piping to each pressure gauge;

.2 each pressure gauge for piping and equipment with normal everyday flow is to be equipped with a brass pressure snubber;

.3 pressure gauges in fire protection piping must be ULC listed and labelled;

.4 pressure gauges in medical gas piping systems are to conform to CSA Z7396.1 and are to be identified with name of service it is provided for as well as "USE NO OIL".

.3 Thermometers as follows:

.1 round, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type thermometers, each accurate to within 1% of full scale;

.2 hermetically sealed stainless steel case with stainless steel ring;

.3 dampened bimetal coil;

.4 calibration adjustment screw;

.5 white aluminum dual scale dial with black and blue markings and a range such that working temperature of system is approximate mid-point of the scale;

.6 black aluminum pointer;

.7 double strength glass window;

.8 12 mm (½") NPT connection with 6.4 mm (¼") diameter stainless steel stem;

.9 suitable thermowell.

.4 Acceptable manufacturers are:

.1 H.O. Trerice Co.;

.2 Weiss Instruments;

.3 Ashcroft.

2.07 EQUIPMENT BELT DRIVES

.1 ANSI/RMA Standard V-belt type rated at minimum 1.5 times motor nameplate rating, and in accordance with following requirements:

.1 belts are to be reinforced cord and rubber, and multiple belts are to be matched sets;

.2 sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch (± 10% range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of mechanical work to suit system air/water quantity testing and balancing work;

.3 motor slide rail adjustment plates are to allow for centre line adjustment.

.2 Supply a spare belt set (tagged and identified) for each belt drive as reviewed with Consultant, and turn over to Owner upon Substantial Performance of the Work.

2.08 EQUIPMENT DRIVE GUARDS AND ACCESSORIES

.1 For V-belt drives – removable, 4-sided, fully enclosed, galvanized sheet steel guards to OHSA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing guard, and 40 mm (1-½") diameter tachometer openings at each shaft location.

.2 For flexible couplings – removable "U" shaped galvanized steel guards to OHSA Standards with a 2.3 mm (3/32") thick frame and expanded mesh face.

.3 For unprotected fan inlets and outlets – unless otherwise specified, removable 20 mm (¾") galvanized steel wire mesh with galvanized steel frames, all to OHSA Standards.

2.09 ELECTRIC MOTORS

.1 Unless otherwise specified, motors are to conform to NEMA Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.

.2 Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.

.3 Efficiency of 1-phase motors to 1 HP is to be in accordance with CAN/CSA C747. Efficiency of 3-phase motors 1 HP and larger is to be in accordance with CAN/CSA C390 or IEEE 112B.

.4 Unless otherwise specified, 1-phase motors smaller than ½ HP are to be 115 volt, continuous duty capacitor start type with an NEMA 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.

.5 Explosion-proof 1-phase motors are to be totally enclosed, fan cooled, 115 volt continuous duty capacitor start type in accordance with CSA C22.2 No. 145, as specified for standard 1-phase motors but suitable for use in Class 1 Group D hazardous locations and complete with a rolled steel shell and a 1.0 service factor at 40°C (105°F) ambient temperature.

.6 Unless otherwise specified, motors ½ HP and larger are to be totally enclosed, fan cooled, 3-phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on Drawings, NEMA Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "B" insulation, a 1.15 service factor at 40°C ambient temperature, grease lubricated open ball bearings with grease fittings to permit re-lubrication without dismantling motor, a cast iron frame with cast iron feet where required, cast iron end bracket and precision machined bearing fit, and balanced carbon steel shaft assembly with die-cast aluminum rotor windings.

.7 Explosion-proof 3-phase motors are to be totally enclosed fan cooled motors in accordance with CSA C22.2 No. 145, generally as specified above for standard 3-phase motors but suitable for use in Class 1 Group D hazardous locations and with a 1.0 service factor at 40°C (105°F) ambient temperature.

.8 Motor(s) for 2-speed cooling tower(s) are to be as specified above but 2-speed single winding type.

.9 Motor(s) for 2-speed fan(s) are to be as above but 2-speed double winding type.

.10 Unless otherwise indicated, motors 30 HP and larger are to be complete with a heat sensing PTC thermistor in the end turn of stator winding for each phase and connected in series inside motor with 2 marked leads brought out to motor conduit box.

.11 Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1 Part 31, quantified by CSA for operation from a variable frequency drive of type specified, and complete with Class "H" insulation. Motors are to be equipped with AEGIS, or approved equal, shaft grounding ring system to protect bearings from damage by diverting harmful shaft voltages and bearing currents to ground.

.12 Motors 150 HP and larger with "wye-delta" reduced voltage starters are to be complete with six leads for connection to motor starter.

.13 Motors for equipment which is scheduled or specified with a corrosion resistant coating or constructed from corrosion resistant materials are to be factory coated with a primer and epoxy paint finish.

.14 Acceptable manufacturers are:

.1 TECO-Westinghouse Motors (Canada) Inc.;

.2 Canadian General Electric;

.3 Baldor Electric Co.;

.4 U.S. Electrical Motors;

.5 WEG Electric Corp.;

.6 Marathon Electric;

.7 Toshiba Corp.;

.8 Leeson Canada.

2.10 MOTOR STARTERS AND ACCESSORIES

.1 Motor starters to be capable of starting associated motors under imposed loads. Confirm starter voltage matches motor prior to ordering.

.2 Unless otherwise specified, starters for 1-phase motors are to be 115 volt, thermal overload protected manual starting switches with neon pilot light, surface or recessed enclosure to suit application, and, where automatic operation is required, separate H-O-A switch in enclosure to match starter enclosure.

.3 Unless otherwise specified, starters for 3-phase motors less than 50 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with overload relay per phase, enclosure to suit application, and accessories in accordance with motor starter schedule.

.4 Unless otherwise specified, starters for 3-phase motors 50 HP to 150 HP are to be reduced voltage, non-reversing, auto-transformer type starters complete with one overload relay per phase, enclosure to suit application, and accessories in accordance with motor starter schedule.

.5 Unless otherwise specified, starters for 3-phase motors 150 HP and larger are to be reduced voltage, non-reversing, closed transition "wye-delta" starters complete with one overload relay per phase, enclosure to suit application, and accessories in accordance with motor starter schedule.

.6 Starters for 2-speed double winding motors are to be generally as specified above but suitable for motor and equipped with 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.

.7 Starters for 2-speed single winding motors are to be generally as specified above but suitable for motor and equipped with 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.

.8 Starters for reversible motors for cooling towers are to be generally as specified above but suitable for motor and equipped with 45 second time delay to allow fan(s) to coast down to stop before being operated in reverse rotation.

.9 Unless otherwise specified, motor starter enclosures are to be in accordance with following NEMA ratings:

.1 enclosures located in sprinklered areas – Type 2;

.2 enclosures exposed to the elements – Type 3R, constructed of stainless steel;

.3 enclosures inside the building in wet areas – Type 3R, constructed of stainless steel;

.4 enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application;

.5 enclosures except as noted above – Type 1;

.6 enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate.

.10 Motor control centres are to be multi-unit, 2.28 m (9') high, NEMA Class 1, type "B", factory assembled, dead front, floor mounted, free-standing motor control centre with tin plated copper bus and NEMA Type 1 or Type 2 enclosure as for loose starters specified above. Each motor control centre is to be complete with starters as specified above, load and control wiring terminal boards, and required facilities for line and load side power wiring connections.

.11 Disconnect switches for motor control centres are to be heavy-duty, CSA certified, front operated switches as per motor starter schedule, each complete with a handle suitable for padlocking in "off" position and arranged so that door cannot be opened with handle in "on" position and an NEMA enclosure as specified for loose starters. Fusible units are to be complete with fuse clips to suit fuse types specified below.

.12 Fuses are to be, unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off.

.13 Acceptable manufacturers are:

.1 Rockwell Automation Inc. - Allen-Bradley;

.2 Eaton;

.3 Siemens Canada;

.4 Schneider Electric.

2.11 SPRINKLER PROTECTION

.1 Provide drip shields for protection of surface mounted equipment enclosures from water spray and dripping of liquids. Features of shields include:

.1 factory constructed by respective equipment manufacturers;

.2 constructed from non-combustible materials (sheet steel);

.3 enamel painted to match equipment;

.4 surfaces and edges filled/sanded smooth prior to painting;

.5 supported from equipment with structural steel rods/metal framing or other method approved by Consultant;

.6 structural support finish painted to match shield.

.2 Include with equipment shop drawings, detailed dimensions of drip shields and methods of supporting.

.3 Equipment with top cable/conduit entries to include additional sealing of entries with gasketing and/or waterproof sealant to prevent water from entering enclosure.

.4 Design ventilation louvers such that live components are not exposed to water spray and dripping liquids.

.5 Above requirements are additional minimum "sprinkler protection" (or sprinkler proof) standards for equipment specified as NEMA 1, 2 or 12.

.6 Obtain CSA approval where required by local governing authorities.

2.12 MECHANICAL WORK IDENTIFICATION MATERIALS

.1 Equipment nameplates are to be minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2-½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:

.1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved wording to completely identify equipment and its use with no abbreviations;

.2 wording is generally to be as per drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served, but must be reviewed with Consultant prior to engraving;

.3 supply stainless steel screws for securing nameplates in place;

.4 nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.

.2 Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

VALVE V12
200 mm (8")
CHILL. WATER
NORMALLY OPEN

.3 Standard pipe identification to be Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:

.1 for pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;

.2 for pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.

.4 Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	green	DOM. COLD WATER
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
tempered domestic water	green	TEMP. DOM. WATER
chilled drinking water	green	CH. DRINK WTR.
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
acid sanitary drainage	yellow	ACID DRAIN
acid drainage vent	yellow	ACID VENT
fire protection standpipe	red	F.P. STANDPIPE
fire protection sprinklers	red	F.P. SPRINKLER
natural gas	to Code	to Code, c/w pressure

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
natural gas vent	to Code	to Code
propane gas	to Code	to Code, c/w pressure
propane gas vent	to Code	to Code
fuel oil supply	yellow	FUEL OIL SUPPLY
fuel oil return	yellow	FUEL OIL RETURN
fuel oil vent	yellow	FUEL OIL VENT
heating water supply	yellow	HTG. WTR. SUPPLY
heating water return	yellow	HTG. WTR. RETURN
heating water drain	yellow	HTG. WTR. DRAIN
glycol heating supply	yellow	GLY. HTG. SUPPLY
glycol heating return	yellow	GLY. HTG. RETURN
glycol heating drain	yellow	GLY. HTG. DRAIN
glycol heat reclaim return	yellow	GLY. HTG. RECLAIM R.
glycol heat reclaim supply	yellow	GLY. HTG. RECLAIM S.
heat pump geothermal loop – source side supply	green	GEO. LOOP SOURCE SUPPLY
heat pump geothermal loop – source side return	green	GEO. LOOP SOURCE RETURN
heat pump geothermal loop – load side supply	green	GEO. LOOP LOAD SUPPLY
Heat pump geothermal loop – load side return	green	GEO. LOOP LOAD RETURN
condenser water supply	green	COND. WTR. SUPPLY
condenser water return	green	COND. WTR. RETURN
chilled water supply	green	CH. WTR. SUPPLY
chilled water return	green	CH. WTR. RETURN
chilled water drain	green	CH. WTR. DRAIN
low pressure steam	yellow	….kPa STEAM
medium pressure steam	yellow	….kPa STEAM
high pressure steam	yellow	….kPa STEAM

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
low pressure condensate	yellow	L.P. CONDENSATE
medium pressure condensate	yellow	M.P. CONDENSATE
high pressure condensate	yellow	H.P. CONDENSATE
pumped condensate	yellow	PUMPED CONDENSATE
steam vent	yellow	STEAM VENT
boiler feedwater	yellow	BLR. FEEDWATER
boiler blowdown	yellow	BLR. BLOW-OFF
refrigerant suction	yellow	REFRIG. SUCTION
refrigerant liquid	yellow	REFRIG. LIQUID
refrigerant hot gas	yellow	REFRIG. HOT GAS
diesel engine exhaust	yellow	ENGINE EXHAUST
gasoline	yellow	GASOLINE
distilled water	green	DISTILL. WATER
demineralized water	green	DEMIN. WATER
compressed air (< 700 kPa)	green	….kPa COMP. AIR
compressed air (>700 kPa)	yellow	….kPa COMP. AIR
control air	green	CONTROL AIR

.5 Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
yellow	black
green	white
red	white

.6 Duct identification is to be custom made Mylar stencils with 50 mm (2") high lettering to accurately describe duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with lettering background.

2.13 FLEXIBLE CONNECTORS

.1 Double wall stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application. Acceptable manufacturers are:

.1 Hyspan Precision Products Inc.;

.2 Senior Flexonics Ltd.;

.3 The Metraflex Co.

3 EXECUTION

3.01 GENERAL PIPING AND DUCTWORK INSTALLATION REQUIREMENTS

.1 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at ceiling on floors, arranged so that under consideration of all other work in area, maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, as reviewed with Consultant and with Owner approval.

.2 Unless otherwise specified, install work concealed in finished spaces, and concealed to degree possible in partially finished and unfinished spaces. Refer to and examine Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Walls which are painted are considered finished.

.3 Install pipes and ducts parallel to building lines and to each other.

.4 Neatly group and arrange exposed work.

.5 Locate work to permit easy access for service or maintenance as required and/or applicable. Locate valves, dampers and any other equipment which will or may need maintenance or repairs and which are to be installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate accessories at floor level.

.6 Make connections between pipes of different materials using adapters suitable for application. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.

.7 Comply with equipment and material manufacturer's installation instructions unless otherwise specified herein or on drawings, and unless such instructions contradict governing codes and regulations.

.8 Carefully clean ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.

.9 Install piping and ductwork which are to be insulated, to have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around pipe or duct, except for ductwork at fire barriers, terminate insulation at each side of duct fire damper.

.10 Inspect surfaces and structure prepared by other trades before performing work. Verify surfaces or structure to receive work has no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing to Consultant. Installation of work will constitute acceptance of such surfaces as being satisfactory.

.11 Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both, is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean piping prior to being concealed.

.12 For factory applied finishes, repaint or refinish surfaces damaged during shipment and installation. Quality of repair work is to match original finish. This requirement also applies to galvanized finishes.

.13 Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminium ductwork, copper or stainless steel pipe, etc.

.14 Provide screwed unions or flanges in piping connections to equipment and in regular intervals in long (in excess of 12 m [40']) piping runs to permit removal of sections of piping.

.15 Unless otherwise specified and except where space limitations do not permit, piping elbows are to be long radius. Eccentric reducers are to be installed with straight side at top of piping.

3.02 PIPE JOINT REQUIREMENTS

.1 Do not make pipe joints in walls or slabs.

.2 Ream piping ends prior to making joints.

.3 Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After pipe has been screwed into fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.

.4 Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove scale and oxide from bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.

.5 Welded joints are to be made by CWB certified licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until welder making joints has inspected them for quality assurance. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.

.6 Unless otherwise specified, make flanged joints with Garlock 5500 or approved equal gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than length necessary to screw nut up flush to end of bolt. Bolts used for flanged connections in piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193 Grade B-7, with heavy hexagon nuts to ASTM A-194 CL-2H. Provide suitable washers between each bolt head and flange and between each nut and flange.

.7 A random check by Consultant at Consultant's option, of bolted flanged connections may be made to verify flanged connections are properly mated with no shear force acting on bolts. When such random check is made, supply labour to disconnect and reconnect selected flanged joints. If improperly mated joints are found, remove and reinstall affected piping so flanges mate properly. If improperly mated joints are found, additional joints may be checked, and be responsible for repair of any other improper joints discovered.

.8 Unless otherwise specified make soldered joints in copper piping using flux suitable for and compatible with type of solder being used. Clean outside of pipe end and inside of fitting, valve, or similar accessory prior to soldering.

.9 Install mechanical joint fittings and couplings in accordance with manufacturer's instructions.

.10 Grooves are to be rolled. Make arrangements with coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding grooved piping system.

.11 If pressure crimped couplings and fittings are used, ensure gaskets are fully compatible with piping fluid, and valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of piping system.

.12 Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with manufacturer's recommendations, ASTM D2855, and CSA requirements.

.13 Install PVC piping with gasketed joints in accordance with manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

3.03 INSTALLATION OF PIPE SLEEVES

.1 Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:

.1 in poured concrete slabs – unless otherwise specified, minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves;

.2 in concrete or masonry walls – Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.

.2 Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with waterstop plate in accordance with drawing detail. Provide waterproof sleeves in following locations:

.1 in mechanical room floor slabs, except where on grade;

.2 in slabs over mechanical, fan, electrical and telephone equipment rooms or closets;

.3 in floors equipped with waterproof membranes;

.4 in roof slab;

.5 in waterproof walls.

.3 Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around pipes, or where pipe is insulated, 12 mm (½") clearance around pipe insulation.

.4 Pack and seal void between pipe sleeves and pipe or pipe insulation in non-fire rated construction for length of sleeves as follows:

.1 pack sleeves in interior construction with mineral wool and seal both ends of sleeves with non-hardening silicone base caulking compound;

.2 pack sleeves in exterior walls above grade with mineral wool and seal both ends of sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified;

.3 seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified.

.5 Where sleeves are required in masonry work, accurately locate and mark sleeve location, and hand sleeves to mason for installation.

.6 Terminate piping for sleeves that will be exposed so sleeve is flush at both ends with building surface concerned so sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above finished floor.

.7 "Gang" type sleeving will not be permitted.

.8 Where sleeves are provided in non-fire rated construction for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of sleeved opening.

3.04 INSTALLATION OF WATERPROOF MECHANICAL SEALS

.1 Provide watertight link type mechanical seals in exterior wall openings.

.2 Assemble and install each mechanical seal in accordance with manufacturer's instructions.

.3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until seal is completely watertight.

3.05 DUCT OPENINGS

.1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by trade responsible for particular construction in which opening is required.

.2 Size openings for fire dampers to 600 mm (24") high to suit damper arrangement with folding blade out of air stream.

.3 For duct openings except where fire dampers are required, pack and seal space between duct or duct insulation and duct opening as specified above for pipe openings in non-fire rated construction.

3.06 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

.1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.

.2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.

.3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.07 INSTALLATION OF PIPE ESCUTCHEON PLATES

.1 Provide escutcheon plates suitably secured over exposed piping passing through finished building surfaces. Finished building surface is any surface with a factory finish or that receives a site applied finish.

.2 Install plates so they are tight against building surface concerned, completely covering pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case fit plate tightly around sleeve.

3.08 INSTALLATION OF FASTENING AND SECURING HARDWARE

.1 Provide fastening and securing hardware required for mechanical work to maintain installations attached to structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding dead loads, live loads, superimposed dead loads, and any vibration of installed products.

.2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where floor, wall or ceiling construction is not suitable to support loads, provide additional framing or special fasteners to ensure proper securement to structure that is to support the products. Provide reinforcing or connecting supports where required to distribute loading to structural components.

.4 Obtain written consent from Owner and review with Consultant, before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CAN/CSA Z166.1 and CAN/CSA Z166.2.

.5 Do not attach fasteners to steel deck without written consent from Owner and review with Consultant.

3.09 INSTALLATION OF PIPE HANGERS AND SUPPORTS

.1 Provide required pipe hangers and supports.

.2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from structure only.

.3 For insulated pipe, size hanger or support to suit diameter of insulated pipe and install hanger or support on outside of insulation and insulation finish.

.4 Support requirements for underground piping are as follows:

.1 support underground pipe, unless otherwise specified, on a well compacted bed of sand earth free from rocks or protrusions of any kind, or on compacted material as specified;

.2 support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs, all as per drawing detail;

.3 ensure bedding and supports for underground pipes are flat and true and allowances are made for pipe hubs, couplings, or other protrusions so no voids are left between pipe and bedding.

.5 Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe less than or equal to 25 mm (1") dia. are to be clevis type or adjustable ring type, and hangers for suspended pipe greater than or equal to 40 mm (1-½") dia. are to be adjustable clevis type.

.6 Space hangers and supports in accordance with following:

.1 cast iron pipe – hang or support at every joint with maximum 2.4 m (8') spacing;

.2 plastic pipe – conform to pipe manufacturer's recommended support spacing;

.3 glass pipe – conform to pipe manufacturer's recommended support spacing and support requirements;

.4 copper and steel pipe – hang or support at spacing in accordance with following schedule:

PIPE DIA.	MAX. SPACING STEEL (meters)	MAX. SPACING COPPER (meters)
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1-½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2-½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3-½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')

.5 flexible grooved pipe/coupling joint piping – as above but with not less than one hanger or support between joints.

.7 Where pipes change direction, either horizontally or vertically, provide a hanger or support on horizontal pipe not more than 300 mm (12") from elbow, and where pipes drop from tee branches, support tees in both directions not more than 50 mm (2") on each side of tee.

.8 When pipes with same slope are grouped and a common hanger or support is used, space hanger or support to suit spacing requirement of smallest pipe in group and secure pipes in place on common hanger or support.

.9 Provide roller hangers or supports for heat transfer piping greater than or equal to 150 mm (6") diameter and conveying a material 75°C (170°F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to pipe to protect piping insulation.

.10 Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with following:

.1 support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser;

.2 for sections of vertical piping with a length less than 3 m (10'), support pipe at least once;

.3 for vertical cast iron plain end pipe (mechanical joint type), secure riser or pipe clamp around pipe under a flange integral with pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support;

.4 for vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to pipe to carry load;

.5 for vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between riser clamps and floor.

.11 Support piping on roof in accordance with requirements of drawing detail.

.12 Support piping on the roof as follows:

.1 on existing roof – provide support members as specified in Part 2 of this Section spaced as per schedule above and of a type to suit the application, and, for each support if on a tar and gravel type roof, carefully scrape away roofing gravel, bed support in a heavy covering of roofing mastic, then scrape gravel back up around support and secure pipes to supports;

.2 on new roof – supply manufactured roof supports as per Part 2 of this Section to accommodate piping involved and support spacing specified above, and hand supports to roofing trade on roof for installation as part of roofing work, then secure piping in place on supports.

.13 Each hanger, support or securement for horizontal bare copper tubing is to be plastic coated to prevent direct contact between pipe and ferrous hanger. Each wall or floor clamp for vertical bare copper piping is to be isolated from pipe by means of strips of flexible rubber inserts. Use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.

.14 For insulated horizontal piping less than or equal to 40 mm (1-½") diameter, provide galvanized steel insulation protection shields between insulation and hanger or support. Install shields immediately after pipe is insulated.

.15 Do not support piping from steel deck without written consent from Owner and review with Consultant.

3.10 SUPPLY OF ACCESS DOORS

.1 Supply access doors to give access to mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on drawings.

.2 Before commencing installation of mechanical work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange mechanical work to suit.

.3 Access doors will be installed by trade responsible for particular type of construction in which doors are required. Supply access doors to trade installing same at proper time.

.4 Wherever possible, access doors to be of a standard size for each application. Review exact dimensions and minimum size restrictions with Consultant prior to ordering.

.5 Group piping and ductwork to ensure minimum number of access doors is required.

.6 Submit a sample of each proposed access door for review with Consultant, prior to ordering.

.7 Coordinate with Electrical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services should, where possible, be accessible from common access door. Coordinate work to ensure common location access doors are not supplied by both Mechanical Divisions and Electrical Divisions.

3.11 INSTALLATION OF VALVES

.1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where valves are specified, however, regardless of locations shown or specified, following requirements apply:

.1 provide shut-off valves to isolate systems, at base of vertical risers, in branch take-offs at mains and risers on floors, to isolate equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance;

.2 install shut-off valves with handles upright or horizontal, not inverted, and located for easy access;

.3 unless otherwise specified, provide a check valve in discharge piping of each pump;

.4 valve sizes are to be same as connecting pipe size;

.5 valves are to be permanently identified with size, manufacturer's name, valve model or figure number and pressure rating, and wherever possible, valves are to be product of same manufacturer;

.6 for valves in insulated piping, design of valve stem, handle and operating mechanism is to be such that insulation does not have to be cut or altered in any manner to permit valve operation.

3.12 INSTALLATION OF PRESSURE GAUGES AND THERMOMETERS

.1 Provide pressure gauges in following locations:

.1 in valved tubing across suction, suction strainer (if applicable), and discharge piping of each circulating pump;

.2 in supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.;

.3 in expansion tank(s);

.4 in separate domestic hot water storage tank(s);

.5 at top most outlet in each standpipe fire protection system riser;

.6 in piping at each side of a pressure reducing valve;

.7 in potable water service piping downstream of meter;

.8 wherever else shown and/or specified.

.2 Provide thermometers in following locations:

.1 in supply and return piping connections to main mechanical plant equipment such as boilers, chillers, cooling towers, heat exchangers, main coils, etc., unless temperature indication is supplied with equipment;

.2 wherever else shown and/or specified.

.3 Conform to following installation requirements:

.1 for installation of thermometers in piping wells, provide a coat of metallic base heat transfer paste or grease in piping well;

.2 for pressure gauges in piping at equipment locations, install pressure gauge between equipment and first pipe fitting;

.3 locate, mount and adjust instruments so they are easily readable;

.4 where pressure gauges and/or thermometers are located at high level or in an area where they cannot be easily seen, provide remote reading instruments.

3.13 INSTALLATION OF EQUIPMENT DRIVE GUARDS AND ACCESSORIES

.1 Provide OHSA guards for exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on mechanical equipment.

.2 Install belt guards to allow movement of motors for adjusting belt tension.

.3 Provide a means to permit lubrication and use of test instruments with guards in place.

.4 Secure guards to equipment or equipment base but do not bridge sound or vibration isolation.

.5 Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.

3.14 MECHANICAL WORK IDENTIFICATION

.1 Identify new exposed piping and ductwork as per Part 2 of this Section in locations as follows:

.1 at every end of every piping or duct run;

.2 adjacent to each valve, strainer, damper and similar accessory;

.3 at each piece of connecting equipment;

.4 on both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;

.5 at 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;

.6 at least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.

.2 Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:

.1 at points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;

.2 at maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;

.3 at each access door location;

.4 at each piece of connected equipment, automatic valve, etc.

.3 Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location.

.4 Paint new natural and/or propane gas piping with primer and 2 coats of paint in accordance with local governing code requirements and requirements of Division 09. Identify piping at intervals as specified above.

.5 For electrically traced mechanical work, identification wording is to include "ELECTRICALLY TRACED".

.6 Tag valves and prepare a valve tag chart in accordance with following requirements:

.1 attach a valve tag to each new valve, except for valves located immediately at equipment they control;

.2 prepare a computer printed valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);

.3 if an existing valve tag chart is available at site, valve tag numbering is to be an extension of existing numbering and new valve tag chart is to incorporate existing chart;

.4 frame and glaze one copy of chart and, unless otherwise directed, affix to a wall in each main Mechanical and/or Equipment Room;

.5 include a copy of valve tag chart in each copy of operating and maintenance instruction manuals;

.6 hand an identified CD of valve tag chart to Owner at same time O&M Manuals are submitted.

.7 Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:

.1	HVAC piping valves and equipment:	yellow
.2	fire protection valves and equipment:	red
.3	plumbing valves and equipment:	green
.4	HVAC ductwork dampers and equipment:	blue
.5	control system hardware and equipment:	orange

3.15 FINISH PAINTING OF MECHANICAL WORK

.1 Finish paint exposed mechanical work as specified and/or scheduled in accordance with requirements of Division 09.

.2 Touch-up paint damaged factory applied finishes on mechanical work products.

.3 Finish painting of exposed mechanical work is specified in Division 09 and is part of the work of Division 09.

3.16 PIPE LEAKAGE TESTING

.1 Before piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test piping for leakage.

.2 Tests are to be witnessed by Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice (minimum 7 working days) of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.

.3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.

.4 Gravity Drainage and Vent Piping

.1 Test piping in accordance with local governing building code.

.2 After fixtures and fittings are set and pipes are connected to building drain or drains, turn on water into pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Perform smoke test if required by local governing authorities.

.5 Pumped Drainage Piping

.1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for minimum of 2 hours.

.6 Domestic Water Piping

.1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for minimum of 2 hours.

.7 Sprinkler System Piping

.1 Test system piping in accordance with requirements of NFPA No. 13, "Installation of Sprinkler Systems", and in accordance with any additional requirements of governing authorities.

.8 Standpipe System Piping

.1 Test system piping in accordance with requirements of NFPA No. 14, "Standpipe and Hose Systems", and in accordance with any additional requirements of governing authorities.

.9 Clean Agent Fire Extinguishing System Piping

.1 Test system piping in accordance with requirements of NFPA No. 2001, "Standard on Clean Agent Extinguishing Systems", and in accordance with any additional requirements of governing authorities.

.10 Heat Transfer (HVAC) System Piping

.1 Test piping with cold water at pressure of 1035 kPa (150 psi) for minimum of 2 hours.

.11 Steam and Condensate Piping

.1 Test piping with cold water for minimum of 2 hours at following pressures:

.1 0 kPa to 105 kPa (0 psi to 15 psi) low pressure piping – 690 kPa (100 psi);

.2 110 kPa to 690 kPa (16 psi to 100 psi) medium pressure piping – 1035 kPa (150 psi);

.3 greater than 690 kPa (100 psi) high pressure piping – 1380 kPa (200 psi).

.12 Natural Gas Piping

.1 Test piping in accordance with requirements of CAN/CSA B149.1 and any additional requirements of local governing authorities.

.2 After completion of the verification test, locate required tag stating results of verification test at point of entry of gas main into building, affixed to pipe in secure manner.

.3 Check piping joints and connections for leaks with water/soap solution while piping is under pressure.

.13 Propane Gas Piping

.1 Test piping in accordance with requirements of CAN/CSA B149.2 and any additional requirements of local governing authorities.

.2 After completion of verification test, locate required tag stating results of verification test at point of entry of gas main into building, affixed to pipe in secure manner.

.3 Check piping joints and connections for leaks with water/soap solution while piping is under pressure.

.14 Compressed Air Piping

.1 Test piping with dry compressed air or nitrogen at 690 kPa (100 psi) for minimum of 2 hours.

.2 Test piping joints with water-soap solution while piping is under pressure to detect leaks.

.15 Fuel Oil Piping

.1 Test piping (not tanks) with dry compressed air or nitrogen for minimum period of 2 hours at 1035 kPa (150 psi).

.2 Check piping joints and connections for leaks with water/soap solution while piping is under pressure.

.16 Gasoline Piping

.1 Test piping (not tanks) with dry compressed air or nitrogen for minimum period of 2 hours at 1035 kPa (150 psi) in accordance with TSSA requirements.

.2 Check piping joints and connections for leaks with water/soap solution while piping is under pressure.

.17 Refrigerant Piping

.1 Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of ASHRAE Handbook - Fundamentals.

.18 Control Air Piping and Tubing

.1 Test control air piping and tubing with dry compressed air or nitrogen before concealing and again before connection of instruments.

.2 Rough-in test pressure is to be 345 kPa (50 psi) maintained over 24 hours with pressure drop not to exceed 35 kPa (5 psi).

.3 Test joints for leaks with soap solution.

.4 Finish test is to be 205 kPa (30 psi) with permissible loss of 7 kPa (1 psi) over 4 hour period. Prior to connecting instruments, blow systems clean and dry, and test component connections for leaks with water/soap solution.

.19 Medical Gas System Piping

.1 Perform leakage and flow tests for piping using oil-free compressed air or oil-free dry nitrogen in accordance with requirements of CAN/CSA Z7396.1.

.20 Pure Water Piping

.1 When piping has been properly flushed and cleaned, test at 690 kPa (100 psi) for 2 hours with only distilled water or filtered dry compressed air. If distilled water is used, drain system when testing is complete.

.21 Following requirements apply to all testing:

.1 ensure piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing;

.2 temporarily remove or valve off piping system specialties or equipment which may be damaged by test pressures prior to pressure testing systems, and flush piping to remove foreign matter;

.3 when testing is carried out below highest level of particular system, increase test pressure by the hygrostatic head of 7 kPa (1 psi) for every 600 mm (24") below high point;

.4 include for temporary piping connections required to properly complete tests;

.5 piping under test pressure is to have zero pressure drop for length of test period;

.6 make tight leaks found during tests while piping is under pressure, and if this is impossible, remove and refit piping and reapply test until satisfactory results are obtained;

.7 where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions;

.8 perform tests in reasonably sized sections so as to minimize number of tests required;

.9 in addition to leakage tests specified above, demonstrate proper flow throughout systems including mains, connections and equipment, as well as proper venting and drainage, and include for any necessary system adjustments to achieve proper conditions.

3.17 SUPPLY OF MOTOR STARTERS AND ACCESSORIES

.1 Motor starters for mechanical equipment, except for starters integral with packaged equipment and starters factory installed in equipment power and control panels, will be provided as part of electrical work.

.2 Where 3-phase starters are indicated in motor control centres, supply motor control centres with starters and bolt to concrete housekeeping pad.

.3 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from motor control centre, provide disconnect switch in motor control centre in lieu of motor starter.

.4 Where 3-phase starters are indicated and/or scheduled to be mounted on a motor starter panel, starters will be mounted and connected, complete with panels and splitter trough, as part of electrical work. Hand starters to electrical trade at site when they are required.

.5 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from motor starter panel, disconnect switch will be provided on motor starter panel as part of electrical work.

.6 Unless otherwise specified or shown on drawings, 1-phase motor starters will be mounted adjacent to equipment they serve and connected complete as part of electrical work. Hand starters to electrical trade at site at proper time.

3.18 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

.1 Unless otherwise specified or indicated, following electrical wiring work for mechanical equipment will be done as part of electrical work:

.1 "line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from starters or disconnects to equipment;

.2 "line" side power wiring to individual wall mounted starters, and "load" side wiring from starters to equipment;

.3 "line" side power wiring to pre-wired power and control panels and variable frequency drives (VFD), and "load" side power wiring from the panels and VFD's to equipment;

.4 provision of receptacles for plug-in equipment;

.5 provision of disconnect switches for motors in excess of 10 m (30') from starter location, or cannot be seen from starter location, and associated power wiring;

.6 motor starter interlocking in excess of 24 volts;

.7 wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts;

.8 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers;

.9 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units;

.10 120 volt wiring connections to duplex receptacles integral with air handling unit control panels.

.2 Mechanical wiring work not listed above or specified herein or on drawings to be done as part of electrical work is to be installed in conduit and is to be done as part of mechanical work in accordance with wiring requirements specified for electrical work.

3.19 INTERRUPTION TO AND SHUT-DOWN OF MECHANICAL SERVICES AND SYSTEMS

.1 Coordinate shut-down and interruption to existing mechanical systems with Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning. Include for costs of premium time to perform work during nights, weekends or other times outside of normal working hours, which may be necessary to comply with stipulations specified herein this Article. Services for operation of existing non-renovated areas of building are to be maintained.

.2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.

.3 Prior to each shut-down or interruption, inform Owner and Consultant in writing minimum 7 working days in advance of proposed shut-down or interruption and obtain written consent to proceed. Do not shut-down or interrupt any system or service without such written consent. Shutdowns of some essential services may require additional advance notification time.

.4 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.

.5 Pipe freezing may be used to connect new piping to existing piping without draining existing piping. Pipe freeze equipment is to be equal to "NORDIC FREEZE" equipment supplied by Mag Tool Inc. (1-800-661-9983) or Rigid Tool Co. RIGID "SuperFreeze".

.6 Confirm any methods of procedures with Owner and review with Consultant prior to start of work.

3.20 EQUIPMENT BASES AND SUPPORTS

.1 Unless otherwise specified or required, set floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of equipment on each side and end, or a minimum of 200 mm (8") from centreline of equipment anchor bolts to edge of the base, whichever is larger. Conform to following requirements:

.1 supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads;

.2 place anchor bolts during concrete pour and be responsible for required levelling, alignment, and grouting of equipment;

.3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.

.2 For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to following requirements:

.1 provide stands and supports, except those for small equipment, designed by a structural engineer registered in jurisdiction of the work, and submit stamped and signed design drawings with calculations as shop drawings for review;

.2 flange bolt steel stands to concrete housekeeping pads;

.3 seismically restrained stands and supports in accordance with applicable requirements.

3.21 MECHANICAL SERVICE REQUIREMENTS FOR FLOATING FLOOR SLABS

.1 Where mechanical services are required to be installed in or through a vibration isolated floating slab, install such services so as not to transmit any vibration to base slab on which floating floor slab is placed.

.2 Wherever possible, arrange mechanical work to avoid penetrating a floating floor slab.

3.22 CONCRETE WORK FOR MECHANICAL EQUIPMENT BASES/PADS

.1 Concrete work required for mechanical equipment bases/pads will be provided as part of concrete work of Division 03.

.2 Exactly locate bases/pads at site and be present during concrete pour to ensure anchor bolts, inserts, plates and similar hardware are not damaged or dislodged.

3.23 CONCRETE WORK FOR MECHANICAL EQUIPMENT BASES/PADS

.1 Provide poured concrete work, including reinforcing and formwork, required for mechanical equipment bases/pads. Perform concrete work in accordance with requirements specified in Division 03.

.2 Submit for review, dimensioned shop drawings, prepared and stamped by a professional structural engineer registered in the jurisdiction of the work, for concrete pads or bases for support of large, heavy equipment. Indicate on shop drawings total weight of pad or base as well as equipment it is provided for, and concrete reinforcing.

3.24 EXCAVATION AND BACKFILL WORK

.1 Excavation, backfill and related work such as dewatering required for mechanical work will be performed as part of excavation and backfill work of Division 02 or 31, except for final hand grading work which is to be done as part of mechanical work. Mark out location and routing of excavation required for work as well as required depth. Ensure that bedding is graded to provide proper drainage for ducts as reviewed with Consultant.

.2 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Confirm local utilities have performed locates and marking out. Ensure inverts and locations are correct, prior to commencement of work. Where discrepancies are found, immediately inform Consultant, and await a direction.

.3 Accurately mark-out location and routing of excavation required, as well as required depth.

.4 Ensure underground piping subject to freezing and located outside building has a minimum of 1.37 m (4-½') of cover.

.5 Ensure underground piping subject to freezing and located inside building in unheated areas has a minimum of 450 mm (18") of cover.

.6 Ensure pipe bedding is proper prior to laying pipes. Hand excavate under pipe hubs, couplings, flanges and similar items to ensure even bearing along the entire barrel of each length of pipe.

.7 Ensure piping is inspected, leakage tested and approved prior to backfilling. Supervise initial backfilling operation to ensure buried work is not disturbed.

.8 Allow work to be inspected by local governing authorities and Consultant before covering and backfilling. Failure to do so prior to backfilling will require re-excavating of work and re-backfill at no additional cost to Owner.

3.25 EXCAVATION AND BACKFILL WORK

.1 Before commencement of excavation for work, determine in consultation with Consultant, Owner, Municipality and utilities, presence, if any, of existing underground services at site. Engage local utilities to locate and mark out such services. Ensure trades concerned are aware of their presence.

.2 Be responsible for any damage done to underground services caused by neglect to determine and mark out location of such services prior to excavation work commences.

.3 Where Work falls under jurisdiction of local governing utility, confirm requirements and comply with utility requirements.

.4 Provide excavation, backfill and related work required for mechanical work. Perform such work in accordance with requirements of the Excavation and Backfill work Section, except as modified by this Article. Obtain a copy of soil test report if available from Consultant. Depth of excavations must accommodate local governing requirements and local standard practices to compensate for local frost levels of Place of the Work.

.5 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Confirm inverts and locations are correct, prior to commencing excavation and contact Utilities to accurately locate their services. Where discrepancies are found, immediately inform Consultant, and await a direction. Grade bottom of trench excavations as required.

.6 In firm, undisturbed soil, lay pipes directly on soil, unless otherwise directed.

.7 Before backfilling, arrange for inspection of work by local governing authority and Consultant. Do not backfill work unless reviewed with Consultant. Failure to do so prior to backfilling will require re-excavating work and re-backfill at no additional cost to Owner.

.8 Unless otherwise specified, backfill trenches within building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact first layers up to a compacted level of minimum 300 mm (12") above top of pipe. Hand or machine compact the balance up to grade.

.9 After first lift of backfill has been compacted, mark entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D-UGMT.

.10 Unless otherwise directed in Division 02 and/or 31, store and dispose of excavated materials as follows:

.1 during progress of contract, place material as directed in such a manner to minimize damage or disfigurement of ground and which in no way impedes progress of work;

.2 separately place surplus topsoil and subsoil as directed; leave site clean and unencumbered.

.11 Perform pumping as required to keep excavations free of water.

.12 Coordinate requirements for final surface toppings (concrete, asphalt, pavers, grass sod, etc.) with General Contractor.

3.26 CUTTING, PATCHING AND CORE DRILLING

.1 Unless otherwise provided by General Trades, perform cutting, patching, and core drilling of existing building required for installation of Mechanical Divisions work. Perform cutting in a neat and true fashion, with proper tools and equipment to Consultant's approval. Patching is to exactly match existing finishes and be performed by tradesmen skilled in particular trade or application. Work is subject to review with Consultant and Owner approval.

.2 Criteria for cutting holes for additional services:

.1 cut holes through slabs only; no holes to be cut through beams;

.2 cut holes 150 mm (6") diameter or smaller only; obtain approval from Structural Consultant for larger holes;

.3 keep at least 100 mm (4") clear from beam faces;

.4 space at least 3 hole diameters on centre;

.5 for holes that are required closer than 25% of slab span from supporting beam face, use cover meter above slab to clear slab top bars;

.6 for holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars;

.7 submit sleeving drawings indicating holes and their locations for Structural Consultant's review.

.3 Do not cut or drill any existing work without approval from Owner and review with Consultant. Be responsible for damage done to building and services caused by cutting or drilling.

.4 Where pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around pipes or pipe insulation.

.5 Prior to drilling or cutting an opening, determine, in consultation with Consultant and Owner, and by use of non-destructive radar scan (magnetic scan) of slab or wall, presence of any existing services and reinforcement bars concealed behind building surface to be cut and locate openings to suit. Coring is not permitted through concrete beams or girders.

.6 Firestop and seal openings in fire rated construction in accordance with requirements of article entitled Firestopping and Smoke Seal Materials in this Section. Do not leave openings open overnight unless approved by Owner and reviewed with Consultant.

3.27 PACKING AND SEALING CORE DRILLED PIPE OPENINGS

.1 Pack and seal void between pipe opening and pipe or pipe insulation for length of opening as follows:

.1 non-fire rated interior construction – pack with mineral wool and seal both ends of opening with non-hardening silicone base caulking compound to produce a water-tight seal;

.2 exterior walls above grade – pack with mineral wool and seal both ends of sleeves water-tight with non-hardening silicone base caulking compound unless mechanical type seals have been specified;

.3 exterior walls below grade (and any other wall where water leakage may be a problem) – seal with link type mechanical seals as specified.

3.28 FLASHING FOR MECHANICAL WORK PENETRATING ROOF

.1 Perform required flashing work, including counter-flashing, for mechanical work penetrating and/or set in roof.

.2 Perform flashing work in accordance with requirements of drawing details, and requirements specified in Division 07.

3.29 CLEANING MECHANICAL WORK

.1 Refer to cleaning requirements specified in Division 01.

.2 Clean mechanical work prior to application for Substantial Performance of the Work.

.3 Include for vacuum cleaning interior of air handling units and ductwork systems.

3.30 CONNECTIONS TO OTHER EQUIPMENT

.1 Carefully examine Contract Documents during bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

3.31 INSTALLATION OF FLEXIBLE CONNECTORS

.1 Provide flexible connectors in piping connections to seismically restrained equipment, and wherever else shown.

.2 Provide flexible connectors in piping connections to vibration isolated equipment.

3.32 FAN NOISE LEVELS

.1 Submit sound power levels with fan shop drawings/product data, with levels measured to AMCA 300 and calculated to AMCA 301.

3.33 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

.1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for equipment/system manufacturer's authorized representative to visit site to examine installation, and after any required corrective measures have been made, to certify in writing to Owner and Consultant that equipment/system installation is complete and in accordance with equipment/system manufacturer's instructions.

3.34 EQUIPMENT AND SYSTEM START-UP

.1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with following requirements:

.1 submit a copy of each equipment/system manufacturer's start-up report sheet to Consultant for review, and incorporate any comments made by Consultant, Owner or Commissioning Agent, as applicable;

.2 under direct on-site supervision and involvement of equipment/system manufacturer's representative, start-up equipment/systems, make any required adjustments, document procedures, leave equipment/systems in proper operating condition, and submit to Consultant complete set of start-up documentation sheets signed by manufacturer/supplier and Contractor;

.3 submit documents signed by authorized testing technician, in both hard copy and pdf electronic copy formats.

END OF SECTION

1 GENERAL

1.01 APPLICATION

.1 This Section specifies insulation requirements common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

1.02 DEFINITIONS

.1 "concealed" – means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces.

.2 "exposed" – means exposed to normal view during normal conditions and operations.

.3 "mineral fibre" – includes glass fibre.

.4 "mineral wool" – includes rock wool and slag wool.

.5 "domestic water" or "potable water" – means piping extended from building Municipal supply main.

1.03 SUBMITTALS

.1 At least 4 weeks prior to insulation work commencing, submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for review. Mount samples on a plywood board. Identify each product with manufacturer's name and insulation type, and proposed use of insulation. When sample board has been reviewed, mechanical insulation work is to conform to reviewed sample board.

.2 Submit a product data sheet for each insulation system product.

.3 For fire rated duct wrap, submit ULC FRD design documentation as part of shop drawing.

.4 In accordance with Part 3 of this Section, submit a letter from fire rated duct wrap supplier certifying duct wrap has been properly installed.

1.04 QUALITY ASSURANCE

.1 Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.

.2 Do not apply insulation unless leakage tests have been satisfactorily completed.

.3 Ensure surfaces to be insulated are clean and dry.

.4 Ensure ambient temperature is minimum 13°C (55°F) for at least 1 day prior to application of insulation, and for duration of insulation work, and relative humidity is and will be at a level such that mildew will not form on insulation materials.

.5 Company with sub-contract for mechanical insulation work is to be a member in good standing of Thermal Insulation Association of Canada (TIAC).

.6 Insulation materials must be stored on site in a proper, dry storage area. Any wet insulation material is to be removed from site.

2 PRODUCTS

2.01 FIRE HAZARD RATINGS

.1 Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.02 THERMAL PERFORMANCE

.1 Unless otherwise specified, thermal performance of insulation is to meet or exceed values given in Tables entitled Minimum Piping Insulation Thickness Heating and Hot Water Systems and Minimum Piping Insulation Thickness Cooling Systems, as stated in ANSI/ASHRAE/IES Standard 90.1 version referenced in Ontario Building Code.

2.03 PIPE INSULATION MATERIALS

.1 Horizontal Pipe Insulation at Hangers and Supports

.1 Equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, pre-moulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.

.2 Flexible Foam Elastomeric

.1 Closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96, Procedure B, and required installation accessories.

.2 Acceptable products are:

.1 Armacell AP/Armaflex;

.2 IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.

.3 Pre-Moulded Mineral Fibre

.1 Rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket.

.2 Acceptable products are:

.1 Johns Manville Inc. "Micro-Lok AP-T Plus";

.2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;

.3 Manson Insulation Inc. "ALLEY K APT";

.4 Owens Corning "Fiberglas" Pipe Insulation.

.4 Blanket Mineral Fibre

.1 Blanket type roll insulation to ASTM C553, 24 kg/m^3 (1-½ lb/ft^3) density, with a factory applied vapour barrier facing.

.2 Acceptable products are:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

2.04 BARRIER-FREE LAVATORY PIPING INSULATION KITS

.1 Removable, flexible, reusable, white moulded plastic insulation kits for barrier-free lavatory drain piping and potable water supplies exposed under lavatory.

.2 Acceptable products are:

.1 Truebo "Lav-Guard 2" E-Z Series;

.2 Zeston "SNAP-TRAP";

.3 McGuire Manufacturing Co. Inc. "ProWrap".

2.05 EQUIPMENT INSULATION MATERIALS

.1 Blanket Mineral Fibre

.1 Blanket type roll form insulation to ASTM C553, 24 kg/m^3 (1-½ lb/ft^3) density, with a factory applied vapour barrier facing.

.2 Acceptable products are:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

2.06 REMOVABLE/REUSABLE INSULATION COVERS

.1 Covers for equipment 12 mm (½") to less than 150 mm (6"):

.1 Valve, etc. covers are to be NO SWEAT reusable insulation wraps with vapour barrier jacket and self-sealing ends and longitudinal seam, with a length to suit application and an insulation thickness equal to adjoining insulation.

.2 Covers for equipment greater than or equal to 150 mm (6"):

.1 Custom manufactured equipment covers conforming to shape of item to be insulated, designed to be easily removable and replaceable to suit use and maintenance procedures of particular item, and to provide adequate personnel protection. Covers are to be complete with minimum 95 kg/m^3 (6 lb/ft^3) density ceramic fibre insulation sewn between minimum 542.5 g/m^2 (1.8 oz/ft^2) weight silicone impregnated fibreglass fabric in a quilted pattern using double stitches made with Kelvar or Teflon coated fibreglass thread. Overlap flaps are to be secured using laces, snaps, or Velcro double stitched in place.

.2 Acceptable manufacturers are:

.1 Crossby Dewar Inc.;

.2 Insufab Systems Inc.;

.3 ADL Insulflex Inc.;

.4 Firwin Corp.;

.5 GlassCell Isofab Inc.

2.07 DUCTWORK SYSTEM INSULATION MATERIALS

.1 Rigid Mineral Fibre Board

.1 Pre-formed board type insulation to ASTM C612, 48 kg/m^3 (3 lb/ft^3) density, with a factory applied reinforced aluminum foil and kraft paper facing.

.2 Acceptable products are:

.1 Knauf Fiber Glass Insulation Board with FSK facing;

.2 Manson Insulation Inc. "AK BOARD FSK";

.3 Johns Manville Inc. Type 814 "Spin-Glas";

.4 Owens Corning 703.

.2 Semi-Rigid Mineral Fibre Board

.1 Roll form insulation to ASTM C1393, consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraft paper facing.

.2 Acceptable products are:

.1 Multi-Glass Insulation Ltd. "Multi-Flex MKF";

.2 Owens Corning Pipe and Tank Insulation;

.3 Johns Manville Inc. Pipe and Tank Insulation "Micro-Flex".

.3 Blanket Mineral Fibre

.1 Blanket type roll form insulation to ASTM C553, 24 kg/m^3 (1-½ lb/ft^3) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing.

.2 Acceptable products are:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.4 Flexible Foam Elastomeric

.1 Sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A.

.2 Acceptable products are:

.1 Armacell "AP Armaflex";

.2 IK Insulation Group "K-Flex Duct Wrap", S2S.

2.08 INSULATING COATINGS

.1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:

.1 anti-condensation coating, "No Sweat-FX";

.2 thermal insulating coating, "ThermaLite".

2.09 INSULATION FASTENINGS

.1 Wire

.1 Minimum #15 gauge galvanized annealed wire.

.2 Aluminium Banding

.1 Equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.

.3 Stainless Steel Banding

.1 Equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.

.4 Duct Insulation Fasteners

.1 Weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1-½") square plastic or zinc plated steel self-locking washers.

.5 Tape Sealant

.1 Equal to 3M 1520-CW self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match surface being sealed.

.6 Mineral Fibre Insulation Adhesive

.1 Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with type of material to be secured, and WHMIS classified as non-hazardous.

.7 Flexible Elastomeric Insulation Adhesive

.1 Armacell "Armaflex" #520 air-drying contact adhesive.

.8 Lagging Adhesive

.1 White, brush consistency, ULC listed and labelled, maximum 25/50 fire/smoke rated in accordance with ULC S102, lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.

.9 Screws

.1 No. 10 stainless steel sheet metal screws.

2.10 INSULATION JACKETS AND FINISHES

.1 Canvas Jacket Material

.1 ULC listed and labelled, 25/50 fire/smoke rated, roll form, minimum 170 g (6 oz.).

.2 Roll Form Sheet and Fitting Covers

.1 Minimum 15 mm (½") thick white PVC, maximum 25/50 fire/smoke rated tested in accordance with ULC S102, complete with installation and sealing accessories. Acceptable products are:

.1 Johns Manville Inc. "Zeston" 300;

.2 Proto Corp. "LoSMOKE".

.3 Thermal Insulating and Finishing Cement

.1 Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable for the application.

.4 Coating for Flexible Foam Elastomeric Insulation

.1 Flexible foam elastomeric insulation protective coating equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.

3 EXECUTION

3.01 GENERAL INSULATION APPLICATION REQUIREMENTS

.1 Unless otherwise specified, do not insulate following:

.1 factory insulated equipment and piping;

.2 branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;

.3 exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;

.4 manufactured expansion joints and flexible connections;

.5 acoustically lined ductwork and/or equipment;

.6 factory insulated flexible branch ductwork;

.7 piping unions, except for unions in "cold" category piping.

.2 Install work generally in accordance with TIAC National Insulation Standards Manual except conform to manufacturer's instructions and recommendations, and requirements specified in this Section.

.3 Install insulation directly over pipes and ducts, not over hangers and supports.

.4 Install piping insulation and jacket continuous through pipe openings and sleeves.

.5 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.

.6 For insulation thicknesses greater than or equal to 75 mm (3"), provide double layer of insulation to achieve required insulation thickness and stagger joint locations.

.7 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect insulation jacketing from condensation at its junction with metal.

.8 Insulate, vapour seal, and finish seismic restraints, braces, anchors, hanger rods, and similar hardware directly connected to "cold" piping and/or equipment, for a distance of 300 mm (12") clear of adjacent pipe or equipment finish, to match piping and/or equipment insulation.

.9 When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above lowest pipe fitting, and thereafter at 4.5 m (14.7') centres and at each valve and flange. Insulate in accordance with Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.

.10 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover exposed end of insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.

.11 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.

.12 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in insulation and provide a suitable grommet in the opening.

3.02 INSULATION FOR HORIZONTAL PIPE AT HANGERS AND SUPPORTS

.1 At each hanger and support location for piping 50 mm (2") diameter and larger to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply insulation sections to piping installers for installation as pipe is erected.

3.03 PIPE INSULATION REQUIREMENTS – MINERAL FIBRE

.1 Insulate following pipe inside building and above ground with mineral fibre insulation of thickness indicated:

.1 domestic cold water piping, less than 100 mm (4") dia. – 25 mm (1") thick;

.2 domestic cold water piping, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;

.3 domestic hot water piping, less than 40 mm (1-½") dia. – 25 mm (1") thick;

.4 domestic hot water piping, greater than or equal to 40 mm (1½") dia. – 40 mm (1-½") thick;

.5 tempered domestic water piping, supply and return, less than 40 mm (1-½") dia. – 25 mm (1") thick;

.6 tempered domestic water piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;

.7 storm drainage piping from roof drains to the point where main vertical risers extend straight down, without offsets, and connect to horizontal underground mains – 25 mm (1") thick;

.8 condensate drainage piping from fan coil unit or any other air conditioning system/unit drain pans to main vertical drain risers or to indirect drainage point – 25 mm (1") thick;

.9 drainage piping from refrigerated drinking fountains to nearest 75 mm (3") dia. or larger drain pipe – 25 mm (1") thick;

.10 refrigerant suction piping (between compressor and evaporator coil) inside building – 25 mm (1") thick;

.11 refrigerant hot gas piping (between compressor and condenser) inside building – 25 mm (1") thick;

.2 Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping with cut and tightly fitted segments of sectional pipe insulation with joints covered with tape sealant, or, alternatively, wrap piping union, valve, strainer, etc., with blanket mineral fibre and cover with PVC covers as for paragraph above.

.3 Terminate sectional insulation approximately 50 mm (2") from flange or coupling on each side of flange or coupling. Cover flange or coupling with a minimum 50 mm (2") thickness of blanket mineral fibre insulation wide enough to butt tightly to ends of adjacent sectional insulation. Secure blanket insulation in place and cover with a purpose made PVC coupling cover.

.4 Take special care at concealed water rough-in piping at plumbing fixtures to ensure piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieu of 25 mm (1") thick insulation.

.5 Insulate seismic restraint hardware such as hanger rods, braces, anchors, etc., directly connected to "cold" category piping and equipment for a distance of 300 mm (12") from piping or equipment with insulation and finish to match pipe or equipment insulation. Coat seismic restraint hardware for a distance of 300 mm (12") from the termination of insulation with Robson Thermal "NO-SWEAT-FX" water based anti-condensation coating.

3.04 PIPE INSULATION REQUIREMENTS – FLEXIBLE FOAM ELASTOMERIC

.1 Install flexible elastomeric pipe insulation in strict accordance with manufacturer's instructions to suit application, and using adhesive, joint sealants and finish to produce a water-tight installation. Insulate following pipe with flexible elastomeric pipe insulation of thickness indicated:

.1 refrigerant suction and hot gas piping outside building – 25 mm (1") thick.

3.05 PIPE INSULATION REQUIREMENTS – FIRE-RATED INSULATION

.1 Where pipe (inside building and above ground) which is to be insulated penetrates fire rated construction, provide fire-rated, non-combustible sectional insulation on portion of pipe in fire barrier and for a distance of 50 mm (2") on either side of fire barrier. Insulation thickness is to be as specified, but in any case minimum 25 mm (1").

3.06 INSTALLATION OF BARRIER-FREE LAVATORY INSULATION KITS

.1 Provide manufactured insulation kits to cover exposed drainage and water piping under barrier-free lavatories.

3.07 EQUIPMENT INSULATION REQUIREMENTS – BLANKET TYPE MINERAL FIBRE

.1 Insulate following equipment with mineral fibre blanket type insulation of thickness indicated:

.1 chilled water and/or domestic cold water pump casings – 40 mm (1-½") thick;

.2 roof drain sumps where inside the building – 25 mm (1") thick;

.3 water meter(s) – 40 mm (1-½") thick;

.2 Unless otherwise noted, wrap equipment to a thickness and insulating value equal to an equivalent thickness of rigid sectional pipe insulation. Laminate insulation in place with a full coverage of adhesive and secure with wire. Apply a jacket of insulation vapour barrier material secured in place with adhesive or sealant tape.

.3 Cover roof drain sumps with purpose made PVC fitting covers.

3.08 INSTALLATION OF REMOVABLE/REUSABLE INSULATION COVERS

.1 Provide custom designed and manufactured removable and reusable insulation covers for following:

.1 plate type heat exchanger(s);

.2 150 mm (6") dia. and larger piping strainers, backflow preventers, etc.;

.2 Provide "wrap type" removable and reusable insulation covers for "cold" circuit balancing valves, backflow preventers, and similar items.

3.09 DUCTWORK INSULATION REQUIREMENTS – MINERAL FIBRE

.1 Insulate following ductwork systems inside building and above ground with mineral fibre insulation of thickness indicated:

.1 outside air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and fresh air is not tempered, then the fresh air ductwork system complete – minimum 76 mm (3") thick as required;

.2 mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

.3 supply air ductwork outward from fans, except for supply ductwork exposed in area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

.4 exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

.5 any other ductwork, casings, plenums or sections specified or detailed on drawings to be insulated – thickness as specified.

.2 Provide rigid board type insulation for casings, plenums, and exposed rectangular ductwork. Provide blanket type insulation for concealed round, oval or rectangular ductwork. Provide semi-rigid mineral fibre board type insulation for exposed round or oval ducts.

.3 Liberally apply adhesive to surfaces of exposed rectangular ducts and/or casings. Accurately and neatly press insulation into adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal joints with 75 mm (3") wide tape sealant. Additional installation requirements as follows:

.1 at trapeze hanger locations, install insulation between duct and hanger;

.2 provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where insulation is subject to accidental damage, and secure in place with tape sealant.

.4 Liberally apply adhesive to surfaces of concealed rectangular or oval ductwork, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal joints with 75 mm (3") tape sealant. At each trapeze type duct hanger, provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between duct and hanger.

.5 Accurately cut sections of insulation to fit tightly and completely around exposed and concealed round or oval ductwork. Liberally apply adhesive to surfaces of duct, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Seal joints with tape sealant. At duct hanger locations install insulation between duct and hanger. At each hanger location for concealed ductwork where flexible blanket type insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between duct and hanger.

.6 Insulation application requirements common to all types of rigid ductwork are as follows:

.1 at duct connection flanges, insulate flanges with neatly cut strips of rigid insulation material secured with adhesive to side surfaces of flange with a top strip to cover exposed edges of the side strips, then butt the flat surface duct insulation up tight to flange insulation, or, alternatively, increase insulation thickness to depth of flange and cover top of flanges with tape sealant;

.2 installation of fastener pins and washers is to be concurrent with duct insulation application;

.3 cut insulation fastener pins almost flush to washer and cover with neatly cut pieces of tape sealant;

.4 accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;

.5 prior to concealment of insulation by either construction finishes or canvas jacket material, patch vapour barrier damage by means of tape sealant.

3.10 APPLICATION OF INSULATING COATINGS

.1 Apply, in accordance with manufacturer's instruction, insulating coatings to following bare metal surfaces:

.1 paint bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating;

.2 paint bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "ThermaLite" insulating coating.

.2 Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

3.11 INSULATION FINISH REQUIREMENTS

.1 Canvas Jacket Material

.1 Unless otherwise shown and/or specified, jacket exposed mineral fibre insulation, and calcium silicate duct insulation work inside building with canvas secured in place with a full covering coat of lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.

.2 PVC Pipe and Fittings Covers

.1 Jacket exposed pipe insulation work inside building with white sheet PVC and fitting covers. Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal joints to produce a neat, water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.

END OF SECTION

1 GENERAL

1.01 APPLICATION

.1 This Section specifies requirements, criteria, methods and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

1.02 SUBMITTALS

.1 Submit documentation to confirm reclaimed refrigerant has been properly removed and stored, recycled, or disposed of as applicable.

2 PRODUCTS

Not Used

3 EXECUTION

3.01 DISCONNECTION AND REMOVAL OF EXISTING MECHANICAL WORK

.1 Where indicated on drawings, disconnect and remove existing mechanical work, including hangers, supports, insulation, etc. Disconnect at point of supply, remove obsolete connecting services and make system safe. Cut back obsolete piping behind finishes and cap water-tight unless otherwise specified.

.2 Scope and extent of demolition or revision work is only generally indicated on drawings. Estimate scope, extent and cost of work at site during bidding period site visit(s). Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at site during bidding period site visits will not be allowed.

.3 If any re-design is required due to discrepancies between mechanical drawings and site conditions, notify Consultant who will issue a Site Instruction. If, in the opinion of Consultant, discrepancies between mechanical drawings and actual site conditions are of a minor nature, required modifications are to be done at no additional cost.

.4 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes.

.5 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused.

.6 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused, except for following which are to be handed over to Owner at site:

.1 N/A;

3.02 HAZARDOUS WASTE

.1 Be advised that items such as drainage sumps, catch basins, interceptors, and the like may contain unidentified hazardous waste and caution is to be taken when disconnecting and removing these items.

.2 If hazardous waste not listed in Specification is found, notify Owner and Consultant immediately and await directions.

3.03 INTERRUPTION TO AND SHUT-DOWN OF MECHANICAL SERVICES AND SYSTEMS

.1 Co-ordinate shut-down and interruption to existing mechanical systems with Owner.

.2 Upon award of contract, submit a list of anticipated shut-down times and their maximum duration.

.3 Prior to each shut-down or interruption, inform Owner in writing 5 business days in advance of proposed shut-down or interruption and obtain written consent to proceed. Do not shut-down or interrupt any system or service without such written consent.

.4 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.

.5 Pipe freezing may be used to connect new piping to existing piping without draining existing piping. Pipe freeze equipment is to be equal to "NORDIC FREEZE" equipment supplied by Mag Tool Inc. or Rigid Tool Co. RIGID "SuperFreeze".

3.04 DECOMMISSIONING OR ALTERATIONS TO REFRIGERATION EQUIPMENT

.1 Remove and reclaim refrigerant from applicable equipment to be decommissioned and/or altered. Refrigerant reclaim and recycling work is to be in accordance with Refrigerant Management Canada guidelines, and governing codes and regulations. Do not under any circumstances vent refrigerant from existing equipment to atmosphere.

.2 Use refrigerant recovery equipment designed specifically to reclaim and recycle refrigerant, and use only skilled refrigeration mechanics to perform reclaim and recycle work.

.3 Provide approved, properly sized and sealable refrigerant containers for reclaimed refrigerant.

.4 Dispose of reclaimed refrigerant by engaging services of a licensed firm specializing in recycling of reclaimed refrigerant. Submit documentation to confirm refrigerant has been properly removed from site and recycled or disposed.

3.05 ROOFING WORK

.1 Where roof revisions and/or replacements are part of project, include for disconnecting, lifting, or temporarily removing mechanical equipment on roof as required to permit completion of roofing work, and for re-installing equipment when roofing work is complete.

END OF SECTION

1 GENERAL

1.01 APPLICATION

.1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 DEFINITIONS

.1 "Agency" – means agency to perform testing, adjusting and balancing work.

.2 "TAB" – means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate specified fluid flow rate and air patterns at terminal equipment, e.g., reduce fan speed, throttling, etc.

.3 "hydronic systems" – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.

.4 "air systems" – includes outside air, supply air, return air, exhaust air, and relief air systems.

.5 "flow rate tolerance" – means allowable percentage variation, minus to plus, of actual flow rate values in Contract Documents.

.6 "report forms" – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form permanent record to be used as basis for required future testing, adjusting and balancing.

.7 "terminal" – means point where controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

.8 "main" – means duct or pipe containing system's major or entire fluid flow.

.9 "submain" – means duct or pipe containing part of the systems' capacity and serving 2 or more branch mains.

.10 "branch main" – means duct or pipe servicing 2 or more terminals.

.11 "branch" – means duct or pipe serving a single terminal.

1.03 SUBMITTALS

.1 Within 30 days of work commencing at site, submit name and qualifications of proposed testing and balancing agency in accordance with requirements of article entitled Quality Assurance below.

.2 Submit sample test forms, if other than those standard forms prepared by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB), are proposed for use.

.3 Submit a report by Agency to indicate Agency's evaluation of mechanical drawings with respect to service routing and location or lack of balancing devices. Include set of drawings used and marked-up by Agency to prepare report.

.4 Submit a report by Agency after each site visit made by Agency during construction phase of this Project.

.5 Submit a draft report, as specified in Part 3 of this Section.

.6 Submit a final report, as specified in Part 3 of this Section.

.7 Submit a testing and balancing warranty as specified in Part 3 of this Section.

.8 Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.04 QUALITY ASSURANCE

.1 Employ services of an independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance building mechanical systems to produce design objectives. Agency is to have successfully completed testing, adjusting and balancing of mechanical systems for a minimum of 5 projects similar to this Project within past 3 years, and is to be certified as a qualified balancing agency with an industry recognized association such as CAABC or NEBB or equal.

.2 Testing, adjusting and balancing of complete mechanical systems is to be performed over entire operating range of each system in accordance with 1 of following publications:

.1 National Standards for a Total System Balance published by Associated Air Balance Council;

.2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by National Environmental Balancing Bureau;

.3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

2 PRODUCTS

Not Used

3 EXECUTION

3.01 SCOPE OF WORK

.1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting results.

.2 Mechanical systems to be tested, adjusted and balanced include:

.1 TAB of domestic water systems (all piping extended from Municipal main) is to include:

.1 domestic hot water recirculation piping;

.2 tempered water piping flows.

.2 TAB of heating systems is to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during heating season, a follow-up site visit during heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".

.3 TAB of air handling systems is to include equipment and ductwork air temperatures, capacities and flows.

.4 The following existing systems, revised as part of mechanical work, are to be tested, adjusted and balanced as for new systems:

.1 Existing branch flow and temperature measurements before construction and adjustments as noted on the plans;

3.02 TESTING, ADJUSTING AND BALANCING

.1 Conform to following requirements:

.1 as soon as possible after award of Contract, Agency is to carefully examine a white print set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing results of the evaluation;

.2 set of drawings examined by Agency is to be returned with evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices;

.3 after review of mechanical work drawings and specification, Agency is to visit site at frequent, regular intervals during construction of mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting and balancing;

.4 after each site visit, Agency is to report results of site visit indicating date and time of visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing;

.5 testing, adjusting and balancing is not to begin until:

.1 building construction work is substantially complete and doors have been installed;

.2 mechanical systems are complete in all respects, and have been checked, started, adjusted, and then successfully performance tested.

.6 mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing;

.7 obtain copies of reviewed shop drawings of applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences;

.8 Agency is to walk each system from system "head end" equipment to terminal units to determine variations of installation from design, and system installation trades will accompany Agency;

.9 Agency is to check valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment;

.10 wherever possible, Agency is to lock balancing devices in place at proper setting, and permanently mark settings on devices;

.11 for belt-driven equipment, Agency is to report to Commissioning Agent who in turn is to inform Contractor and Consultant of any situation where sheaves have to be replaced to suit testing and balancing, and replacements are to be done by Contractor at no cost;

.12 Agency is to leak test ductwork as specified in Section entitled HVAC Air Distribution in accordance with requirements of SMACNA "HVAC Air Duct Leak Test Manual", coordinate work with work of aforementioned Sections, provide detailed sketch(es) to Sheet Metal Contractor and Consultant identifying ductwork not in accordance with acceptable leakage values specified in aforementioned Sections, and retest corrected ductwork;

.13 Agency is to balance systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at design conditions, Agency is to immediately report problem and submit data, including sound readings, to permit an accurate assessment of noise problem to be made;

.14 Agency is to check supply air handling system mixing plenums for stratification, and where variation of mixed air temperature across coils is found to be in excess of ±5% of design requirements, Agency is to report problem and issue a detail sketch of plenum baffle(s) required to eliminate stratification;

.15 Agency is to perform testing, adjusting and balancing to within ±5% of design values, and make and record measurements which are within ±2% of actual values;

.16 for air handling systems equipped with air filters, test and balance systems with simulated 50% loaded (dirty) filters by providing a false pressure drop;

.17 test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.

.2 Prepare reports as indicated below.

.1 Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in same manner specified for final reports.

.2 Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. Use units of measurement (SI) as used on Project Documents.

.3 Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, 3-ring binders. Provide binding edge labels with project identification and a title descriptive of contents. Divide contents of binder into divisions listed below, separated by divider tabs:

.1 General Information and Summary;

.2 Air Systems;

.3 Hydronic Systems;

.4 Temperature Control Systems;

.5 Special Systems.

.4 Agency is to provide following minimum information, forms and data in report:

.1 inside cover sheet to identify Agency, Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of instrumentation used for procedures along with proof of calibration;

.2 remainder of report is to contain appropriate forms containing as a minimum, information indicated on standard AABC or NEBB report forms prepared for each respective item and system;

.3 Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying equipment, terminals, and accessories;

.4 Agency is to include report sheets indicating building comfort test readings for all rooms.

.3 After final testing and balancing report has been submitted, Agency is to visit site with Contractor and Consultant to spot check results indicated on balancing report. Agency is to supply labour, ladders, and instruments to complete spot checks. If results of spot checks do not, on a consistent basis, agree with final report, spot check procedures will stop and Agency is to then rebalance systems involved, resubmit final report, and again perform spot checks with Contractor and Consultant.

.4 When final report has been accepted, Contractor is to submit to Owner, in name of Owner, a certificate equal to AABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, Contractor is to submit a written extended warranty from Agency covering one full heating season and one full cooling season, during which time any balancing problems which occur, with exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by Agency and reported on to Owner, and if it is determined that problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to Owner.

.5 After acceptance of final report, Agency is to perform post testing and balancing site visits in accordance with following requirements:

.1 post testing and balancing site visits are to be made:

.1 once during first month of building operation;

.2 once during third month of building operation;

.3 once between fourth and tenth months in a season opposite to first and third month visit.

.2 during each return visit and accompanied by Owner's representative, Agency is to spot rebalance terminal units as required to suit building occupants and eliminate complaints;

.3 Agency is to schedule each visit with Contractor and Owner, and inform Consultant;

.4 after each follow-up site visit, Agency is to issue to Contractor and Consultant a report indicating any corrective work performed during visit, abnormal conditions and complaints encountered, and recommended corrective action.

END OF SECTION

1 GENERAL

1.01 APPLICATION

.1 This Section specifies material requirements for firestopping and smoke seal systems that are common to mechanical work Sections and it is a supplement to each Section and is to be read accordingly.

1.02 SUBMITTALS

.1 At least 4 weeks prior to work commencing, submit a sample of each type of material requirements for firestop and smoke seal systems in applied form. Identify each system with manufacturer's name and type, ULC designation, and proposed use. After samples are reviewed, work is to conform to reviewed samples.

.2 Submit a product data sheet and WHIMIS sheet for each firestopping and smoke seal product.

.3 Submit for review, full company name and experience of proposed firestopping and smoke seal system applicator.

.4 Submit letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.03 QUALITY ASSURANCE

.1 Applicator is to have a minimum of 3 years of successful experience on projects of similar size and complexity, and applicator's qualifications are to be submitted to Consultant for review.

.2 Comply with firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

2 PRODUCTS

2.01 FIRESTOPPING AND SMOKE SEAL SYSTEM MATERIALS

.1 Asbestos-free, elastomeric materials and intumescent materials, tested, listed and labelled by ULC in accordance with CAN/ULC S115, and CAN/ULC S101 for installation in ULC designated firestopping, and smoke seal systems to provide a positive fire, water and smoke seal and a fire resistance rating (flame, hose stream and temperature) no less than fire rating for surrounding construction.

.2 Firestopping and smoke seal material system to be specifically ULC certified with designated reference number for its specific installation. As part of shop drawing submission, submit copies of firestopping drawings with ULC certificate and system number for each specific installation.

.3 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly. Coordinate material requirements with trades supplying abutting areas of materials.

.4 Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.

.5 Typically, for openings of up to 250 mm (10") in diameter, provide putty pad type firestop materials equivalent to Specified Technologies Inc. "SpecSeal" intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibres or silicone compounds.

.6 Typically, for openings of greater than 250 mm (10") in diameter, and for rectangular openings, provide pillow type firestop materials equivalent to Specified Technologies Inc. "SpecSeal" re-enterable, non-curing, mineral fibre core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag.

.7 Pipe insulation forming part of a fire and smoke seal assembly is specified in Section entitled Mechanical Insulation.

.8 Supply products of a single manufacturer for use on work of this Division.

.9 Installer to be manufacturer trained and certified on specific product. Submit copy of certificate with shop drawings.

.10 Include for manufacturer's authorized representative to inspect and verify each installation and application. Submit test report signed and verified by system installer's authorized representative and manufacturer's representative.

.11 Acceptable certification to also include certification by Underwriters Laboratories of Northbrook IL, using tests conforming to ULC-S115 and given cUL listing published by UL in their "Products Certified for Canada (cUL) Directory".

.12 Acceptable manufacturers are:

.1 Specified Technologies Inc.;

.2 3M Canada Inc.;

.3 Tremco;

.4 A/D Fire Protection Systems;

.5 Nelson;

.6 Hilti Canada.

3 EXECUTION

3.01 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Where work penetrates or punctures fire rated construction, provide ULC certified, listed and labelled firestopping and smoke sealing packing material systems to seal openings and voids around and within raceway and to ensure that continuity and integrity of fire separation is maintained. Openings not in immediate vicinity of working areas are to be firestopped and sealed same day as being opened.

.2 Install firestopping and smoke seal materials for each installation in strict accordance with specific ULC certification number and manufacturer's instructions. Comply with local governing building code requirements and obtain approvals from local building inspection department. Ensure that openings through fire separations do not exceed maximum size wall opening, and maximum and minimum dimensions indicated in ULC Guide No. 40 U19 for Service Penetration Assemblies and firestopping materials.

.3 Ensure that continuity and integrity of fire separation is maintained and conform to requirements of latest edition of ULC publication "List of Equipment and Materials, Volume II, Building Construction".

.4 Comply with following requirements:

.1 Examine substrates, openings, voids, adjoining construction and conditions under which firestop and smoke seal system is to be installed. Confirm compatibility of surfaces.

.2 Verify penetrating items are securely fixed and properly located with proper space allowance between penetrations and surfaces of openings.

.3 Report any unsuitable or unsatisfactory conditions to Consultant in writing, prior to commencement of work. Commencement of work will mean acceptance of conditions and surfaces.

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces. Remove stains on adjacent surfaces.

.5 Prime substrates in accordance with product manufacturer's written instructions.

.6 Provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing.

.7 Tool or trowel exposed surfaces to a neat, smooth, and consistent finish.

.8 Remove excess compound promptly as work progresses and upon completion.

.9 At fusible link damper locations, seal perimeter of angle iron framing on both sides of wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal.

.5 Notify Consultant when work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of work by local governing authority inspector prior to concealing or enclosing work. Make any corrections required.

.6 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to Consultant certifying the firestopping and smoke sealing installation has been carried out throughout the building to service penetrations and that installation has been performed in strict accordance with requirements of local governing building code, any applicable local municipal codes, ULC requirements, and manufacturer's instructions.

.7 Manufacturer's authorized representative to inspect and verify each installation and provide a test report signed by installing trade and manufacturer's representative. Test report to list each installation and respective ULC certification and number.

.8 Where work requires removal of existing firestopping materials and replacement of firestopping materials after cabling changes have been made, ensure that replacement material is same material and manufacturer of existing if any remains in place, or ensure that all existing material is removed before installation of replacement material.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets to regulatory authority for review and approval prior to submitting to Consultant. Conform to following requirements:

.1 submit shop drawings/product data sheets for products specified in this Section except pipe and fittings;

.2 submit complete CAD layout drawings indicating source of water supply with test flow and pressure, "head-end" equipment piping schematic, pipe routing and sizing, and risers, all signed and sealed by a qualified professional mechanical engineer registered in the jurisdiction of the work as specified below;

.3 submit copies of calculations signed by same engineer who signs layout drawings, and a listing of design data used in preparing calculations, system layout and sizing;

1.02 QUALITY ASSURANCE

.1 Fire protection standpipe system work is to be in accordance with following Codes and Standards:

.1 NFPA 14, Standard for the Installation of Standpipes and Hose Systems;

.2 CSA B137.2, Polyvinylchloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications;

.3 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless;

.4 ASTM A234,Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service;

.5 ASTM A536, Standard Specification for Ductile Castings;

.6 ANSI/ASME B16.4, Grey Iron Threaded Fittings (Classes 125 and 250);

.7 CAN/CSA B64.10, Backflow Preventers and Vacuum Breakers.

.2 Site personnel are to be licensed in jurisdiction of the work and under continuous supervision of a foreman who is an experienced fire protection system installer and a journeyman pipe fitter licensed in jurisdiction of the work.

.3 Check and verify dimensions and conditions at site and ensure work can be performed as indicated. Coordinate work with trades at site and accept responsibility for and cost of making adjustments to piping and/or spacing to avoid interference with other building components.

.4 Verify working condition of existing standpipe system equipment which has direct interface with project work and is to remain. Replace with new equipment where necessary.

.5 System components must be ULC listed and labelled.

.6 All grooved couplings, and fittings, valves and specialties are to be products of a single manufacturer. Grooving tools are to be of same manufacturer as grooved components.

.7 All castings used for coupling housings, fittings, valve bodies, etc., are to be date stamped for quality assurance and traceability.

1.03 DESIGN REQUIREMENTS

.1 Fire protection standpipe work is to be designed in accordance with latest edition of OBC, NFPA 14 2013 and Provincial Standards, and, where required, local building and fire department requirements and standards of Owner's Insurer.

.2 Include for a qualified mechanical professional engineer registered and licensed in the jurisdiction of the work to design the fire protection standpipe work. Refer to Section entitled Mechanical Work General Instructions for requirements regarding Contractor retained engineers.

2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

.1 Pipe, fittings and joints are to be as follows, with exceptions as specified in Part 3 of this Section:

.1 Schedule 10 Steel – Grooved Coupling Joints

.1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints. Strap-on fittings such as Victaulic "Snap-Let" strap type fittings are not acceptable.

.2 Victaulic Standard Mechanical Couplings: Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets are to be pressure-responsive synthetic rubber, grade to suit intended service, conforming to ASTM D-2000. Mechanical Coupling bolts are to be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183. Couplings are to comply with ASTM F1476, Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

.1 Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads are to be used to provide system rigidity and support and hanging in accordance NFPA-13. Couplings are to be fully installed at visual pad-to-pad offset contact. Couplings that require exact gapping of bolt pads at specific torque ratings are not permitted.

.2 Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 177 (Quick-Vic™), flexible coupling.

.2 Schedule 40 Steel – Screwed and Welded Joints

.1 Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping is to be complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping is to be complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever

3 EXECUTION

3.01 DEMOLITION

.1 Refer to demolition requirements specified in Section entitled Demolition and Revision Work.

3.02 PIPING INSTALLATION REQUIREMENTS

.1 Provide required standpipe system piping. Unless otherwise specified, piping is to be as follows:

.1 for piping inside building and above ground, Schedule 40 grooved end black steel with Victaulic or equal fittings and coupling joints, or, for piping to and including 50 mm (2") diameter, screwed fittings and joints or piping 65 mm (2-½") diameter and larger, welding fittings and welded joints.

.2 Perform piping work in accordance with requirements of NFPA 14, governing regulations, and "reviewed" shop drawings.

.3 Exceptions to piping requirements specified above are as follows:

.1 steel piping, fittings, unions, couplings and flanges for work exposed to weather either inside or outside the building (including parking garages), are to be galvanized;

.2 ferrous pipe hangers, supports, and similar hardware used for galvanized steel piping are to be galvanized.

.4 Pipe sizes, pipe routing, and layout of work shown on drawings are to assist during the tendering period. Do not reduce size of standpipe main or re-route the main unless approved by Consultant.

.5 Install grooved joints in accordance with manufacturer's latest installation instructions. Grooved ends are to be clean and free from indentations, projections and roll marks. Gaskets are to be moulded and produced by coupling manufacturer, and verified as suitable for intended service. Have factory-trained representative from mechanical joint manufacturer provide on-site training in proper use of grooving tools and installation of grooved piping products. Have factory-trained representative periodically review product installation and ensure best practices are being followed. Remove and replace any improperly installed products.

.6 Clean pipe, fittings, couplings, flanges, and similar components after erection is complete. Wire brush clean any ferrous pipe, fitting, coupling, flange, hanger, support and similar component which exhibit rust and carefully coat with suitably coloured primer.

.7 Slope horizontal piping so it may be completely drained. Provide capped drain points.

.8 Provide a pressure gauge at the highest outlet in each standpipe riser. Locate gauges so they can be read easily. Where possible, locate gauges in fire hose cabinets. See Section entitled Basic Mechanical Materials and Methods for pressure gauge requirements.

3.03 INSTALLATION OF SHUT-OFF VALVE SUPERVISORY SWITCHES

.1 Equip each shut-off valve with a supervisory switch.

.2 Identify each supervised valve with a 150 mm (6") square, engraved, laminated red-white plastic tag to correspond with supervised valve numbering specified and/or shown as part of the electrical work fire alarm system.

.3 At low point near each fire department connection, install a 90° elbow with drain connection to allow for system drainage to prevent freezing.

3.04 INSTALLATION OF FIRE HOSE CABINETS

.1 Provide fire hose cabinets.

.2 Confirm exact cabinet locations prior to roughing-in.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets to regulatory authority for review and approval prior to submitting to Consultant. Conform to following requirements:

.1 submit shop drawings/product data sheets for all products specified in this Section;

.2 submit complete CAD layout drawings indicating source of water supply with test flow and pressure, "head-end" equipment piping schematic, pipe routing and sizing, and zones, all signed and sealed by a qualified professional mechanical engineer registered in jurisdiction of the work as specified below;

.3 submit copies of all calculations, including hydraulic calculations, stamped and signed by same engineer who signs layout drawings, and a listing of all design data used in preparing the calculations, system layout and sizing, including occupancy-hazard design requirements;

.4 in addition to submitting shop drawings to regulatory authority as specified above, shop drawings must be approved by Owner's insurer prior to being submitted to Consultant for review.

.2 Submit a complete sprinkler system test certificate as specified in Part 3 of this Section.

.3 Sprinklers are to be identified on drawings and product submittals and be specifically identified by manufacturer's listed model or series designation. Trade names and other abbreviated listings are unacceptable.

1.02 QUALITY ASSURANCE

.1 Fire protection sprinkler system work is to be in accordance with following Codes and Standards:

.1 NFPA 13, Standard for the Installation of Sprinkler Systems;

.2 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless;

.3 ASTM A135, Standard Specification for Electric-Resistance-Welded Steel Pipe;

.4 ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service;

.5 ASTM A536, Standard Specification for Ductile Castings;

.6 ASTM A795, Standard Specification for Black and Hot-Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use;

.7 ANSI/ASME B16.4, Grey Iron Threaded Fittings (Classes 125 and 250);

.8 CAN/CSA B64.10, Backflow Preventers and Vacuum Breakers.

.2 Fire protection sprinkler work is to be performed by a sprinkler company who is a member in good standing of the Canadian Automatic Sprinkler Association. Site personnel are to be licensed in jurisdiction of the work and under the continuous supervision of a foreman who is an experienced fire protection system installer and a journeyman pipe fitter licensed in jurisdiction of the work.

.3 Check and verify dimensions and conditions at site and ensure work can be performed as indicated. Coordinate work with trades at site and accept responsibility for and cost of making adjustments to piping and/or spacing to avoid interference with other building components.

.4 System components must be ULC listed and labelled.

.5 Grooved couplings, and fittings, valves and specialties are to be products of a single manufacturer. Grooving tools are to be of same manufacturer as grooved components.

.6 Castings used for coupling housings, fittings, valve bodies, etc., are to be date stamped for quality assurance and traceability.

1.03 DESIGN REQUIREMENTS

.1 Fire protection sprinkler work is to be designed in accordance with NFPA 13, 2013 and current OBC and, where required, local building and fire department requirements and standards of Owner's Insurer. If water supply flow and pressure test data is not available, conduct Municipal main water flow and pressure tests at nearest fire hydrant to obtain criteria to be used in system design. Include hydrant location and flow and pressure test data with system design calculations.

.2 Include for a qualified mechanical professional engineer registered and licensed in the jurisdiction of the work to design the fire protection standpipe work. Refer to Section entitled Mechanical Work General Instructions for requirements regarding Contractor retained engineers.

.3 Sprinkler System Occupancy – Hazard Design requirements: In accordance with NFPA 13 occupancy-hazard density requirements, unless otherwise specified.

.4 Contractor shall coordinate sprinkler head layouts with architectural, structural, mechanical and electrical systems in order to avoid obstruction of sprinkler head. Contractor to provide heads, takeoffs and branch lines as required to provide full coverage to meet layouts.

2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

.1 Pipe, fittings and joints are to be as follows, with exceptions as specified in Part 3 of this Section:

.1 Schedule 40 Steel – Grooved Coupling Joints

.1 Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and mechanical fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints. Strap type outlet fittings such as Victaulic "Snap-Let" are not acceptable.

.2 Schedule 10 Steel – Grooved Coupling Joints

.1 Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 009N, 107H, and 107N QuickVic and 005 rigid coupling joints.

.3 Standard Mechanical Couplings: Equal to Victaulic

.1 Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets are to be pressure-responsive synthetic rubber, grade to suit intended service, conforming to ASTM D-2000. Mechanical coupling bolts are to be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183. Couplings are to comply with ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

.2 Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads are to be used to provide system rigidity and support and hanging in accordance
NFPA-13. Couplings are to be fully installed at visual pad-to-pad offset contact. Couplings that require exact gapping of bolt pads at specific torque ratings are not permitted.

.3 Flexible Type: Use in locations where vibration attenuation and stress relief are required; Victaulic Style 177 (Quick-Vic™) flexible coupling.

.2 bonnet, EPDM O-ring stem seals and body gasket. Equal to Victaulic Series 771H (Grooved ends) and Series 771F (Grooved x Flanged).

2.02 SPRINKLER HEADS

.1 Sprinkler heads, unless otherwise specified, are to be as scheduled in Part 3 of this Section.

.2 Sprinkler body is to be die-cast, with a hex-shaped wrench boss integrally cast into sprinkler body to reduce risk of damage during installation. Wrenches are to be provided by sprinkler manufacturer that directly engages wrench boss.

.3 For locations where corrosive resistant coatings are required, body is to be coated with ULC listed and FM approved anti-corrosion VC-250 coating (silver colouring).

.4 Recessed sprinkler heads in finished areas are to be chrome plated unless otherwise specified. Concealed sprinkler head ceiling plates are to match ceiling colour.

.5 Where exposed pendent heads occur in areas with suspended ceilings, they are to be complete with white factory-painted escutcheon plates. Similarly, sidewall heads with concealed piping are to be complete with white escutcheon plates.

.6 Sprinkler heads which are exposed in areas where they may be subject to damage are to be complete with wire guards, chrome plated where in finished areas.

.7 Escutcheons and guards are to be listed, supplied, and approved for use with sprinkler by sprinkler manufacturer.

.8 Sprinkler heads located in areas or over equipment where high ambient temperature is present are to be, unless otherwise specified, 74°C (165°F) heads. All other heads, unless otherwise specified or required, are to be 57°C (135°F) rated.

.9 Acceptable manufacturers are:

.1 Victaulic Co.;

.2 Tyco Fire Suppression & Building Products;

.3 The Viking Corporation;

.4 The Reliable Automatic Sprinkler Co.

3 EXECUTION

3.01 PIPING INSTALLATION REQUIREMENTS

.1 Provide required sprinkler system piping.

.2 Perform piping work in accordance with requirements of NFPA 13 2013, governing regulations, and "Reviewed" shop drawings.

.3 Piping, unless otherwise specified, is as follows:

.1 for piping inside building and above ground except as noted below – Schedule 40 grooved end black steel with Victaulic or equal fittings and coupling joints, or, for piping to and including 50 mm (2") diameter, screwed fittings and joints, or, for piping 65 mm (2-½") diameter and larger, welding fittings and welded joints;

.2 for piping downstream of "head end" alarm valve(s) and equipment – Schedule 10 or "Light wall" black steel pipe with Victaulic or equal fittings and coupling joints or screwed fittings and joints;

.4 Pipe sizes, pipe routing, sprinkler head quantities and locations, and layout of work shown on drawings are to assist during tendering period. Ensure adequate head coverage, head quantities and pipe sizing as specified in Part 1 of this Section. Do not reduce size of sprinkler main or re-route main unless reviewed with and approved by Consultant.

.5 Install grooved joints in accordance with manufacturer's latest installation instructions. Grooved ends are to be clean and free from indentations, projections and roll marks. Gaskets are to be molded and produced by coupling manufacturer and verified as suitable for intended service. Have factory-trained representative from mechanical joint manufacturer provide on-site training in proper use of grooving tools and installation of grooved piping products. Have factory-trained representative periodically review product installation and ensure best practices are being followed. Remove and replace any improperly installed products.

.6 Clean pipe, fittings, couplings, flanges and similar components after erection is complete. Wire brush clean any ferrous pipe, fitting, coupling, flange, hanger, support and similar component which exhibit rust and carefully coat with suitably coloured primer.

.7 When sprinkler work is complete, test system components and overall system(s) and submit completed test certificate and other documentation in accordance with Chapter 25 of NFPA 13 2013.

3.02 INSTALLATION OF SPRINKLER HEADS

.1 Provide required sprinkler heads in accordance with following schedule (or equivalent):

APPLICATION	SPRINKLER HEAD TYPE
Rooms/areas with a suspended ceiling	Victaulic V38/V39 or Tyco Series RFII "Royal Flush II" concealed pendent Victaulic V27 or Tyco Series TY-FRB recessed pendent Victaulic V27 or Tyco Series TY-FRB pendent with escutcheon plates
Rooms/areas without a suspended ceiling	Victaulic V27 or Tyco Series TY-FRB pendent
Elevator shafts	Victaulic V27 or Tyco Series TY-FRB horizontal sidewall
Heated areas with overhead doors	Victaulic V27 or Tyco Series TY-FRB horizontal sidewall
At non-rated windows in rated walls	Tyco Model WS horizontal and pendent vertical sidewall
Attic	Specific Application Attic Sprinklers

.2 Sprinkler head manufacturers indicated on schedule are for type indication purposes. Acceptable manufacturers are listed in Part 2 of this Section.

.3 Coordinate sprinkler head locations with all drawings, including architectural reflected ceiling plan drawings, and, where applicable, electrical drawings. Coordinate sprinkler head locations in areas with suspended ceilings with the location of lighting, grilles, diffusers, and similar items recessed in or surface mounted on the ceiling as per the reflected ceiling plans. In areas with lay-in tile, centre the sprinkler head both ways in the lay-in tile wherever possible. Confirm locations prior to roughing-in.

.4 Maintain maximum headroom in areas with no ceilings.

.5 Provide guards for heads where they are subject to damage.

.6 Provide high temperature heads in equipment rooms and similar areas over heat producing or generating equipment.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in Part 2 of this Section except for pipe, fittings, and chlorine.

.2 Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance of the Work.

.3 Prior application for Substantial Performance of the Work, submit a minimum of 3 identified keys for key operated hydrants.

.4 Submit signed test results and inspection and test log cards for each backflow preventer as specified in Part 3 of this Section.

1.02 QUALITY ASSURANCE

.1 Domestic water piping and valves are to comply with following codes, regulations and standards (as applicable):

.1 applicable local codes and regulations;

.2 CAN/CSA B125.1, Plumbing Supply Fittings;

.3 CAN/CSA B125.3, Plumbing Fittings;

.4 CAN/ULC S102.2, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies;

.5 CAN/ULC S101, Fire Endurance Tests of Building Construction and Materials;

.6 NSF/ANSI 61, Drinking Water System Components – Health Effects;

.7 NSF/ANSI 372, Drinking Water System Components – Lead Content.

2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

.1 Soft Copper

.1 Type "K" soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.

.2 Hard Copper - Solder Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using The Canada Metal Co. Ltd. "SILVABRITE 100" or equal lead-free solder for cold water pipe, and 95% tin/ 5% Antimony or "SILVABRITE 100" solder for other services.

.3 Copper Pressure Coupled Joint

.1 Type "L" hard drawn seamless copper to ASTM B88 with Viega "ProPress with Smart Connect feature" copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.

.4 Semi-Rigid Polyethylene Tubing

.1 Versa Fittings and Mfg. Inc. 12 mm (½") dia., high density, semi-rigid polyethylene tubing, 1380 kPa (200 psi) rated.

2.02 SHUT-OFF VALVES

.1 Ball Valves

.1 Class 600, 4140 kPa (600 psi) WOG rated, lead-free, full port ball type valves, each complete with a forged brass body with solder ends, forged brass cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, and a removable lever handle. Valves in insulated piping are to be complete with stem extensions.

.2 Acceptable products are:

.1 Toyo Valve Co. Fig. 5049A-LF;

.2 Milwaukee Valve Co. #UPBA485B;

.3 Kitz Corporation Code 859;

.4 Apollo Valves #77LF-200;

.5 Watts Industries (Canada) Inc. #LFFBVS-3C.

.2 Butterfly Valves - Flanged Joint

.1 Non-corrosive, minimum 1200 kPa (175 psi) cold water pressure rated, resilient seated butterfly valves, each complete with a coated cast ductile iron lug type body, stainless steel shaft, bronze disc, and EPDM seat, and each suitable for domestic water bubble-tight dead end service with valve in position and either side of connecting piping removed. Butterfly valves to and including 100 mm (4") dia. are to be equipped with lever handles. Butterfly valves larger than 100 mm (4") dia. are to be equipped with worm gear operators.

.2 Acceptable products are:

.1 DeZurik #632L Series;

.2 Kitz Corporation Code #6122EL/EG;

.3 Toyo Valve Co. #918BESL/EG;

.4 Bray Valve and Controls Canada Series 31;

.5 Apollo Valves #141 Series;

.6 Watts Industries (Canada) Inc. #BF-03.

2.03 CHECK VALVES

.1 Horizontal

.1 Lead-free, Class 125, bronze, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with solder ends.

.2 Acceptable products are:

.1 Toyo Valve Co. Fig. 237A-LF;

.2 Milwaukee Valve Co. #UP1509;

.3 Kitz Corporation Code 823;

.4 Apollo Valves #61LF Series.

.2 Vertical

.1 Equal to Kitz Corp. Code 826, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with soldering ends.

2.04 DRAIN VALVES

.1 Minimum 2070 kPa (300 psi) water rated, 20 mm (¾") dia., straight pattern full port bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm (¾") dia. garden hose, and a cap and chain.

.2 Acceptable products are:

.1 Toyo Valve Co. Fig. 5046;

.2 Dahl Brothers Canada Ltd. Fig. No. 50. 430;

.3 Kitz Corporation Code 58CC;

.4 Apollo Valves #78-104-01;

.5 Watts Industries (Canada) Inc. #B6000.

2.05 DOMESTIC HOT WATER PIPING BALANCING VALVES

.1 Solder or flanged end type as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

.2 Acceptable products are:

.1 S.A. Armstrong Model CBV Series;

.2 Tour and Andersson Model TBV Series;

.3 Watts Industries (Canada) Inc. Model CSM Series.

2.06 DOMESTIC HOT WATER THERMOSTATIC MIXING VALVES

.1 Lead Free, cast copper silicon alloy body, integral filter washers and an adjustment cap with locking feature. Solid wax hydraulic principle thermostat. check valves in both the hot and cold water inlets to protect against cross flow.

.2 Acceptable manufacturers are:

.1 Watts.

.2 Leonard Valve Co.

.3 Symmons Industries Inc.

.4 Powers.

2.07 CHLORINE

.1 Sodium hypochlorite to AWWA B300.

2.08 FLOOR DRAIN TRAP SEAL PRIMERS

.1 Primer Valve Type with Manifold

.1 Precision Plumbing Products Inc. Model P1-500 trap primer valve constructed as specified above for the Model P2-500 primer valve, complete with a Model DU-3 or DU-4, 3 or 4 outlet distribution unit for priming 3 or 4 traps, and at Model "YS-8" supply tube with combinations of Model DU-3 and DU-4 distribution units for priming from 5 to 6 traps.

2.09 WATER HAMMER ARRESTORS

.1 Piston type, sealed, pressurized water hammer arrestors suitable for either horizontal or vertical installation, each complete with a hard drawn copper body, "O"-ring piston seals, an air charge, and an inlet opening equal to diameter of pipe in which arrestor is required.

.2 Acceptable products are:

.1 Watts Industries (Canada) Inc.;

.2 Zurn #Z1705;

.3 Precision Plumbing Products Inc. #SC;

.4 Mifab MWH Series.

2.10 DOMESTIC WATER THERMAL EXPANSION TANK

.1 Pre-charged domestic water thermal expansion tank in accordance with Section VIII of the ASME Boiler and Pressure Code, carbon steel outer shell construction and complete with fixed butyl rubber bladder to prevent water from contacting shell interior, top NPT stainless steel system connection, 7.6 mm to 813 mm (0.301" to 32") charging valve connection and prime painted exterior.

.2 Acceptable products are:

.1 Watts Industries (Canada) Inc. Model PLT-5

.2 Zurn/Wilkins Model WTTA.

2.11 STRAINERS

.1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS 2 and under: bronze body, screwed ends, with brass cap. Acceptable material: Watts 777 series.

.3 NPS 2 ½ and over: cast iron body, flanged ends, with bolted cap. Acceptable material: Watts 77F series, or equal

3 EXECUTION

3.01 PIPING INSTALLATION REQUIREMENTS

.1 Provide required domestic water piping.

.2 Piping, unless otherwise specified, is as follows:

.1 for underground piping less than 100 mm (4") dia. inside building – Type "K" soft copper;

.2 for 12 mm (½") dia. trap seal primer tubing located underground or in concrete or masonry construction – semi-rigid polyethylene;

.3 for pipe inside building and aboveground in sizes to 100 mm (4") dia. – Type "L" hard copper with solder joints or Type "L" hard copper with pressure coupled mechanical joints.

.3 Slope piping so it can be completely drained.

.4 Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe or equipment.

3.02 INSTALLATION OF SHUT-OFF AND CHECK VALVES

.1 Refer to Part 3 of Section entitled Basic Mechanical Materials and Methods.

.2 For shut off valves installed on solder joint copper piping up to and including 75 mm (3") diameter, provide ball type valves, and for flanged joints copper or stainless steel piping larger than 75 mm (3") diameter provide butterfly type valves.

3.03 INSTALLATION OF DRAIN VALVES

.1 Provide a drain valve at the bottom of domestic water piping risers, at other piping low points, and wherever else shown.

.2 Locate drain valves so they are easily accessible.

3.04 INSTALLATION OF DOMESTIC HOT WATER PIPING BALANCING VALVES

.1 Provide balancing valves in domestic hot water recirculation piping where shown or required.

.2 Locate each valve so it is easily accessible.

3.05 INSTALLATION OF DOMESTIC HOT WATER THERMOSTATIC MIXING VALVES

.1 Provide a domestic hot water thermostatic mixing valve assembly and wall mount.

.2 Adjust each valve to design requirements and check and test operation. Set maximum temperature limit stops.

.3 Identify each valve and its water temperature delivery setting with an engraved nameplate.

3.06 INSTALLATION OF TRAP SEAL PRIMERS

.1 Provide required accessible trap seal primers to automatically maintain a water seal in floor drain traps, whether shown on drawings or not.

.2 Provide trap primer valves to prime single or multiple (1 to 6) traps. Install trap primer valves in domestic cold water piping to frequently used plumbing fixtures. Where from 2 to 6 traps are to be primed from same primer valve, provide appropriate supply and distribution tube assemblies. Ensure primer valves are accessible.

.3 Ensure trap primer piping is secured to floor drain primer tappings and not terminated through the tapping in the throat of the drain.

3.07 INSTALLATION OF WATER HAMMER ARRESTORS

.1 Provide accessible water hammer arrestors in domestic water piping in locations as follows:

.1 in headers at groups of plumbing fixtures;

.2 at top of risers;

.3 at ends of long horizontal runs of piping;

.4 in piping connecting solenoid valves or equipment with integral solenoid valves;

.5 wherever else shown or required by Code.

.2 Install each unit in a piping tee either horizontally or vertically in the path of potential water shock in accordance with manufacturer's instructions and details.

3.08 INSTALLATION OF DOMESTIC WATER THERMAL EXPANSION TANK

.1 Provide domestic water thermal expansion tanks.

.2 Unless otherwise specified, mount at least 450 mm (18") from cold water inlet to domestic water heater.

.3 Adjust pre-charge to match incoming water pressure after installation.

.4 Install in accordance with manufacturer's instructions and as per local governing Codes and Regulations.

3.09 FLUSHING AND DISINFECTING PIPING

.1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.

.2 Flush piping until all foreign materials have been removed and flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.

.3 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with AWWA C601.

.4 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of test results and fill the systems.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings.

.2 Submit a copy of plumbing inspection certificate prior to application for Substantial Performance of the Work.

.3 Submit letters from product manufacturers/suppliers to certify correct installation of products as specified in Part 3 of this Section.

2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

.1 Copper - Solder Joint

.1 Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.

.2 Cast Iron

.1 Class 4000 cast iron pipe, fittings, and mechanical coupling joints to CAN/CSA B70.

2.02 VENT STACK COVERS

.1 Equal to Lexcor Model "Flash-Tite" seamless, spun aluminum, insulated vent stack covers with caps and a factory applied asphalt primer coating on top and bottom of flange.

.2 Each vent stack cover is to be complete with a vandal-proof cap.

2.03 CLEANOUTS

.1 Horizontal Piping

.1 TY pipe fitting with an extra heavy brass plug screwed into the fitting.

.2 Vertical Piping

.1 Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.

2.04 FLOOR CLEANOUT TERMINATIONS

.1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware.

.2 Acceptable products are:

.1 Watts Industries (Canada) Ltd. # CO-200-R-1;

.2 Jay R. Smith #4020-F-C Series;

.3 Zurn # ZN-1602-SP Series;

.4 Mifab # C1100-XR-1 or #C1000-R-3.

.3 Cleanout terminations in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.

2.05 FLOOR DRAINS, FUNNEL FLOOR DRAINS AND HUB DRAINS

.1 Unless otherwise specified or indicated, floor drains are to be vandal-proof drains in accordance with drawing symbol list, each complete with a cast iron body and a trap seal primer connection. Cast iron components are to be factory finished with latex based paint coating. Floor drains to CAN3-B79.

.2 Floor drains in areas with a tile or sheet vinyl floor finish are to be as above but with a square grate in lieu of a round grate.

.3 Acceptable manufacturers are:

.1 Watts Industries (Canada) Ltd.;

.2 Jay R. Smith Manufacturing Co.;

.3 Zurn Industries Ltd.;

.4 Mifab Inc.

.4 FD-1: General areas: general duty, lacquered cast iron body, adjustable head, 150mm nickel bronze strainer, integral seepage pan, trap primer tapping. Provide surface membrane clamping collars in areas with membrane floors. Standard of acceptance: Watts FD-200.

.5 HD-1: Hub drain: General areas single pipe hub drain with bronze body double drainage weepholes and adjustable satin nickel bronze hub. Standard of acceptance: Watts FD-200-DD.

3 EXECUTION

3.01 DRAIN AND VENT PIPING INSTALLATION REQUIREMENTS

.1 Provide required drainage and vent piping. Pipe, unless otherwise specified, as follows:

.1 for pipe inside building and aboveground in sizes less than or equal to 65 mm (2-½") dia. – type DWV copper;

.2 for pipe inside building and aboveground in sizes greater than or equal to 75 mm (3") dia. – Class 4000 cast iron;

.3 for drainage pump discharge pipe connections from pump to and including shut-off and check valve connections – Type "DWV" copper with Victaulic "Copper Connection" fittings and couplings, or Schedule 40 galvanized steel with Victaulic fittings and couplings.

.2 Unless otherwise specified, slope horizontal drainage piping aboveground in sizes to and including 75 mm (3") dia. 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") dia. and larger 25 mm (1") in 2.4 m (8').

.3 Install and slope underground drainage piping to inverts or slopes indicated on drawings to facilitate straight and true gradients between points shown. Verify available slopes before installing pipes.

.4 Unless otherwise specified, slope horizontal branches of vent piping down to fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').

.5 Extend vent stacks up through roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above roof (including roof parapets) in vent stack covers. Where not shown on drawings, route vent piping from source to building exterior as required in order to satisfy local governing codes and authority. Coordinate vent routing with other building services and ensure there is no architectural impact.

.6 Provide cast brass dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.02 SUPPLY OF VENT STACK COVERS

.1 Supply a properly sized vent stack cover for each vent stack penetrating roof.

.2 Hand vent stack covers to roofing trade at site for installation and flashing into roof construction as part of roofing work. Coordinate installation to ensure proper locations. Provide waterproofing caps over vent stacks.

3.03 INSTALLATION OF CLEANOUTS

.1 Provide cleanouts in drainage piping in locations as follows:

.1 in building drain or drains as close as possible to inner face of outside wall, and, if a building trap is installed, locate cleanout on downstream side of building trap;

.2 at or as close as practicable to the foot of each drainage stack;

.3 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") dia. and smaller;

.4 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") dia.;

.5 wherever else shown on drawings.

.2 Cleanouts are to be same diameter as pipe in piping to 100 mm (4") dia., and not less than 100 mm (4") dia. in piping larger than 100 mm (4") dia.

.3 Where cleanouts in vertical piping are concealed behind walls or partitions, install cleanouts near floor and so cover is within 25 mm (1") of the finished face of the wall or partition.

3.04 INSTALLATION OF FLOOR CLEANOUT TERMINATIONS

.1 Where cleanouts occur in horizontal inaccessible underground piping, extend cleanout TY fitting up to floor, and provide a cleanout termination set flush with finished floor.

.2 In waterproof floors, ensure each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit floor finish.

.3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.

.4 Ensure cleanout termination covers in tiled floor are square in lieu of round.

3.05 INSTALLATION OF FLOOR DRAINS, FUNNEL FLOOR DRAINS AND HUB DRAINS

.1 Provide floor drains, funnel floor drains and hub drains.

.2 Coordinate location of floor drains, funnel floor drains and hub drains with equipment provided by Mechanical Division and Owner's supplied equipment. Install in accordance with manufacturer's instructions.

.3 Equip each drain with a trap.

.4 In equipment rooms and similar areas, exactly locate floor drains to suit location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.

.5 Confirm exact location of drains prior to roughing in. Where floor drains occur in washrooms coordinate locations with toilet partition installations.

.6 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final clean-up work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates, and refinish any areas of the drain where cast iron finish has been damaged or removed, including rusted areas.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings.

2 PRODUCTS

2.01 GENERAL RE: PLUMBING FIXTURES AND FITTINGS

.1 Fixtures and fittings, where applicable, are to be in accordance with requirements of CAN/CSA B45 Series, General Requirements for Plumbing Fixtures, including supplements, ASME A112.1.18.1/CSA B125.1, Plumbing Supply Fittings, and CSA B125.3, Plumbing Fittings.

.2 Barrier-free fixtures and fittings are to be in accordance with governing Code requirements.

.3 Unless otherwise specified, vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.

.4 Unless otherwise specified, fittings and piping exposed to view are to be chrome plated and polished.

.5 Fittings located in areas other than private washrooms are to be vandal-proof.

.6 Fixture carriers are to be suitable in all respects for the fixture they support and construction in which they are located.

.7 Floor flanges for floor mounted water closets are to be cast iron or brass, secured to floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.

.8 Proper seal to mate with fixture carrier flange and produce a water-tight installation.

.9 Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit fixture type and drain connection.

.10 Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to be adjustable cast brass with cleanout plugs, all to suit fixture type and drain connection.

.11 Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit fixture.

.12 Water piping as specified, complete with ball type shut-off valves as specified with water piping, or Dahl Bros. Canada Ltd. ¼ turn Mini Ball Valves.

2.02 PLUMBING FIXTURES AND FITTINGS

.1 Water Closets:

.1 WC-1: Standard

.1 Vitreous china wall mounted, 410mm high flush valve, 4.2 to 6.0 lpf, elongated bowl, siphon jet flush action, internal trap way area fully glazed, 50mm ball pass. Colour: white.

.2 Seat: White, elongated to match bowl, open front, moulded solid plastic, stainless steel check hinges.

.3 Supply: Chrome-plated brass angle stop, c/w rigid chrome-plated flexible tubing, escutcheon.

.4 Flush valve shall be: exposed, hard-wired, automatic c/w transformer.

.2 WC-2: Barrier-Free for Universal Washrooms

.1 Vitreous china wall mounted, 410mm high flush valve, 4.2 to 6.0 lpf, elongated bowl, siphon jet flush action, internal trap way area fully glazed, 50mm ball pass. Colour: white

.2 Seat: White, elongated to match bowl, open front, moulded solid plastic, stainless steel check hinges, with backrest. Seat shall be between 430mm and 485mm above the finished floor.

.3 Dimensions and installation heights shall conform to CSA B651.

.4 Supply: Chrome-plated brass angle stop, c/w rigid chrome-plated flexible tubing, escutcheon.

.5 Flush valve shall be: exposed, hard-wired, automatic c/w transformer.

.3 Lavatories:

.1 .L-1: Barrier-Free for Universal Washrooms

.1 Wall-hung, vitreous china, with overflow, single faucet hole, self-draining deck area. Complete with protective shroud for drain piping. Coordinate size with architectural. Lav dimensions shall comply with the OBC barrier-free requirements.

.2 Trim:

.1 Cast brass washer-less ceramic disc valve cartridge. Chrome-plated, hard-wired, automatic sensing faucet with aerator and 120V/24V AC transformer.

.2 Supply: Chrome-plated brass angle stop, c/w rigid chrome-plated flexible tubing, and escutcheon. Provide point-of-use mixing valve on supplies.

.3 Waste: chrome-plated open grid type strainer

.4 Trap: chrome-plated adjustable p-trap with cleanout.

.5 Provide manufactured insulation covering for plumbing on all barrier-free lavatories.

.6 Standard of acceptance: American Standard Murro.

.4 Sinks

.1 KS-1 – Single Compartment Stainless Steel Sink:

.1 Sink: 20 gauge, type 304 18-8 stainless steel. Under-mount, self-rimming with faucet ledge, undercoated, exposed surfaces are satin finished. Coordinate faucet hole drilling with trim selection. Overall size is approximately 480 x 400 x 125. Coordinate exact dimensions with architectural for fit. Standard of acceptance: Franke UCS.

.2 Trim: Single handle kitchen faucet with 12" spout and side spray. Standard of acceptance: Moen 8717.Drain: Cast brass or copper P-trap with clean-out.

.3 Supplies: Chrome-plated brass rigid angle.

.5 Fixture piping:

.1 Hot and cold-water supplies to each fixture:

.1 Chrome plated rigid supply pipes each with screwdriver stop, reducers, escutcheon.

.2 Waste:

.1 Brass P trap with cleanout on each fixture not having integral trap.

.2 Chrome-plated in all exposed places.

.6 Heavy duty lavatory Carrier:

.1 Lavatory carrier with oven cured epoxy coated extra heavy duty hollow structural steel uprights with integral steel floor plates and oven cured epoxy coated square steel support arms with electroplated hardware and basin locking device.

.2 Carrier to suit all types of wall hung fixtures including barrier-free.

.7 Heavy duty water closet Carrier:

.1 Siphon jet water closet carrier system with 4" [102mm] no-hub connections. epoxy-coated cast iron main fitting with optimized sweep and extended 2" [51mm] vent, adjustable gasketed faceplate, floor mounted pre-fab slotted foot supports with top anchoring pre-fab support base, heavyduty1/2" [13mm] rear anchor tie down, fixture bolts, trim, stud protectors, bonded gasket, and corrosion resistant, adjustable 3" [76mm] dia. X 6" [152mm] coupling with integral test cap.

2.03 ACCEPTABLE MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, following:

.1 Flush Valves:

.1 Sloan;

.2 Delta Commercial;

.3 Zurn Industries;

.4 Moen Commercial.

.2 Plumbing Brass:

.1 Sloan;

.2 Acorn Engineering;

.3 American Standard;

.4 Delta Commercial;

.5 Chicago Faucet;

.6 Moen Commercial.

.3 Stainless Steel Sinks:

.1 Franke Commercial;

.2 Novanni Commercial;

.3 Aristaline;

.4 Arch Metal Ind.

.4 Mop Sinks:

.1 Stern Williams;

.2 Acorn Engineering;

.3 Zurn Industries.

.5 Drain Fittings, Angle Supplies, and Traps:

.1 McGuire;

.2 American Standard;

.3 Delta Commercial;

.4 Zurn Industries.

.6 Fixture Carriers:

.1 Watts Industries;

.2 Jay R. Smith;

.3 Zurn Industries.

.7 Hose Bibbs:

.1 Jay R. Smith;

.2 Zurn Industries.

.8 Water Closets, Lavatories, and Urinal:

.1 American Standard;

.2 Zurn Industries;

.3 Kohler.

.9 Thermostatic Mixing Valves:

.1 Lawler;

.2 Delta Commercial;

.3 Leonard.

.10 Shower and Associated Trim:

.1 American Standard;

.2 Delta Commercial;

.3 Zurn Industries;

.4 Moen Commerical.

.11 Toilet Seats:

.1 Olsonite;

.2 Centoco;

.3 Bemis Commercial.

.12 Electronic "No Touch" Flush Valves:

.1 Sloan;

.2 Delta Commerical;

.3 Zurn Industries;

.4 Moen Commercial.

.13 Electronic "No Touch" Faucets:

.1 Sloan;

.2 Delta Commercial;

.3 Zurn Industries;

.4 Moen Commercial.

2.04 CAULKING

.1 General Electric Series SCS-1200 Silicone Construction Sealant or Dow Corning 780 silicone rubber sealant with primers as recommended by sealant manufacturer. Caulking colour(s) for coloured fixtures other than white, if any, will be selected by Consultant from sealant manufacturer's standard colour range.

3 EXECUTION

3.01 INSTALLATION OF PLUMBING FIXTURES AND FITTINGS

.1 Provide required plumbing fixtures and fittings.

.2 Connect plumbing fixtures and fittings with piping sized in accordance with drawing schedule. Refer to manufacturer's published connection (rough-in) requirements. Where manufacturer requires piping connection larger than shown below, provide piping accordingly:

FIXTURE AND/OR FITTING	DRAIN SIZE MM (IN.)	VENT SIZE MM (IN.)	DHW SIZE MM (IN.)	DCW SIZE MM (IN.)	TEMP WATER SIZE MM (IN.)

FIXTURE AND/OR FITTING	DRAIN SIZE MM (IN.)	VENT SIZE MM (IN.)	DHW SIZE MM (IN.)	DCW SIZE MM (IN.)	TEMP WATER SIZE MM (IN.)
Water Closets Flush Valve Type	100 (4)	38 (1-½)	----------	25 (1)	----------
Urinals	75 (3)	38 (1-½)	----------	25 (1)	----------
Lavatories	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	----------
Lavatories (Electronic Faucet)	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	12 (½)
Counter Sinks	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	----------
Shower Valves and Heads	----------	----------	12 (½)	12 (½)	12 (½)
Shower Stalls	50 (2)	38 (1-½)	12 (½)	12 (½)	12 (½)
Prefab. Mop Sinks with Drain	75 (3)	38 (1-½)	20 (¾)	20 (¾)	----------
Emergency Eye Wash	----------	----------	----------	----------	12 (½)
Emergency Shower	----------	----------	----------	----------	25 (1)

.3 Confirm exact location of plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.

.4 When installation is complete, check, and test operation of each fixture and fitting. Adjust or repair as required.

.5 For barrier-free fixtures, comply with mounting height and other requirements of governing Code(s).

.6 Supply templates for counter mounted fixtures and trim and hand to trades who will cut the counter. Ensure openings in counter are properly located.

.7 Locate control panels for electronic faucets under lavatories and recessed into wall. Coordinate panel installations with electrical trade who will provide 115 volt power wiring to panels. Install flexible conduit (supplied with box) and extend cord from faucet through the flexible conduit to control box. Connect hot and cold water piping to mixing valve in each box, and tempered water piping from each mixing valve to faucet. Set mixing valve maximum temperature limit stops to 43°C (110°F) after domestic water systems (hot and cold) are complete. Ensure each programmable controller is properly programmed and water off after deactivation is set for 3 seconds.

.8 For electronic flush valves, locate transformer in ceiling space above electronic units to be served. Coordinate locations with electrical trade who will provide 120 volt line supply to transformers. Provide low voltage wiring from transformers to each electronic flush valve terminal point. Electrical line supply and low voltage wiring is to be concealed and access to transformer must be provided for servicing.

.9 Protect baths from damage during construction and finishing work. Unless otherwise specified, pack concealed voids under baths with batt type glass fibre insulation as baths are installed.

.10 Protect shower bases from damage during construction and finishing work.

.11 Confirm exact mixing valve and shower head locations prior to roughing-in.

.12 Install refrigerated drinking fountains in accordance with manufacturer's instructions. Plug into a wall receptacle provided as part of electrical work. Coordinate receptacle installation with electrical trade on site.

.13 For emergency showers, install so bottom of shower head is approximately 2 m (82") above floor, and approximately 400 mm (16") out from the wall. Wall mount mixing valve approximately 1.5 m (5') above floor and adjacent shower head. Set valve temperature limit stop to 35°C (95°F). Ensure valve is open and exposed piping is chrome plated or stainless steel.

.14 Install eye wash fixtures in accordance with manufacturer's instructions. Ensure exposed piping is painted.

.15 Wall mount mixing valves for emergency fixtures approximately 1.5 m (5') above floor and secure in place. Check and confirm valve operation and temperature of tempered water supply. Provide cabinets. Identify each cabinet and hand 3 identified cabinet keys to Consultant prior to Substantial Performance of the Work.

.16 Set mop service basins on floor over drain piping and connect to roughed-in service. Install wall supply trim and any accessories specified.

3.02 CAULKING AT PLUMBING FIXTURES AND FITTINGS

.1 Caulk around plumbing fixtures and fittings where they contact walls, floors, and any other building surface.

.2 Clean areas/surfaces to be caulked and prime in accordance with sealant manufacturer's instructions. Where damage to a building surface may occur, mask surface to prevent damage and ensure a clean exact edge to the caulking bead.

.3 Apply caulking using a gun with proper size and shape of nozzle and force sealant into joints to ensure good surface contact and a smooth and even finished bead of sealant.

.4 If joints have been masked sealant may be tooled in a continuous stroke to obtain complete void filling. Remove masking tape immediately after tooling and before sealant begins to skin.

3.03 DISHWASHER CONNECTIONS

.1 Provide roughed-in water and drain connections for Owner supplied dishwasher consisting of:

.1 15 mm (½") dia. domestic hot water connection with a Dahl "Mini-Ball" valve with hose end and water hammer arrestor;

.2 40 mm (1-½") dia. DWV copper drain connection with "P" trap and cleanout plug.

3.04 CLOTHES WASHER CONNECTIONS

.1 Provide roughed-in water and drain connections for Owner supplied clothes washer consisting of:

.1 15 mm (½") dia. piping connection for both hot and cold water, each terminated in a Dahl "Mini-Ball" Valve with hose end and water hammer arrestor;

.2 40 mm (1-½") dia. standing waste with a height to suit the washer drain and complete with a "P" trap.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in this Section except piping and unions.

.2 Submit motor product data sheets and certified performance curves with all pump shop drawings.

.3 Submit with delivery of each unit a copy of factory inspection and test report, and include a copy of each report with O&M Manual project close-out data.

.4 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

.5 Prior to Substantial Performance of the Work, submit a spare seal flush line filter for each pump equipped with a seal flush line.

.6 Shop drawings for piping anchors must be prepared and stamped by a professional Structural Engineer registered in the jurisdiction of the work. Refer to requirements for Contractor retained engineers specified in Section entitled Mechanical Work General Instructions.

.7 Submit a letter from pipe anchor design engineer to stating engineer has visited site to examine installation of pipe anchors and pipe anchor installation is in accordance with reviewed anchor shop drawing.

1.02 QUALITY ASSURANCE

.1 Pump motors are to comply with requirements of Section entitled Basic Mechanical Materials and Methods.

2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

.1 Black Steel - Screwed Joint

.1 Mild black carbon steel, Grade B, ASTM A53, complete with Class 125 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.

.2 Black Steel - Grooved End Mechanical Joint

.1 Mild black carbon steel, Grade B, ASTM A53, factory or site roll grooved, complete with cast ductile iron grooved end fittings, including full flow elbows, and conforming to ASTM A536.

.2 Acceptable products are:

.1 Victaulic Style 107 "QuickVic" rigid couplings for sizes 50 mm (2") to 200 mm (8"), Style 07 "Zero-Flex" rigid couplings for sizes 250 mm (10") to 300 mm (12"), Style W07 AGS rigid couplings for sizes 350 mm (14") to 1525 mm (60");

.2 Gruvlok Fig. 7402 "SlideLOK" for sizes 50 mm (2") to 200 mm (8"), Fig. 7401 "Rigidlok" for sizes 250 mm (10") to 610 mm (24").

.3 Hard Copper - Solder Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper fittings to ANSI B16.22, and 95% tin / 5% Antimony solder joints.

.4 Hard Copper - Pressure Coupled Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with Viega "ProPress with Smart Connect feature" system copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.

2.02 PIPING UNIONS

.1 Screwed Piping

.1 Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).

.2 Flanged Piping

.1 Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

2.03 SHUT-OFF VALVES

.1 Ball Type

.1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, threaded ends, and removable lever handle.

.2 Acceptable products are:

.1 Toyo Valve Co. Fig. 5044A;

.2 Watts Industries (Canada) Inc. #FBV-3;

.3 Kitz Corp. Code 58;

.4 Victaulic Co. of Canada Ltd. Series 722;

.5 Apollo Valve #77-100.

2.04 SWING CHECK VALVES

.1 Bronze - Screwed

.1 Class 125, 1380 kPa (200 psi) WOG rated horizontal swing check valves, each complete with a "Y" pattern bronze body, hinged brass disc, easy access screw-in cap, and screwed ends.

.2 Acceptable products are:

.1 Toyo Valve Co. Fig. 236;

.2 Nibco #T-433;

.3 Kitz Corp. Code No. 22.

.2 Steel - Grooved Ends

.1 Victaulic Co. of Canada Ltd. Series 716, 779 or W715 grooved end carbon steel check valves suitable for mounting horizontally or vertically.

.3 Cast Iron - Screwed and Flanged

.1 Cast iron, bronze trim, 1380 kPa (200 psi) rated swing check valves, each complete with a bronze disc and seat, malleable iron hinge, bolted cover, and screwed or flanged ends as required.

.2 Acceptable products are:

.1 Toyo Valve Co. Fig. 435A;

.2 Watts Industries (Canada) Inc. #F-511;

.3 Kitz Corp. Code No. 78.

2.05 DRAIN VALVES

.1 Minimum 2070 kPa (300 psi) WOG rated, 20 mm (¾") diameter straight pattern bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm (¾") diameter hose, and a cap and chain.

.2 Acceptable products are:

.1 Toyo Valve Co. Ltd. Fig. 5046;

.2 Watts Industries (Canada) Inc. #B-6000-CC;

.3 Kitz Corp. Code No. 68AC;

.4 Apollo Valves #78-104-01.

2.06 CIRCUIT BALANCING VALVES

.1 Screwed or flanged as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

.2 Acceptable products are:

.1 S.A. Armstrong Ltd. Series "CBVI" screwed or "CBVII" flanged;

.2 Victaulic Co. of Canada Ltd. (Tour & Anderson) Series 787 screwed, Series 788 flanged, and 789 grooved end, and Series 78K "Koil Kit" valves.

2.07 AIR VENTS

.1 Manual Air Vents

.1 Equal to Conbraco 27 Series, 3.2 mm (⅛") diameter with a key handle.

.2 Automatic Air Vents

.1 Float actuated air vents, each complete with a semi-steel body and cap, a stainless steel float assembly and seat, and a neoprene head.

.2 Acceptable products are:

.1 Spirax Sarco Ltd., Type 13 W for system working pressures to 1035 kPa (150 psi), 13 WH for system working pressures greater than 1035 kPa (150 psi);

.2 Armstrong International Inc. No. 1-AV.

2.08 STRAINERS

.1 Cast iron wye shaped strainers, minimum 890 kPa (125 psi) rated and complete with a removable type 304 stainless steel screen with perforations sized to suit the application, and, for strainers 50 mm (2") diameter and larger, a blowdown pipe connection tapping.

.2 Acceptable products are:

.1 Spirax Sarco Ltd. Type IF-125 screwed or Type AF-250 flanged;

.2 Toyo Valve Co. Ltd. Fig. 380A screwed or Fig. 381 flanged;

.3 Victaulic Co. of Canada Style 732 or W732 "Vic-Strainer";

.4 Armstrong International Inc. A1 Series;

.5 Watts Industries (Canada) Inc. #77SCI;

.6 Mueller Steam Specialty Products Model 11M screwed or Model 758 flanged.

2.09 PIPE ANCHORS

.1 Welded structural black steel anchors of a design, size, and type to securely anchor pipe at point shown. Each anchor is to withstand 150% of axial thrust, and, as specified in Part 1 of this Section, is to be designed and detailed by a Professional Structural Engineer.

3 EXECUTION

3.01 PIPING INSTALLATION REQUIREMENTS

.1 Provide required hydronic piping. Pipe, unless otherwise specified, is to be:

.1 for pipe to and including 65 mm (2-½") diameter, Schedule 40 black steel, screwed, or type "L" hard copper with solder joints or pressure coupled joints;

.2 for pipe 65 mm (2-½") to 300 mm (12") dia. and larger, Standard weight grooved end black steel (10 mm [0.375"] thickness) pipe with grooved end fittings and couplings, or, Standard weight black steel (10 mm [0.375"] thickness) pipe with welding fittings and welded joints;

.3 for short branch connections to heating equipment where structural obstructions occur and site bending of pipe is advantageous, a single length of type "L" soft copper.

.2 Slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m (20') to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm (1") in 1.2 m (4'). Leave sufficient room at high points for installation and maintenance of air vents.

.3 Install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems supplied as part of the control work. Refer to drawing control diagrams and details.

.4 Connect equipment provided as part of the work of other Sections with piping as indicated and/or required. Refer to pipe connection details on drawings.

.5 Provide screwed unions, removable mechanical joint couplings, or weld-on or solder-on flanges in piping at all connections to valves, strainers and similar piping system components which may need maintenance or repair, at equipment connections, in runs of piping exceeding 9 m (30') at 4.5 m (15') regular intervals to permit removal of sections of piping, and wherever else indicated on drawings.

.6 Provide shut-off valves in piping connections to equipment, to isolate piping risers, to isolate other sections of systems as shown, and wherever else indicated on drawings. Valves in piping to and including 50 mm (2") dia. are to be ball type. All other shut-off valves are to be ball or butterfly type unless otherwise specified. Locate valves so they are easily accessible. Wherever possible, install valves at uniform height. Provide chain operators for valves which are inaccessible for operation from floor level.

.7 Provide a check valve in discharge piping of every pump, and elsewhere in piping where shown on drawings. Where check valves are required in vertical piping, ensure they are suitable in all respects for the application. Check valves for vertical in-line and/or base mounted circulating pumps are integral with the discharge accessory.

.8 Provide a drain valve at base of each piping riser, in drain connections to equipment, in low points of horizontal piping, and wherever else shown and/or specified.

.9 Provide circuit balancing valves in piping generally where shown on drawings but with exact locations in accordance with instructions of personnel doing system flow balancing work. Confirm locations prior to installation.

3.02 INSTALLATION OF AIR VENTS

.1 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else shown and/or specified. Equip each air vent with a ball type shut-off valve. Install vents in 100 mm (4") dia. and larger piping and all vents in mechanical rooms in accordance with drawing detail.

.2 Provide 9 mm (3/8") dia. copper drain piping from each automatic air vent to nearest suitable drain and terminate so discharge is visible. Identify drain piping.

3.03 INSTALLATION OF STRAINERS

.1 Provide strainers in piping. Locate strainers so baskets are easily accessible and removable. Clean strainer baskets during and after piping system flushing and cleaning is complete, and before water quantity balancing commences.

3.04 INSTALLATION OF PIPING ANCHORS

.1 Provide anchors to secure piping to structure. Locate anchors generally where shown but with exact locations to suit piping as installed and requirements of reviewed anchor shop drawings.

.2 When installation of anchors is complete, arrange, and pay for anchor design engineer to visit site to review anchor installation. Submit a signed letter with engineer's stamp from design engineer confirming each anchor is properly installed.

3.05 INSTALLATION OF FLEXIBLE PIPING CONNECTIONS

.1 Provide flexible connections in piping connections to equipment.

.2 Install in accordance with manufacturer's instructions.

3.06 FLUSHING AND CLEANING PIPING

.1 Flush and clean new piping in accordance with requirements specified in Section entitled HVAC Water Treatment.

3.07 TESTING, ADJUSTING AND BALANCING

.1 When work is complete and equipment is operating as intended, test, adjust and balance water flows in accordance with requirements specified in Section entitled Testing, Adjusting, and Balancing.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in this Section except shop fabricated ductwork and fittings.

.2 Include capacity, throw and terminal velocity, noise criteria, and pressure drops with grille and diffuser shop drawing/product data sheet submission.

.3 With shop drawing/product data sheet submission, supply evidence that fire rated duct manufacturer is ULC listed to size requirements shows on drawings.

.4 Submit duct leakage test data prior to ductwork being covered from view.

.5 Submit manufacturer's colour chart(s) for all items for which a finish colour is to be selected.

.6 Submit proper installation certification from fire rated duct manufacturer as specified in Part 3 of this Section.

.7 Supply and hand to Owner at Substantial Performance of the Work, a minimum of 10 identified (with tags) grille/diffuser volume control damper adjustment keys.

1.02 QUALITY ASSURANCE

.1 Grilles and diffusers are to be tested and performance certified to ANSI/ASHRAE 70, Method of Testing the Performance of Air Outlets and Air Inlets.

2 PRODUCTS

2.01 GALVANIZED STEEL DUCTWORK

.1 Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. G60 galvanizing for bare uncovered duct to be finish painted. G90 for all other galvanizing.

.2 Rectangular

.1 Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.

.3 Round

.1 Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.

.4 Flat Oval

.1 Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

2.02 FLEXIBLE METALLIC DUCTWORK

.1 Bare

.1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-UN", ULC S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 3 m (10') lengths.

.2 Insulated

.1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", ULC S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1-½") thick, 12 kg/m^3 (0.75 lb/ft^3) density fibreglass insulation with a vinyl jacket meeting 25/50 flame spread and smoke developed requirements tested in accordance with CAN/ULC S102.

2.03 FLEXIBLE CONNECTION MATERIAL

.1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber. Acceptable products are:

.1 Duro Dyne Canada Inc. "DUROLON";

.2 Dyn Air Inc. "HYPALON".

2.04 METAL DUCT SYSTEM JOINT SEALANT

.1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 tested maximum flame spread rating of 5 and smoke developed rating of 0.

.2 Acceptable manufacturers are:

.1 Johns Manville;

.2 Manson Insulation;

.3 Knauf Insulation.

2.05 ACOUSTIC LINING

.1 Minimum 25 mm (1") thick acoustic lining material meeting 25/50 flame spread and smoke developed ratings tested in accordance with CAN/ULC S102, meeting NFPA 90A, ASTM C1071, and ASTM G21 requirements, not supporting microbial growth, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fiberglass mat coated on inside (airside) face with a black fire-resistant coating.

.2 Acceptable manufacturers are:

.1 Johns Manville;

.2 Manson Insulation;

.3 Knauf Insulation.

2.06 CASING AND PLENUM MATERIAL AND ACCESSORIES

.1 Unless otherwise specified, casing and plenum material is to be same as connecting duct material.

.2 Accessories such as access doors and drain pans are to be constructed of same material as casing and plenum and are to be in accordance with Chapter 6 of SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.07 PLENUM ACCESS DOORS

.1 Factory fabricated, double wall insulated access doors, sized as indicated on drawings, and constructed of same material as connecting ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit operating pressure of the system.

2.08 ROUND TO RECTANGULAR DUCT CONNECTIONS

.1 Equal to Flexmaster Canada Ltd. galvanized steel, flared, flanged or notched "Spin-On" round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.09 SPLITTER DAMPERS

.1 Minimum #20 gauge damper blade constructed of same material as duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to DynAir Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.10 AIR TURNING VANES

.1 For square elbows, multiple-radius turning vanes interconnected with bars, adequately reinforced to suit pressure and velocity of system, constructed of same material as duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 For short branch ducts at grille and diffuser connections, air extractor type each equipped with a matching bottom operated 90° opposed blade volume control damper, constructed of same material as duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.11 MANUAL BALANCING (VOLUME) DAMPERS

.1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of same material as connecting ductwork unless otherwise specified, each designed to maintain internal free area of connecting duct, and each complete with:

.1 hexagonal or square shaft extension through frame;

.2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;

.3 blade stops for single blade dampers, designed to prevent blade from moving more than 90°;

.4 linkage for multiple blade dampers;

.5 locking hand quadrant damper operator with, for insulated ducts 50 mm (2") standoff mounting.

.2 Rectangular Dampers: Nailor Industries Inc. 1800 Series, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.

.3 Round Dampers: Nailor Industries Inc. Model 1890, maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.

.4 Multiple Rectangular Damper Section Assembly: Rectangular assembly supplied with the dampers or site constructed, of same material as damper and designed for tight and secure mounting of individual dampers.

.5 Acceptable manufacturers are:

.1 Nailor Industries Inc.;

.2 T.A. Morrison & Co. Inc. "TAMCO";

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.

2.12 BACKDRAFT DAMPERS

.1 Nailor Industries Model 1370CB counterbalanced backdraft dampers, vertical or horizontal mounting, 50 mm (2") wide, sized as shown and complete with:

.1 extruded 6063-T5 aluminum frame, 2.3 mm (0.090") nominal wall thickness, with mitred corners;

.2 extruded 6063-T5 aluminum blades, 1.3 mm (0.050") nominal wall thickness on 92 mm (3-5/8") centres, and with extruded PVC blade seals;

.3 corrosion-resistant synthetic bearings;

.4 adjustable plated steel counterweights mounted internally in the airstream;

.5 concealed blade linkage located out of the airstream.

.2 Acceptable manufacturers are:

.1 Nailor Industries Inc.;

.2 T.A. Morrison & Co. Inc. "TAMCO";

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.

2.13 FUSIBLE LINK DAMPERS

.1 Curtain blade type, static, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to CAN/ULC S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1-1/2 hour or 3 hour rated as required, and complete with a constant force type 301 stainless steel closure spring, a blade lock assembly, a steel sleeve, retaining angles, and, unless otherwise specified, a 74°C (165°F) rated standard fusible link.

.2 Fusible link dampers are to be Type "B" or Type "C" (as required) with folded curtain blade out of air stream except where damper size or location requires use of type "A" dampers with curtain blade in air stream.

.3 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.

.4 Acceptable manufacturers are:

.1 Nailor Industries Inc.;

.2 NCA Manufacturing Ltd.;

.3 Ruskin Co.;

.4 Price Industries (E.H. Price).

2.14 DUCT ACCESS DOORS

.1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for purpose for which they are provided, and, unless otherwise specified, constructed of same material as duct they are associated with.

2.15 DUCTWORK DRAIN POINTS

.1 Equal to Ductmate Canada Ltd. "Moisture Drain", 20 mm (¾") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.16 INSTRUMENT TEST PORTS

.1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leakproof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.

2.17 WIRE MESH (BIRDSCREEN)

.1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm (½" x ½") secured in a rigid galvanized steel or aluminum framework, sized as indicated on drawings, and constructed so as to be removable.

2.18 LOUVRES

.1 Price Industries Inc. DE439 or DE635, 100 mm (4") or 150 mm (6") deep (to suit wall thickness) factory assembled stationary, drainable, storm-proof louvres sized as indicated on drawings, each AMCA water penetration and air performance certified, constructed of welded, extruded, alloy 6063-T5 aluminum with drainable blades, mounting and securing hardware to suit the application, and 12 mm (½") mesh aluminum birdscreen in an aluminum frame.

2.19 BRICK AND BLOCK VENTS

.1 Equal to Price Industries Inc. vents constructed of 6063-T5 alloy extruded aluminum, sized as shown, complete with stainless steel fasteners, aluminum rod vertical supports on minimum 300 mm (12") centres, #2 mesh fixed aluminum screen, and all required accessories to suit the application.

2.20 GRILLES AND DIFFUSERS

.1 Grilles and diffusers of type, size, capacity, finish, and arrangement as shown on drawings and in accordance with drawing schedule, each equipped with all required mounting and connection accessories to suit mounting location and application.

.2 Acceptable manufacturers are:

.1 Price Industries Inc.;

.2 Krueger Division of Air System Components Inc.;

.3 Titus;

.4 Nailor Industries Inc.;

.5 Tuttle & Bailey.

.3 mounting gasket: roll type gasket material supplied with units for site installation on T-bar ceiling members;

.4 factory secured seismic restraint connection hardware.

3 EXECUTION

3.01 CLEANLINESS REQUIREMENTS FOR HANDLING AND INSTALLATION OF DUCTWORK

.1 Handle and install ductwork in accordance with SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

3.02 FABRICATION AND INSTALLATION OF GALVANIZED STEEL DUCTWORK

.1 Provide required ductwork, rectangular, round and/or flat oval. Where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.

.2 It is to be understood that all duct dimensions shown on drawings are clear internal dimensions.

.3 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so ductwork does not "drum". Flat surfaces of rectangular ductwork are to be cross-broken. Duct system sealing is to meet ANSI/SMACNA Seal Class A requirements.

.4 Variable air volume ductwork from supply fans to boxes is as above but rectangular duct take-offs are double side straight taper type with a take-off length equal to 0.5 times the branch duct width but minimum 150 mm (6") length, and double taper side is to have an included angle of minimum 60°.

.5 Confirm routing of all ductwork at site and site measure ductwork prior to fabrication. Duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by Consultant. Duct routing and/or dimension revisions to suit conditions at site are not grounds for a claim for an extra cost.

.6 Refer to structural drawings. Where ductwork is to be run within or through open web steel joists, ductwork shown on mechanical drawings is schematic only and is to be altered as required to suit steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.

.7 Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install ductwork only after fireproofing work is complete and do not compromise fire rating of sprayed fireproofing.

.8 Install (but do not connect) duct system mounted automatic control components supplied as part of the automatic control work.

.9 Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.

.10 Flange connect ductwork to hot water reheat coils in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Coils will be suspended independent of connecting ductwork as part of the heat transfer work.

.11 Support horizontal rectangular ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for exposed ducts and concealed ducts wider than 500 mm (20"). Support hardware constructed of same material as duct for metal duct, and, unless otherwise specified, type 316 stainless steel for non-metal duct. Supports for "heavy" duct such as cementitious core duct is to be suitable in all respects for the application and approved by Consultant.

.12 Support round and flat oval ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at top of duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If duct is insulated, size strap to suit diameter of insulated duct. Unless otherwise specified, duct support hardware for metal duct is constructed of same material as duct, and for non-metal duct, type 316 stainless steel.

.13 Where flanged duct joints are used, do not locate joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.

.14 Where watertight horizontal ductwork is required, construct ducts without bottom longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide drain points. Provide watertight ductwork for:

.1 ductwork outside building or otherwise exposed to the elements;

.2 dishwasher exhaust;

.3 shower exhaust ducts from grilles to duct main or riser;

.4 minimum of 3 m (10') upstream and downstream of duct mounted humidifiers or humidifier manifolds;

.5 fresh air intakes;

.6 wherever else shown.

.15 Leakage Testing:

.1 Upon failure of satisfactory sealing of joints in ductwork from a visual examination, Consultant may require additional testing of duct leakage in accordance with SMACNA HVAC Duct Leakage Test Manual to verify leakage does not exceed leakage class 24 for a 2 in. pressure class. Two percent maximum leakage.

.2 Perform leakage tests in sections.

.3 Make trial leakage tests as instructed to demonstrate workmanship.

.4 Install no additional ductwork until trial test has been passed.

.5 Test section minimum of 30m (100 ft.) long with not less than 3 branch takeoffs and 2 90^0 elbows.

.6 Complete test before insulation or concealment.

.16 Seal all ductwork in accordance with SMACNA Seal Class "A", except for round duct with self-sealing gasketed fittings and couplings which does not require site applied sealant. Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

.17 Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

.18 Clean exterior exposed (uninsulated) ducts and coat with a heavy full coverage of Bakor #410-02 black metal paint.

.19 Where dissimilar metal ducts are to be connected, isolate ducts by means of flexible duct connection material.

.20 Round exposed ductwork in Gymnasium is to be 2 metal gauges heavier than standard metal gauge for same size duct, and duct hangers are to be pairs of 9.5 mm (⅜") diameter hanger rods secured to 40 mm (1-½") wide #12 gauge galvanized steel split clamps around full circumference of duct at maximum 1.8 m (72") centres. Provide double nuts and lock washers on each hanger rod above and below each clamp.

.21 Equip ducts with a dimension of 600 mm (24") and larger and located in mechanical equipment rooms of any kind with hanger rods equipped with double deflection neoprene rod isolation hangers properly sized for associated load. Also refer to Section entitled Seismic Control and Restraint.

3.03 INSTALLATION OF FLEXIBLE DUCTWORK

.1 Provide maximum 3 m (10') long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on drawings.

.2 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.

.3 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.

.4 Do not penetrate fire barriers with flexible duct.

3.04 INSTALLATION OF ACOUSTIC LINING

.1 Provide acoustic lining in ductwork in locations as follows:

.1 wherever shown and/or specified on drawings;

.2 supply and return ductwork at heat pumps for a distance of 2.4 m (8') measured along duct and outward from heat pump in all directions;

.3 all transfer air ducts.

.2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel in accordance with detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.05 INSTALLATION OF CASINGS AND PLENUMS

.1 Provide required shop or site fabricated casings and plenums. Unless otherwise specified or shown, construct casings and plenums of same material as connecting duct system.

.2 Construct and install casings and plenums in accordance with Chapter 6 of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit systems' pressure classification. Ensure plenums and casings secured to building structure are gasketed air-tight and equipped with angle reinforcing.

.3 Provide drain pans with accessible trapped drains for fresh air intake plenums, and wherever else shown.

3.06 INSTALLATION OF CASING AND PLENUM ACCESS DOORS

.1 Provide access doors into all site or shop fabricated casings and plenums requiring access, and wherever shown.

.2 Construct access doors to open in or out to suit positive and negative pressures of system.

.3 Provide pitot tube openings in access doors where required for system air quantity balancing purposes.

.4 Provide suitably sized, engraved, red-white laminated Lamacoid warning nameplates on access doors into casings and plenums where equipment is located, i.e. fans.

3.07 INSTALLATION OF ROUND TO RECTANGULAR DUCT CONNECTIONS

.1 Cut round holes in rectangular ducts and provide round to rectangular lock-in fittings with dampers for connection of flexible round ductwork.

3.08 INSTALLATION OF SPLITTER DAMPERS

.1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on drawings. Install splitter dampers so they cannot vibrate and rattle and so damper operation mechanisms are in an easily accessible and operable location. Ensure operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.09 INSTALLATION OF TURNING VANES

.1 Provide turning vanes in ductwork elbows where shown on drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

3.10 INSTALLATION OF MANUAL BALANCING (VOLUME) DAMPERS

.1 Provide manual balancing dampers as required to provide a fully balanced system, including but not limited to in all open end ductwork, in all duct mains, and wherever else shown and/or specified.

.2 Install dampers so operating mechanism is accessible and positioned for easy operation, and so dampers cannot move or rattle. Ensure operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.

.3 Where a duct for which a balancing damper is required has dimensions larger than dimensions of maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.

.4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

3.11 INSTALLATION OF BACKDRAFT DAMPERS

.1 Provide backdraft dampers.

.2 Install and secure dampers so they cannot move or rattle.

3.12 INSTALLATION OF FUSIBLE LINK DAMPERS

.1 Provide fusible link dampers. Ensure damper rating (1-½ or 3 hr.) is suitable for fire barrier it is associated with.

.2 Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.

.3 Provide expansion clearance between damper or damper sleeve and opening in which damper is required. Ensure openings are properly sized and located, and all voids between damper sleeve and opening are properly sealed to maintain rating of fire barrier.

.4 Where size of fire barrier opening requires use of a sectionalized fire damper assembly, provide multiple fusible link dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.13 INSTALLATION OF FLEXIBLE CONNECTION MATERIAL

.1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or easings connect to fans, and wherever else shown or specified.

.2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of flexible fabric and to fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure connections to flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

3.14 INSTALLATION OF ROOF MOUNTED DUCT SUPPORTS

.1 Supply supports for roof mounted ductwork.

.2 Hand adjustable structural supports to roofing trade on roof for installation and flashing into roof construction as part of roofing work. Accurately mark exact locations and spacing of structural supports and supervise installation. Provide properly sized hot dip galvanized structural steel angles between structural supports and secure in place on support studs. Support ductwork on the angles and provide galvanized steel banding to secure ducts to the angles.

3.15 INSTALLATION OF DUCT ACCESS DOORS

.1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure doors are properly located for damper maintenance.

.3 When requested, submit a sample of proposed duct access doors for review.

.4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce ductwork to suit access door installed.

3.16 INSTALLATION OF INSTRUMENTS TEST PORTS

.1 Provide instrument test ports in all main ducts at connections to fans, plenums or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.

.2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.

3.17 INSTALLATION OF WIRE MESH (BIRDSCREEN)

.1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on drawings. Rigidly secure in place but ensure panels are removable.

.2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on drawings or not.

3.18 INSTALLATION OF LOUVRES

.1 Provide louvres for wall openings.

.2 Install louvre assemblies and secure in place in accordance with manufacturer's instructions and details.

.3 Confirm exact louvre sizes and finish prior to ordering.

3.19 INSTALLATION OF BRICK AND BLOCK VENTS

.1 Supply brick or block vents for installation in exterior walls.

.2 Hand assemblies to masonry trade for installation.

.3 Accurately mark exact locations and coordinate installation.

3.20 INSTALLATION OF GRILLES AND DIFFUSERS

.1 Provide grilles and diffusers. Wherever possible, grilles and diffusers are to be product of same manufacturer.

.2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.

.3 Exactly locate grilles and diffusers to conform to final architectural reflected ceiling plans and detailed wall elevations, and to conform to final lighting arrangement, ceiling layout, ornamental and other wall treatment.

.4 Equip supply diffusers having a basic 4-way or all round air pattern for operation in 1-, 2-, or 3-way pattern where indicated on drawings.

.5 Provide sheet metal plenums, constructed of same material as connecting duct, for linear grilles and/or diffusers where shown. Construct and install plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip duct connection collar(s) with volume control device(s).

.6 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip diffusers/grilles in place using clip supplied by diffuser/grille manufacturer.

.7 Confirm grille and diffuser finishes prior to ordering.

3.21 SUPPLY OF DOOR GRILLES

.1 Supply door grilles as shown and scheduled.

.2 Hand grilles to appropriate trade at site for installation.

3.22 DUCT SYSTEM PROTECTION, CLEANING AND START-UP

.1 Temporarily cover all open ends of ducts during construction.

.2 Remove all dirt and foreign matter from entire duct systems and clean duct system terminals and interior of air handling units prior to operating fans.

.3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.

.4 Provide cheesecloth over duct system inlets and outlets and run system for 24 hours, after which remove cheesecloth and construction filters, and install new permanent filters.

.5 Include all labour for a complete site walk-through with testing and balancing personnel following route of all duct systems to be tested, adjusted and balanced for the purpose of confirming proper position and attitude of dampers, location of pitot tube openings, and any other work affecting testing and balancing procedures. Perform corrective work required as a result of this walk-through.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for air terminals. Include following:

.1 capacity and pressure drop;

.2 sound power data to verify conformance with specified sound power levels;

.3 leakage and dimensions;

.4 mounting details to suit locations shown, indicating methods and hardware to be used;

.5 control components and a control wiring schematic.

.2 Submit with shop drawings/product data, a test report in accordance with ANSI/AMCA 210 requirements and ISO 3741, published test data on DIN (Direct Internal Noise) made by an independent testing agency for 2.5 and 6 m/s (8.2 and 19.7 ft/min) branch velocity or inlet velocity, sound power levels with a minimum inlet pressure of 0.25 kPa (0.036 psi) in accordance with ISO 3741 for the 2nd through 7th octave bands, and confirmation pressure loss through a silencer will not exceed 60% of inlet velocity pressure maximum.

.3 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

1.02 QUALITY ASSURANCE

.1 Air terminals manufacturers are to be current members of Air-Conditioning, Heating and Refrigeration Institute (AHRI), and terminals are to be in accordance with requirements of following standards:

.1 ANSI/AHRI Standard 880, Performance Rating of Air Terminals;

.2 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating;

.3 International Organization of Standardization (ISO) Standard 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure-Precision Methods for Reverberation Rooms.

.2 Acceptable manufacturers are:

.1 Price Industries Inc.;

.2 Titus;

.3 Nailor Industries Inc.;

.4 Krueger Division of Air System Components Inc.

2 PRODUCTS

2.01 VARIABLE AIR VOLUME (VAV) TERMINAL BOXES

.1 Single duct, controller type, pressure independent variable air volume boxes in accordance with drawing schedule, each individually field adjustable to minimum and maximum air volumes, and complete with:

.1 #22 gauge galvanized steel housing, sealed and gasketed, and complete with:

.1 internally lined with 25 mm (1") thick glass fibre duct lining material with a neoprene coating meeting NFPA 90A and 25/50 flame spread/smoke developed ratings when tested in accordance with CAN/ULC S102;

.2 exposed cut edges of the liner material factory coated with NFPA 90A and CAN/ULC S102 approved sealant;

.3 50 mm (2") long, round inlet duct connection;

.4 rectangular discharge opening with slip and drive cleat duct connection facilities;

.5 protective galvanized steel shroud for controller and damper actuator.

.2 air valve damper, normally open, galvanized steel blade with peripheral gasket, pivoting in self-lubricating bearings and with air leakage past a closed damper of 2% or less of rated capacity at 750 Pa (3" wc) inlet static pressure;

.3 air flow sensor located at box inlet, complete with gauge taps, multiple pressure sensing ports, and an averaging chamber designed to accurately average the flow across the inlet of box with an accuracy of within 5% with a 90° sheet metal elbow located directly at inlet, and amplify the sensed air flow signal;

.4 digital controller/actuator factory installed or field installed by controls contractor, connected and tested control package including a microprocessor based stand-alone digital controller capable of networking with a building automation system, personal computer, or a portable operator interface device, an electronic flow transducer, and an electronic actuator for damper, all calibrated and factory set for maximum and minimum air flow, field adjustable and equipped with gauge taps for balancing with a standard pressure gauge;

.1 Class II, 24 volt AC control transformer as required.

3 EXECUTION

3.01 INSTALLATION OF TERMINAL BOXES

.1 Provide ceiling mounted terminal boxes.

.2 Secure each box in place from structure by means of galvanized steel angles and hanger rods, independent of connecting ductwork.

.3 Coordinate provision of transformers, actuators and controllers with Controls Contractor.

.4 Connect each box with ductwork as indicated. Provide straight inlet duct same size as box inlet and of a length equal to a minimum of 4 duct diameters. Refer to drawing detail. Coordinate final box adjustments and settings with personnel doing system testing and balancing work.

.5 Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system start-up requirements.

.6 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including, but not limited to, a full operation and maintenance demonstration, and setting and adjusting controls.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for radiation units, including accessories, and any required control wiring schematics.

.2 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

.3 Submit manufacturer's standard colour chart for flat tube panel radiation.

2 PRODUCTS

2.01 HYDRONIC RADIANT HEATING PANEL

.1 610mm x 1220mm Modular aluminum drop-in ceiling panels 542W (1852Btu/hr) heating capacities and element lengths indicated are based on 82.2°C (180°F) average entering water temperature at a velocity of 0.09 m/s (3 ft/sec) with an 11.1°C (20°F) temperature drop through the element, and 21 °C (70°F) room temperature.

.2 Radiant panels complete with:

.1 16mm copper tubing mechanically fastened to extruded aluminum panels with a non-hardening heat paste between tubing and panel. Panel backed with 25mm thick foil backed batt insulation.

.3 Acceptable manufacturers are:

.1 TWA Panel systems Inc.;

.2 Price Industries Limited.;

.3 Sigma Cororation.;

3 EXECUTION

3.01 INSTALLATION OF FIN-TUBE DIRECT RADIATION UNITS

.1 Provide fin-tube type direct radiation units.

.2 Secure enclosure brackets in place at maximum 900 mm (35") centres and install element supports or cradles. Slope elements to ensure proper water circulating and to eliminate air. Ensure enclosures are level and plumb. Provide required enclosure accessories.

.3 Connect elements with piping. Provide radiator type valves in piping at each element or group of series connected elements, shut-off type in supply piping, balancing type in return piping. Unless otherwise noted or specified, locate valves and accessories inside enclosures or behind trim, and ensure valves are accessible.

.4 Where 2 or more heating elements are connected in series, join elements with piping the full size of the element tubes or use piping sized to supply pipe size and connect elements with eccentric fittings.

.5 Equip each element or group of series connected elements with a manual air vent installed in an accessible location.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for following:

.1 all control system components;

.2 identified schematic control diagrams with component identification, catalogue numbers, and sequence of operation for all systems;

.3 certified wiring diagrams for all systems.

.2 Submit following samples for review:

.1 control damper section with linkage, operator, and certified flow and leakage data;

.2 wall mounting control system flow diagram as specified in Part 2 of this Section;

.3 each type of thermostat to be used, each identified as to intended use.

.3 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

.4 Submit written confirmation from control component manufacturer that site installation personnel are qualified and experienced in installation of components, and have parts and service availability on a 24/7 basis.

1.02 QUALITY ASSURANCE

.1 Control systems are to be installed by control component manufacturer or by licensed personnel authorized by control component manufacturer. Submit written confirmation from control component manufacturer.

.2 Control system installation company is to have local parts and service availability on 24/7 basis.

.3 Control wiring work is to be performed by licensed journeyman electricians, or under direct daily supervision of journeyman electricians.

2 PRODUCTS

2.01 AUTOMATIC CONTROL VALVES AND OPERATORS

.1 Each control valve must be suitable in all respects for application, including system pressure, and have design output and flow rates with maximum pressure drops as follows:

.1 chilled water valves for coils: 35kPa (5 psi);

.2 heating water/glycol solution valves for coils: 35 kPa (5psi);

.3 heating water valves for radiation units: 14 kPa (2 psi);

.2 Unless otherwise indicated, control valves for proportional operation are to have equal percentage characteristics, and control valves for open/shut 2-position operation are to have straight line flow characteristics. Valves are to have position indicators. Valves for outdoor applications to be suitable in all respects for application.

.3 Heating valves are to be normally open, unless otherwise specified.

.4 Cooling valves are to be normally closed, unless otherwise specified.

.5 Unless otherwise specified, control valves in hydronic piping systems are to conform to requirements specified in Section entitled HVAC Piping and Pumps.

.6 Unless otherwise specified, valves in steam/condensate piping are to generally conform to requirements specified in Section entitled Steam and Condensate Piping and Pumps but must be equipped with stainless steel plugs and stems, removable screwed stainless steel seat rings, and spring loaded Teflon V-ring packing.

.7 Control valve operators are to be spring return type for fail safe operation, sized to tightly shut the control valves against differentials imposed by system, equipped with position indicators, and suitable in all respects for environment in which they are located.

.8 Electric valve operators are to be Belimo "EF Series" or approved equal, enclosed reversible gear type operators that can accept modulating control signals as required. Each is to be 1-phase AC, 120 or 24 volt as required or indicated, overload protected, and complete with enclosure to suit the mounting location.

2.02 CONTROL DAMPERS AND OPERATORS

.1 T. A. Morrison & Co. Inc. "TAMCO" 100 mm (4') deep, flanged, AMCA low leakage certified aluminium dampers. Dampers for modulating and mixing applications are to be opposed blade type. Dampers for open-shut service are to be parallel blade type. Maximum blade length is to be 1 m (4'). Dampers greater than 2 sections wide are to be complete with jackshaft. Each damper is to be complete with:

.1 extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket;

.2 extruded TPE frame gaskets and extruded EPDM blade gaskets;

.3 slip-proof aluminium and corrosion resistant plated steel linkage of metal thickness to prevent warping or bending during damper operation, concealed in frame, equipped with seal-sealing and self-lubricating bearings consisting of Celcon inner bearing fixed on hexagonal blade pin and rotating in polycarbonate outer bearing inserted in frame.

.2 For standard damper(s), Series 1000 as above.

.3 For insulated damper(s), Series 9000 as above but with all 4 sides of frame insulated with polystyrene, and blades thermally broken and insulated with expanded polyurethane foam.

.4 For stainless steel dampers, as above but constructed of type 316 stainless steel and equipped with Teflon blade bearings.

.5 Each damper motor is to be shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit sizes of dampers involved, and to provide sufficient force to maintain damper rated leakage characteristics. Each operator is to be complete with a damper position indicator, and external adjustable stops to limit length of stroke in either direction, and is to be mounted on a corrosion resistant adjustable bracket. Operating arms are to have double yoke linkages and double set screws for fastening to damper shaft. Operators for dampers to be connected to building fire alarm system or to freeze protection devices are to be equipped with additional relays to permit dampers to respond and go to required position in less than 15 seconds upon receipt of a signal. Operator enclosures are to be suitable in all respects for environment in which they are located.

.6 Electric damper operators are to be Belimo EF Series or approved equal, 24 volt or 120 volt AC spring return, direct coupled electric motor operators for either modulating or 2-position control as required. Each operator is to be overload protected and complete with an enclosure to suit the mounting location.

2.03 LOCAL CONTROL PANELS

.1 NEMA 1 (NEMA 2 in sprinklered areas) wall mounting, enamelled steel barriered enclosures sized to suit the application with 20% spare capacity, perforated sub-panel, numbered terminal strips for all low and line voltage wiring, hinged door, and slotted flush latch.

2.04 CONTROL SYSTEM COMPONENTS

.1 Components specified below are required for control of equipment and systems in accordance with drawing control diagrams and sequences of operation. Not all required components may be specified.

.2 Sensor/transmitter input devices to be suitable in all respects for application and mounting location. Devices are as follows:

.1 unless otherwise specified, temperature sensors are to be resistance type, either 2-wire 1000 ohm nickel RTD or 2-wire 1000 ohm platinum RTD with accuracy (includes errors associated with sensor, lead wire, and A to D conversion), equipped with type 316 stainless steel thermowells for pipe mounting applications, as follows:

.1 chilled water, room temperature, and duct temperature points, ±1°C (±0.5°F);

.2 all other points, ±0.75°C (±1.3°F).

.2 room temperature sensors constructed for surface or recessed wall box mounting, complete with an adjustable set-point reset slide switch with a ± 1.66°C (±3°F) range, individual heating/cooling set-point slide switches as required, momentary override request pushbutton for activation of after-hours operation, an analogue thermometer;

.3 outside air sensors designed and constructed for ambient temperatures and to withstand environmental conditions to which they are exposed, complete with NEMA 3R enclosure, solar shield, and a perforated plate surrounding sensor element where exposed to wind velocity pressure;

.4 insertion duct mounting sensors type with lock nut and mounting plate, designed to mount in an electrical box (weather-proof with gasket and cover where outside) through a hole in duct;

.5 for ducts greater than 1.2 m (4') or for ducts where air temperature stratification occurs, averaging type sensors with multiple sensing points, and for plenums for applications such as mixed air temperature measurement to account for air turbulence and/or stratification, averaging string of sensors with capillary supports on sides of duct/plenum;

.6 factory solid-state relative humidity sensors with element that resists contamination, weather-proof with NEMA 3R enclosure for outside air applications, supplied with type 304 stainless steel probe with mounting bracket and hardware for duct mounting, each complete with factory calibrated humidity transmitter which is accurate (including lead loss and analog to digital conversion) to 3% between 20% to 80% RH at 25°C (77°F) and equipped with non-interactive span and zero adjustments, and 2-wire isolated loop powered, 4-20 mA, 0 to 100% linear proportional output;

.7 carbon dioxide sensors for air quality control purposes having a maximum 20 second response time, suitable for operating conditions from 0°C to 50°C (32°F to 122°F) and 0 to 100% RH non-condensing, complete with a calibration kit (to be handed to Owner) and characteristics as follows:

.1 measurement range: 0 to 2000 ppm;

.2 accuracy: ±100 ppm;

.3 repeatability: ±20 ppm;

.4 drift: ±100 ppm per year;

.5 output signal: 0 to 10 VDC proportional over the 0 to 2000 ppm range.

.3 Pressure transmitters are to be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input. Pressure transmitters are to transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal. Differential pressure transmitters used for flow measurement are to be sized to the flow sensing device and supplied with a tee fitting and shut-off valves in the high and low sensing pick-up lines to allow permanent ease of use connection for balancing, etc. Transmitter housing is to suit mounting location. Standalone pressure transmitters are to be mounted in a minimum NEMA 1 (NEMA 2 in sprinklered area) by-pass valve assembly panel with high and low connections piped and valved, air bleed units, by-pass valves, and compression fittings. Transmitters are to be as follows:

.1 low differential water pressure, 0 to 5 kPa (0 to 20" wc): industrial quality transmitter capable of transmitting a linear 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:

.1 maintain accuracy up to 20 to 1 ratio turndown;

.2 reference accuracy: +0.2% of full scale.

.2 medium to high differential water pressure, over 5 kPa (20" wc): transmitters as specified above for low pressure transmitters but with a pressure range of from 2.5 kPa (10" wc) to 2070 kPa (300 psi), a reference accuracy of ±1% of full span (includes non-linearity, hysteresis, and repeatability);

.3 building differential air pressure: industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:

.1 maintain accuracy up to 20 to 1 ratio turndown;

.2 reference accuracy: +0.2% of full span.

.4 low differential air pressure, 0 to 1.25 kPa (0" to 5" wc): industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:

.1 maintain accuracy up to 20 to 1 ratio turndown;

.2 reference accuracy: +0.2% of full span.

.5 medium differential air pressure, over 1.5 kPa (5" wc): as specified above for low pressure air transmitters, but performance requirements as follows:

.1 zero and span: (c/o F.S./Deg. F); .04% including linearity, hysteresis, and repeatability;

.2 accuracy: 1% F.S. (best straight line); static pressure effect: 0.5% F. S.;

.3 thermal effects: <+0.33 F.S./°F over 40°F to 100°F (calibrated at 70°F).

.6 Static Pressure Traverse Probe: Duct mounting, complete with multiple static pressure sensors located along exterior surface of cylindrical probe.

.7 Shielded Static Air Probe: Indoor type or outdoor type as required, each with multiple sensing ports, an impulse suppression chamber, and air flow shielding.

.8 Water Flow Monitoring: Equal to Onicon microprocessor-based electromagnetic water flow meters with an accuracy of 0.25%.

.4 Power (amps) monitoring is to be performed by a combination of a current transformer and a current transducer with transformer sized to reduce full amperage of monitored circuit to a maximum 5 ampere signal which will be converted to a 4 to 20 mA DDC compatible circuit for use by building automation system. Current transformer and current transducer are as follows:

.1 equal to Veris Industries split core current transformer with an operating frequency of from 50 to 400 Hz, 0.6 Kv class, 10 Kv BIL insulation, and 5 ampere secondary;

.2 equal to Veris Industries current to voltage or current to mA transducer with an accuracy of ±5%, a minimum load resistance of 30 kOhm, an input of 0 to 20 amperes and an output of 4 to 20 mA, and a 24 VDC regulated power supply.

.5 Duct mounting smoke detectors supplied as part of electrical work for mounting as part of control system work.

.6 Double contact switches to monitor equipment status and safety conditions, and generate alarms when a failure or abnormal condition occurs. Status and safety switches are to be as follows:

.1 current sensing switches: self-powered dry contact output switches for sensing run status of motor loads, each calibrated to indicate a positive run status only when motor is operating under load, and each consisting of a current transformer, a solid-state current sensing circuit, adjustable trip point, solid-state switch, SPDT relay, and a LED to indicate on or off status;

.2 air filter status switches:, automatic reset type differential pressure switches, each complete with SPDT contacts rated for 2 amperes at 120 VAC, a scale range and differential pressure adjustment appropriate for the service, and an installation kit which includes static pressure taps, tubing, fittings, and air filters;

.3 air flow switches: pressure flow switches, bellows actuated mercury switch or snap-acting micro-switch type with an appropriate scale range and pressure adjustment;

.4 air pressure safety switches: manual reset switches, each complete with SPDT contacts rated for 2 amperes at 120 VAC and an appropriate scale range and pressure adjustment;

.5 water flow switches: Johnson Controls Inc. Model P74 or approved equal;

.6 low temperature limit switches: manual reset type, each complete with DPST snap acting contacts rated for 16 amperes at 120 VAC, a minimum 4.5 m (15') sensing element for mounting horizontally across duct/plenum with sensing reaction from coldest 450 mm (18") section of element, and where sensing element does not provide full coverage of air stream, additional switches are to be supplied as required.

.7 Control relays as follows:

.1 control pilot relays: modular plug-in design with snap-mount mounting bases, retaining springs or clips, DPDT, 3 PDT or 4 PDT as required for the application, with contacts rated for 10 amperes at 120 VAC;

.2 lighting control relays: latching type with integral status contacts rated for 20 amperes at 120 VAC, each complete with a split low voltage coil that moves the voltage contact armature to On or Off latched position, each controlled by a pulsed tri-state output (preferred) or pulsed paired binary outputs, and each designed so power outages will not result in a change-of-state and so multiple same state commands will simply maintain commanded state.

.8 Electronic signal isolation transducers for installation whenever analog output signal from building automation system is to be connected to an external control system as an input (i.e. equipment control panel) or is to receive as an input signal from a remote system, and to provide ground plane isolation between systems.

.9 Each manual override station is to be complete with contacts rated minimum 1 ampere at 24 VAC and is to provide following:

.1 integral H-O-A switch to override controlled device pilot relay;

.2 status input to building automation system to indicate whenever switch is not in the Auto position;

.3 status LED to illuminate whenever output is On;

.4 override LED to illuminate whenever H-O-A switch is in either the Hand or Off position.

.10 Electronic/pneumatic transducers with output of from 3 to 15 psig, an input of from 4 to 20 mA or 10 VDC, manual output adjustment, a pressure gauge, and an external replaceable supply air filter.

.11 Thermostats:

.1 Wall mounting adjustable set-point thermostats, each suitable in all respects for equipment (and operating sequence) they are provided for, equipped with a thermometer, cover and any required mounting and connection accessories.

.2 Line voltage thermostats are to be 115 volt.

.3 Low voltage thermostats are to be 24 volt electronic type.

.4 Set-point adjustment for thermostats in public spaces is to be concealed behind cover. Set-point adjustment for other thermostats is to be accessible through cover.

.5 Covers are to be removable, tamper-proof covers with temperature set-point and thermometer displays.

.6 Guards for thermostats are to be clear, ventilated polycarbonate covers with allen key locking hardware.

.12 Humidistats:

.1 Direct or reverse acting (to suit system), proportional type, adjustable humidity controllers, each corrosion resistant, suitable in all respects for application and complete with nylon element, replaceable cartridge type air filter, internally adjustable limit stops for maximum and minimum settings, a cover, and required mounting and connection accessories.

.2 Electric humidistats are to be line voltage (115 volt), or 24 volt electronic type.

.3 Wall mounting humidistats are to be complete with a tamper-proof display type cover.

.4 Duct mounting humidistats are to be complete with a display type cover, duct sampling chamber with 300 mm (12") long extruded pick-up tube for duct mounting, a moulded mounting base, and ventilated cover.

.13 Hardware to permit building automation system control and monitoring of input/output points in accordance with Section entitled Building Automation System, points schedule, and drawing control diagrams and operation sequences. Such hardware is to be suitable in all respects for interface with BAS.

2.05 SYSTEM WIRING MATERIALS

.1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in appropriate Section(s) of Electrical Work specification.

3 EXECUTION

3.01 DEMOLITION

.1 Perform required control system demolition work.

.2 Refer to demolition requirements specified in Section entitled Demolition and Revision Work.

3.02 GENERAL RE: INSTALLATION OF CONTROLS

.1 Provide complete systems of control and instrumentation to control and supervise building equipment and systems in accordance with this Section and drawings.

.2 Control systems are to generally be as indicated on drawing control diagrams and are to have elements therein indicated or implied.

.3 Control diagrams show only principal components controlling equipment and systems. Supplement each control system with relays, transformers, sensors, etc., as required to enable each system to perform as specified and to permit proper operation and supervision.

3.03 INSTALLATION OF CONTROL AIR PIPING AND TUBING

.1 Provide required control air piping and tubing.

3.04 SUPPLY OF CONTROL AIR DAMPERS AND OPERATORS

.1 Unless otherwise specified, supply required control dampers. Hand dampers to sheet metal trade at site in location where they are required for installation as part of sheet metal work. Ensure each damper is correctly located and mounted.

.2 Provide linkage and operators for dampers. Wherever possible locate damper operators so they are accessible from outside duct, plenum, and equipment casings. Bracket mount operators on ducts or plenums clear of insulation where applicable.

.3 Where sequence operation is indicated, or where multiple operators drive a series of dampers, provide pilot positioners to couple their action.

.4 Ensure dampers located in ductwork other than galvanized steel are constructed of type 316 stainless steel.

3.05 SUPPLY OF AUTOMATIC CONTROL VALVES AND OPERATORS

.1 Unless otherwise specified, supply required automatic control valves. Hand valves to appropriate piping trades at site in locations they are required for installation as part of piping work. Ensure each valve is properly located and installed.

.2 Provide operator for each valve.

3.06 SUPPLY OF ACTUATORS, CONTROLLERS, AND TRANSFORMERS FOR TERMINAL UNITS

.1 Supply required 24 volt actuators, controllers, and transformers for terminal units.

.2 Deliver actuators and controllers to successful terminal unit manufacturer's factory.

.3 Coordinate delivery of product with General Contractor and successful terminal unit manufacturer.

3.07 INSTALLATION OF THERMOSTATS

.1 Unless otherwise noted, provide required thermostats.

.2 Provide a ventilated clear polycarbonate cover for each thermostat located in finished areas, and a wire type guard for each thermostat located in unfinished areas and in areas such as mechanical rooms where thermostat is subject to damage.

.3 Unless otherwise indicated, mount room thermostats in accordance with requirements of local governing authority and, where applicable, barrier-free requirements. Review exact location of thermostats with Consultant prior to roughing-in.

.4 Provide stand-off mounting and an insulated sub-base for thermostats on outside walls.

.5 Perform control wiring associated with installation of electric or electric-electronic thermostats.

3.08 INSTALLATION OF CONTROL SYSTEM COMPONENTS

.1 Provide required control system components and related hardware. Refer to drawing control diagrams and sequences.

.2 Where components are pipe, duct, or equipment mounted supply components at proper time, coordinate installation with appropriate trade, and ensure components are properly located and mounted.

3.09 CONTROL WIRING

.1 Perform required control wiring work for control systems except:

.1 power wiring connections to equipment and panels, except as noted below;

.2 control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;

.3 starter interlock wiring.

.2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2') connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.

.3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.

.4 Wiring work is to be in accordance with certified wiring schematics and instructions, and wiring standards specified in appropriate Sections of Electrical Work Specification.

3.10 IDENTIFICATION AND LABELLING OF EQUIPMENT AND CIRCUITS

.1 Refer to identification requirements specified in Section entitled Basic Mechanical Materials and Methods.

.2 Identify equipment as follows:

.1 enclosures and components: engraved laminated nameplates with wording listed and approved prior to manufacture of nameplates;

.2 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.

3.11 TESTING, ADJUSTING, CERTIFICATION, START-UP, AND TRAINING

.1 When control work is complete, check installation of components and wiring connections, make any required adjustments, and coordinate adjustments with personnel doing HVAC testing, adjusting and balancing work.

.2 Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system manufacturer certification requirements.

.3 Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system start-up requirements.

.4 Include for 2 full, 8 hour days on-site operation demonstration and training sessions. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

.5 Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full, 8 hour day to provide additional system training as required, and to demonstrate troubleshooting procedures.

END OF SECTION

1 GENERAL

1.01 DESCRIPTION OF WORK

.1 Provide labour, materials, equipment, and services necessary for a complete Building Automation System (BAS) comprised of various types of BACnet Testing Laboratories (BTL) listed BACnet-communicating Direct Digital Control (DDC) controllers (referred to as "BAS Controllers"), BTL listed BACnet-communicating operator interface software, conventional electric/electronic controls, and equipment-mounted controls. System is to be fully functional and include software and hardware for specified capabilities.

.2 Refer to Section entitled Automatic Control Systems for requirements regarding control valves, control dampers, actuators, sensors/transmitters, switches/auxiliary control devices, and other similar field devices.

.3 Summary of Project Scope:

.1 Modify existing BAS control system to accommodate mechanical equipment changes. Seamlessly integrate into the existing system and the Queen's University remote access server platform. Provide all components and programming necessary to provide local control with remote access consistent with existing user interface;

.2 Scope of work includes controls for VAV terminal boxes, exhaust fans, and other systems as identified within contract documents.

.4 Integrate and coordinate controls required by this project into a single system as follows:

.1 Each supplier of a controls product is responsible for installation, configuration, programming, start-up and testing of that product unless otherwise stated.

.2 Coordinate resolution of any incompatibility issues between BAS products provided under this section and those provided elsewhere in Contract Documents. Equipment/system manufacturer/supplier is responsible for supplying technicians that are to be available to troubleshoot any issues and coordinate with contractor.

.3 Be responsible for material and labour to interconnect control products provided by multiple suppliers regardless of where these products are described within Contract Documents.

.4 Coordinate to ensure sufficient space and power for BAS components is provided/available.

.5 Resolve any conflicts that arise in control of same equipment by both BAS and fire alarm systems. Coordinate with fire alarm system manufacturer and installing contractor to resolve any issues that arise. Fire alarm system control is to be given priority, except where stated otherwise.

1.02 DEFINITIONS/ABBREVIATIONS

.1 Advanced Application Controller (AAC) – Fully programmable controller which is BTL-listed as a B-AAC device and which communicates via BACnet MS/TP to an associated network controller (NC). These controllers are used for terminal unit (including VAV boxes) and small AHU/RTU control.

.2 Application Specific Controller (ASC) – Low-level MS/TP controller typically not custom-programmable and BTL-listed as a B-ASC device.

.3 BACnet/IP – Use of Ethernet and IP data/network link protocols to transport BACnet messages.

.4 B-BC, B-AAC, B-ASC and B-AWS – Abbreviations for BACnet Building Controller, BACnet Advanced Application Controller, BACnet Application Specific Controller, and BACnet Advanced Operator Workstation Software. Used by BACnet standard and BTL to define various device and software profiles, and BACnet functionality to be provided by different classes of DDC devices (for support of interoperability).

.5 BBMD – BACnet/IP Broadcast Management Device. Method used by BACnet for handling broadcast messages over IP (which does not support broadcasting). Approach involves use of one BACnet/IP device per IP segment to maintain a Broadcast Distribution Table (BDT) listing all other BACnet devices on that network segment. This allows a multi-cast message sent over IP (to each BBMD) to be in turn broadcasted to all other devices on each BACnet/IP segment.

.6 BTL – BACnet Testing Laboratory. Provides BACnet conformance testing (e.g., to confirm a B-BC device meets minimum requirements for Building Controller profile as defined in BACnet standard). If device passes BTL testing it is said to be "BTL-listed" as, say, a "B-BC device". Devices tested by an ISO accredited laboratory may also issue a certificate, and be referred to as "BTL-certified" device.

.7 COV (Change of Value) – Optional BACnet service that allows data to be communicated only when it has changed state and/or has changed its value by a pre-defined threshold. This service substantially reduces use of communications bandwidth by BACnet in lieu of using standard "Read" services (which must be polled at regular intervals to ensure changes in values are seen by system).

.8 FEC – field equipment controller; AAC's and ASC's are field equipment controllers.

.9 Gateway – Software used to translate one application's protocol data (i.e., BACnet) to another (e.g., Modbus or LonTalk). This software can be installed as a "driver" in a BAS controller (i.e., for Modbus) or provided by a separate gateway device (i.e., for LonTalk) so BAS can connect to "Third Party" devices).

.10 MS/TP – Master-Slave/Token-Passing, an EIA-485 data link technology unique to and defined by BACnet for transport of BACnet messages.

.11 NC – Network Controller, highest-level controller in BAS architecture, with B-BC listing, BACnet/IP communications, and routing to/from MS/TP controller sub-networks.

.12 PICS – Protocol Implementation Conformance Statement, a BACnet form that must be completed for BTL-listing in which device's BACnet device profile (e.g., B-BC), required feature choices (e.g., BACnet/IP vs. MS/TP), and optional features (e.g., COV) are to be documented.

1.03 SUBMITTALS

.1 For each control device submit shop drawings/product data sheets including manufacturer's name, product name and specific model number, options included, product image, proof of BTL listing, dimensions, functional description and operating characteristics, protocol conformance information, and electrical requirements (AC vs. DC, voltage and current draw, or VA).

.2 Provide system architecture diagram showing communications wiring topology, model number or designation of each communicating device, HVAC or other system/equipment controlled, location and designation of each enclosure containing communicating device, and connections to 3rd party controls.

.3 For renovation projects, system architecture is to show complete existing network highlighting where and how new devices are to be added.

.4 Provide schematic diagram of each controlled system/equipment showing point devices/interfaces with a point naming scheme matching that used on associated control enclosure wiring diagram. Provide a bill of material for devices shown with nomenclature keyed to catalogue data.

.5 Proprietary services and object types, if used in system, to be thoroughly documented and provided as part of submittal data. Necessary tools to be supplied for working with proprietary information.

.6 Provide floor plans showing enclosure locations, field devices not mounted in enclosures or on equipment (e.g., space temperature), terminal devices (e.g., VAV box) controller locations, and workstation/server locations.

.7 Provide enclosure layout and wiring diagram showing BAS controllers, gateways/interfaces to 3rd party controls, enclosure-mounted field devices, internal wiring and wiring to field devices (with wiring tags matching those used on schematic diagrams), a point list with expanded point description information, communications wiring connections, and power supply. Label enclosure devices and key to bill of materials.

.8 Provide sequence of operation modified and expanded from that provided in this specification to include control details specific to mechanical and controls equipment provided.

.9 Provide list of data communicated via digital communications interfaces to 3rd party controls (e.g., a chiller or boiler gateway).

.1 Prior to completion of submittals, coordinate with 3rd party equipment suppliers to review their documentation and verify data (i.e., BACnet objects and properties, Modbus registers, etc.) required to complete system is available.

.2 Prior to completion of submittals, schedule meeting with Consultant to review data lists available for communication to/from 3rd party controls. Based on Consultant's input modify list of data to be communicated from that specified.

.10 Provide a list of graphic screens, and, for each screen, conceptual layout with points/data to be included and linkages to other screens. Meet with Owner and Consultant prior to submittals to determine their graphic screen format and content preferences.

.11 Provide, for review, a description of BAS acceptance tests along with forms/checklists to be used during testing.

.12 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

1.04 QUALITY ASSURANCE

.1 Electrical installation work is to comply with latest version of local governing electrical code and installed by experienced personnel trained by BAS manufacturer/supplier.

.2 Provide electrical products which have been tested, listed and labelled by CSA or ULC, and comply with NEMA standards.

.3 Comply with following codes and standards:

.1 UL 916, Energy Management Equipment;

.2 ASHRAE BACnet Standard 135;

.3 local governing electrical code.

.4 Controls Contractor is to provide an experienced project manager (minimum 10 years of related experience) to oversee all aspects of project including design, installation and start-up.

.5 Anyone involved in design, installation, programming and verification of BAS are to be authorized and trained by BAS manufacturer.

1.05 WARRANTY

.1 Provide labour, material and equipment necessary for operation of BAS according to design for a period of 1 year after Substantial Completion of Project. Warranty or final completion service is to be scheduled with Owner to minimize disruptions to facility operations.

.2 Provide Owner with a telephone number where service representative can be reached at all times. Within 24 hours after receiving a request for service, problem is to be remotely resolved (i.e. via remote communications with BAS) or service personnel are to be at site. Fully restore BAS to proper operating condition within 2 days.

1.06 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers are:

.1 Delta

.2 BAS controllers and operator interface software are to be by one of above manufacturers, except when controls are specified under another section (i.e., referenced as "controls provided with unit," "factory-mounted controls," or "unit manufacturer provided controls," etc. within this section). "BAS Components" includes BAS controllers and operator interface software. Acceptable manufacturers of dampers, valves, actuators, sensors, and other field devices are to be as specified in Section entitled Automatic Control Systems.

2 PRODUCTS

2.01 MATERIALS

.1 Use new products manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts are to be available for at least 5 years after completion of this contract.

2.02 BAS ARCHITECTURE AND GENERAL REQUIREMENTS

.1 BAS using a client server architecture based around a modular PC network, utilizing industry standard operating systems, networks and protocols, and meeting system manufacturer's general requirements.

.2 BAS is to include, but not be limited to, following:

.1 operator workstation to use as primary interface into BAS;

.2 custom built graphics including an overview, floor plans, individual graphics for each system, and summary graphics for system comfort and major equipment operation;

.3 high speed, peer to peer network of DDC controllers, a control system server, and web-based operator interface;

.4 utilize distributed control and not rely on any single controller;

.5 software designed around open standards with the control system server being accessible using a web browser over control system network, Owner's LAN or over the internet, and requiring no special software other than web browser to access system information;

.6 utilize BACnet protocol for communication to operator workstation, web server and controllers and designed around ANSI/ASHRAE BACnet Standard 135;

.7 open system architecture is to allow system to integrate to multiple vendors;

.8 capable of future expansion through addition of control devices, DDC controllers and/or operator devices, and is to include capability of 25% expansion.

.3 Each NC is to have a spare Ethernet/IP port connection for local connection of an operator interface.

.4 Each BAS controller is to continue to execute its control software, sample input points, and update output points without connection to its BACnet/IP or MS/TP network or an operator interface. If global variables such as OAT are used within a controller's programming/sequence of operation, the global variable is to maintain its last value prior to network disruption.

.5 BAS is to be remotely accessible via an internet connection coordinated with Owner and reviewed with Consultant.

.6 Point termination types include:

.1 analogue input (AI) - thermistor, 0-10 VDC or 4-20 mA DC;

.2 binary input (DI) - monitoring of dry contacts, including contact closure "pulses" up to 10 per second;

.3 analogue output (AO) - 0-10 VDC, 0-20 VDC or 4-20 mA DC;

.4 binary output (DO) - 2-state DC voltage signal or magnetically held dry contact closure.

.7 Each BAS controller is to be able detect a changeover to battery-backed power and modify state of control program, if required by sequence of operation.

.8 Upon reestablishment of power to a BAS controller, devices are to return to normal operation in less than one minute.

.9 Server computer and operator workstation hardware capable of interfacing to an IEEE 802.3 Standard Local Area Network (LAN), and also capable to operate using IEEE 802.11 Wireless Local Area Network (WLAN).

.10 Digital Communications to 3rd Party Controls

.1 BAS is required to send/receive information via digital communications technologies (i.e. Ethernet/IP, or EIA-485) and application protocols (i.e., BACnet, or Modbus) to specified "3rd Party" controls provided under other sections of this specification (e.g., VFD's, Chillers, etc.).

.2 Refer to specification sections of equipment involved (e.g., VFD, Chiller, etc. section) for type of communications technology/interface (e.g., data link layer protocol) and application protocol used by each of 3rd Party controls, and for list of data to be shared with these controls.

.3 Communications not requiring a BAS Gateway (i.e., BACnet) - Design BAS to include NC's and sufficient EIA-485 communications ports (for MS/TP) to support communications and data handling capacities required.

.4 Communications Requiring a Network Controller "Driver" (e.g., Modbus) - Design BAS to include NC's and sufficient EIA-485 communications ports (for Modbus-RTU), and any optional software "drivers" and/or hardware if necessary to support communications technology and application protocol gateway interfaces.

.5 Communications Requiring a Gateway (e.g., LonTalk) - Design BAS to include sufficient BACnet/IP-communicating devices, with sufficient LonTalk communications capacity to support LonTalk 3rd Party devices.

.11 System is to perform following general functions:

.1 building management and control;

.2 monitoring and control of controllers, remote devices and programmable logic controllers including sensors, actuators, environmental delivery systems (chillers, boilers, room climate control, lighting systems, electrical systems etc.);

.3 operator interface to allow general supervision of room controls;

.4 video display integration;

.5 data collection and historization;

.6 alarm management;

.7 trending;

.8 report generation;

.9 network integration;

.10 controller scheduling;

.11 data exchange and integration with a diverse range of other computing and facilities systems using industry standard techniques.

.12 In event of a power failure or disconnection from BAS, controllers are to continue to be fully operational with full time program capability.

2.03 NETWORK CONTROLLER (NC)

.1 NC is a BTL listed BACnet B-BC device in accordance with following requirements:

.1 non-volatile memory for operating system software;

.2 read/write memory for custom control programming, trending, and alarming;

.3 real time clock;

.4 integral point or point expansion terminations;

.5 communications support to other NC's;

.6 minimum Quad Core 996Ghz processor;

.7 global control algorithms and automated control functions to execute using a 64-bit processor;

.8 minimum of 1 GB of DDR3 SDRAM on a 533Mhz bus;

.9 EIA-485 ports capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus;

.10 provide normal seven-day scheduling, holiday scheduling and event scheduling;

.11 logging capabilities for any object type with sample time interval adjustable at operator workstation;

.12 alarm generation for any object change of value or state;

.13 built-in, user-configurable demand limiting of energy.

.2 Each BACnet MS/TP LAN to support a minimum of 50 BACnet devices.

.3 NC Communications Network: 100baseT Ethernet minimum communications with BACnet/IP support for interconnection to other NC's, operator interfaces, and to an Internet/Intranet connection, if specified.

.4 Web-Server: Password-protected access directly to controller to view, diagnose and modify operating features/parameters using a web browser with factory provided web pages used for this capability that require no setup other than required for programming controller.

.5 NC is to provide:

.1 Communications support as "master" to up to 3 separate 76.8Kbps minimum BACnet MS/TP data link layer communications connections for advanced application and application specific controllers.

.2 BACnet Clause 6 Routing (between specified NC's and controller network technologies) and BACnet/IP Broadcast Management (BBMD).

.6 NC is to be of scalable design such that number of trunks and protocols may be selected to fit specific requirements of a given project.

.7 Controller to be capable of running up to six independent control strategies simultaneously. Modification of one control strategy does not interrupt function or runtime others.

.8 Controllers for critical applications are to be B-BC controllers with IP connectivity.

2.04 FIELD EQUIPMENT CONTROLLERS (FEC)

.1 Advanced Application Controller (AAC)

.1 BTL listed BACnet B-AAC device with:

.1 non-volatile memory for operating system software;

.2 read/write memory for custom programming;

.3 76.8Kbps minimum BACnet MS/TP communications;

.4 direct point termination through integral point connections;

.5 communications support for operator interface and controller network.

.2 Application controllers to include universal inputs with 12-bit resolution that accept 3K and 10K thermistors, 0–10VDC, Platinum 1000 ohm RTD, 0–5VDC, 4–20mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller to include binary and analog outputs on board. Analog outputs with 12-bit resolution to support either 0–10VDC or 0–20mA. Binary outputs to have LED indication of status. Software to include scaling features for analog outputs. Application controller to include 20VDC voltage supply for use as power supply to external sensors.

.3 Programming of application controller to be completely modifiable in field over installed BACnet LANs or remotely using modem interface.

.2 Application Specific Controller (ASC)

.1 BTL listed BACnet B-ASC device dedicated for use with specific equipment and applications, and provided with:

.1 non-volatile memory for operating system software;

.2 read/write memory for all other purposes;

.3 factory-provided control software;

.4 76.8Kbps minimum BACnet MS/TP controller network connection (as an MS/TP master);

.5 integral point termination;

.6 communications support for operator interface, and controller network.

.2 Application controllers to include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller to also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller to include microprocessor driven flow sensor for use in pressure independent control logic. All boxes to be controlled using pressure-independent control algorithms and all flow readings to be in LPS (CFM).

.3 Program sequences to be stored on board application controller in EEPROM. No batteries are to be needed to retain logic program. Program sequences to be executed by controller 10 times per second and be capable of multiple PID loops for control of multiple devices. Programming of application controller to be completely modifiable in field over installed BACnet LANs or remotely using modem interface. Operator to program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller to be programmed using same programming tool as Building Controller and as described in operator's workstation section. Programming tools to be provided as part of system.

.4 Do not use application specific controllers for systems/equipment that require custom application programming to meet sequence of operation (i.e., if an application specific controller is used, factory-provided control software/program is to perform sequence of operation without "upper level" control from another BAS controller).

.5 Include an integral differential pressure sensor for controllers used for air flow measurement and an optionally integral damper actuator.

.3 FEC's for terminal units to be provided by terminal unit manufacturer.

.4 FEC's for Variable Air Volume (VAV) Terminal Units:

.1 FEC's for VAV terminal units are to comply to above requirements and following additional requirements:

.1 On-board flow sensor is to be microprocessor-driven and pre-calibrated at the factory. Pre-calibration is to be at 16 flow points as a minimum. All factory calibration data is to be stored in non-volatile memory. Calibration data is to be field adjustable to compensate for variations in VAV box type and installation. Operator's workstation, portable computers, and special hand-held field tools are not to be needed for field calibration.

2.05 DISTRIBUTED SYSTEM SERVERS

.1 Method for monitoring and control of points on remote BAS servers, specifically, real-time and history values. Features supported include:

.1 Global access to data, such that users at operator workstations on one server can access data, history, point detail displays, etc. for points on any other server. It is not to be necessary to configure system wide, more than one point for each data value or signal, regardless of number of servers accessing data.

.2 Ability to nominate sets of points to be accessed on a server-by-server and user-by-user basis. Mechanism is to be same as mechanism to control individual operator and workstation access to data for single server systems.

.3 Operators and workstations at any server are to see alarms from any other server, and not necessary to configure alarms more than once, regardless of number of servers accessing data.

.4 Ability to configure real time and historical trends that combine data from any connected server on a single trend, and not necessary to configure more than one point for each data value or signal, regardless of number of servers accessing data.

.5 Graphics, reports, and applications at a server have same distributed access to data on other servers as described above for operators and workstations, and not necessary to configure more than one point for each data value or signal, regardless of number of servers accessing data.

.6 Important service oriented architecture (SoA) web services enabling extension of BAS system providing seamless access to points, alarms and history from any distributed system server, without needing to directly address each individual server. Data across distributed system servers is to be seamlessly integrated into Web services.

.2 System to support identical point names on any of the connected servers in distributed system. With exception of scope of responsibility assignment, there is to be no engineering effort to connect these distributed systems.

.3 Connections between servers can be made through local Ethernet connections, plant's LAN, or corporate WAN. Connections are optionally redundant. Both redundant and non-redundant servers must be supported, and no additional engineering effort is to be required to connect both kinds of servers.

2.06 OPERATOR INTERFACE

.1 Operator interface allowing for efficient communication of operational data and abnormal conditions, providing a consistent framework for viewing of information, and following requirements:

.1 critical areas (such as alarm icons) visible at all times;

.2 predefined area on screen providing operator messaging visible at all times;

.3 set of standard displays for configuration, and navigation around BAS system provided with every system and not requiring any engineering;

.4 unlimited number of custom (facility specific) displays created to meet needs of specific facility.

.5 software capable of running in Windows Server environment of version recommended by manufacturer;

.6 interactive and totally graphics and/or icon based, capable of supporting at least 65,000 colours at a minimum 1280 x 1024 pixel resolution;

.7 employ standard Windowing conventions so as to reduce required operator training, in particular, standard, totally configurable tool bar icons and drop-down menus available on standard and custom displays to allow easy access to common functions, and such functions also available via a standard set of function-key based pushbuttons without requiring configuration;

.8 support ability to "full screen lock" window so users cannot access other applications, and if "full screen lock" is not enabled, support for copy and paste facilities are to be provided between operator window and other Microsoft applications;

.9 operator interface connection:

.1 flexible in its connection to BAS server;

.2 Ethernet LAN or Internet connection used between server and operator workstations and browser clients;

.3 provide standard remote access support using industry standard tools like VNC, RADMIN, and Windows Terminal Services;

.4 where used, remote connections are to use password protected user authentication and encrypted network/internet protocols.

.10 following functions performed through operator interface:

.1 display and control of field equipment;

.2 acknowledge alarms on a priority basis;

.3 initiate printing of reports;

.4 archive and retrieve event logs;

.5 view historical plant information on predefined trend windows;

.6 view intranet or information from the Internet in a secure environment;

.7 change own password;

.8 monitoring of data communications channels;

.9 configure system parameters.

.2 Web Browser Operator Interface

.1 Operator interface fully available and functional through internet via an Internet Explorer browser allowing an operator to operate facility and perform all functions on same standard and custom graphics as used in standard operator interface. Custom graphics, alarm graphics and standard graphics available without modification or reengineering through Internet in an Internet Explorer browser user interface.

.2 Browser interface providing login and security authentication in same way as standard operator interface. Large number of casual users permitted without any additional licensing burden with licensing based on number of simultaneous operator connections on a "first come first served" basis. Users with casual access are to automatically disconnect from BAS server after an idle timeout period.

.3 Operator Interface Characteristics

.1 Following minimum capabilities are standard and require no custom programming or scripting:

.1 window re-size, zoom in, zoom out with display resolutions continuously resized to fit available window size;

.2 dedicated icons and pull down menus to perform multiple operations.

.2 Operator Input Devices

.1 Operator interface capable of being mouse driven and simultaneously support keyboard data input. Both fixed menus and configurable function keys supported to aid novice and experienced operator respectively. Interface also capable of supporting a touch-screen for pointing and command input.

.2 Utilizing a Tool Bar for common operator commands, and able to request display of commonly used displays and activate system functions via drop-down menus.

.3 Operator interface input is possible using only pointing device and QWERTY section of keyboard.

2.07 OPERATOR SECURITY

.1 If necessary, each operator may be assigned a user profile that defines following:

.1 security and/or control level;

.2 operator identifier;

.3 unique encrypted password;

.4 operator scope of responsibility assignment;

.5 start graphic for that operator;

.6 timeout value for that operator.

.2 Log actions initiated by operator in event database by operator identifier. In addition, any control actions to a given point are only allowed if control level configured in operator's profile exceeds level assigned to controlled point.

.3 System to support at least 6 levels of operator security.

.4 Sign-On/Sign-Off

.1 Operator is permitted to sign on to system if correct operator identity and password have been entered. It is possible to have system authentication integrated directly into Windows, Windows Group Accounts, or an LDAP Server such that operator uses pre-existing account details to sign on to BAS system ensuring operators only need to remember 1 set of credentials for both their workstation and BAS.

.2 Each operator is to be assigned a password and a defined scope of responsibility which defines locations in facility that may be managed and controlled by individual operator.

.3 Operator may sign-off at any time by issuing a sign-off command.

.5 Location Assignment / Scope of Responsibility Profile

.1 Each operator is to be assigned one or more specific areas of building with appropriate monitoring and control responsibility (no view, view only, alarm acknowledge only or full control). Location is defined in this context as a logical entity comprising of a set of points in system. This in turn may represent a physical space in building. Locations are used to partition BAS database in such a way as to assign operators control over certain areas and prevent unauthorized access to other areas.

.6 Duress

.1 System to support operator duress function, so operator may discretely indicate they are signing in to BAS system under duress. System is to recognize operator is signing on under duress and be able to issue a control to alert appropriate assistance.

.7 Command Partitioning

.1 Possible to assign each operator a set of allowed commands for each assigned location. Commands can be mapped against output state of any given digital point in respective area to determine whether a control command is allowed for particular operator.

.2 With this feature, it will, for example, be possible to configure an operator to set a digital point to "on", but to disallow same operator from setting same digital point to "off".

2.08 STANDARD SYSTEM DISPLAYS

.1 Following displays are to be included as part of system:

.1 alarm summary display;

.2 event summary display;

.3 point detail template displays (for each point in database);

.4 trend set template displays;

.5 group control and group trend template displays;

.6 communications status displays;

.7 system status displays;

.8 face plates for all common point types;

.9 configuration displays.

.2 In the case of trend and group displays, configuration of these displays only require entry of a point name to completely configure display. Alarm summary, event summary, point detail, communications status, and system status do not require any configuration.

.3 System Status Display

.1 Available on each operator workstation and automatically built by BAS system, requiring no engineering to add additional devices to be monitored. It is to display following information in a hierarchical system tree:

.1 points in alarm condition pending "acknowledge" command;

.2 points which remain in an alarm state but which have been acknowledged;

.3 communication failures;

.4 printer status;

.5 operator workstations status;

.6 communication links status;

.7 controller status;

.8 system interfaces status;

.9 additional connected server status.

.4 Administration Displays

.1 System is to provide following full screen displays:

.1 master system menu;

.2 report summary;

.3 alarm summary;

.4 event summary;

.5 display summary;

.6 system status display;

.7 system parameters configuration;

.8 operator workstation configuration;

.9 scope of responsibility assignment;

.10 time schedule assignment;

.11 calendar assignment (holidays/special occasions);

.12 history assignment;

.13 push-button assignment;

.14 operator definition;

.15 operator message board;

.16 events archive and retrieval;

.17 time period summary and configuration;

.18 point detail for every configured point.

2.09 CREATING CUSTOM DISPLAYS

.1 Graphic Display Building Editor

.1 Include a graphic display building editor for creation of site specific graphic displays allowing one-step online building of display static and dynamic objects. It is a WYSIWYG editor (what you see is what you get) allowing displays drawn using editor to appear exactly same when viewed from an operator workstation.

.2 Displays are created in HTML 5 (Hypertext Markup Language) format. This is essential so displays can also be viewed through a web browser as well as normal BAS operator interface. Displays are to be saved in standard HTML format. Graphic elements are to be available as HTML elements. It is not acceptable to have an HTML format which merely links to a proprietary object or bit map of entire display. It is to be possible to view and edit resulting HTML file using a text editor. Systems which do not support HTML displays are not acceptable.

.3 It is to be possible to link dynamic objects to BAS database. They are to allow information to be displayed from database or to allow an operator to interact with them in order to make changes in database and to perform control actions. Dynamic objects are to include dynamic text, push buttons, indicators, charts, check boxes, combo boxes, pop up boxes, ActiveX controls and scroll bars.

.4 Graphic display building editor to support multiple features including but not limited to following:

.1 one step display building (both background and dynamic information);

.2 point and click operation;

.3 paste to and from Clipboard;

.4 control for display status of system schedules;

.5 configurable tool, colour and line palettes;

.6 dialog boxes for definition of object properties;

.7 import graphics from 3rd party packages including WMF, BMP, TGA, GIF and JPEG formats;

.8 standard library of BAS industry objects;

.9 live video element;

.10 ActiveX controls;

.11 ActiveX documents;

.12 display scripts written in either JavaScript or VBScript;

.13 multilevel undo and redo;

.14 transparent images;

.15 popup displays;

.16 standard alarm symbols;

.17 real time and historical trend object supporting up to 32 points on 1 trend.

.2 Display Scripting

.1 It is to be possible to further animate display elements using standard HTML scripts such as JavaScript or VBScript. Include script editor supporting one of standard script languages. By using script programs, individual elements on display may be manipulated. Proprietary scripting language or additional scripting and drawing package is not acceptable.

.2 It is to be possible to perform a variety of animations.

.3 Live Video

.1 Both graphic display building editor and operator interface are to have built in support for creation and display of live video objects without need for programming. Size and position of video object is configured on a per display basis.

.4 Web Technology

.1 Displays created in graphic display building editor are to be usable in a web browser such as Microsoft's Internet Explorer without modification. Displays are to be usable in this manner enabling operators to completely operate system through a web browser via internet. Displays may also incorporate data from intranet, Internet, or ActiveX documents along with other building data.

.5 Launching External Applications

.1 It is to be possible to launch applications (such as Microsoft Word, Excel, custom help files or any 3rd party applications) from a custom display. If supported by application, it is to be possible to launch application with a specified file opened within launched application. Launching of such applications is to be possible from operator workstation pull down menus or from a push button on a custom display.

2.10 MONITORING AND CONTROL

.1 System is to support acquisition of data using following techniques:

.1 periodic scanning;

.2 report by exception;

.3 data on demand.

.2 In order to minimize communications traffic, system is to automatically group together data requests using contiguous addresses and scan intervals to generate scan packets, optimizing throughput for a given scanning load. System is to provide utilities to examine scan packet allocation for each scan interval, and compile aggregate statistics on communication link usage.

.3 Where supported by controlling device, use Report by Exception (RBE) protocols to reduce scanning load of system while improving system response. If necessary, periodic scanning may be used in conjunction with RBE to ensure data integrity.

.4 Device Control

.1 Communicate control transactions issued by operator to control devices using a write followed by read to ensure integrity of transaction. If read following write to device indicates control action has failed, inform operator by means of a control failure alarm. Priority of control failure alarm is to be configurable by user.

.2 Include option to assign a control confirmation message to individual points. Message is to request operator confirm requested supervisory control action prior to sending entered value to controller.

2.11 SYSTEM DATABASE

.1 System is to provide a real-time database incorporating data from analogue, logical or pulse inputs. Database is to be configurable by end user without need for any programming and able to be modified on-line without interrupting operation of system. In addition to point-based information, database is to provide historization capabilities for analogue, digital, pulse and event based information. Information is to be accessible by all facilities of system such as custom displays, reports, trends, user written applications, etc.

.2 Database Structure

.1 Real-time database is to support collection of data and storage using following structures:

.1 access point structures;

.2 analog point structures;

.3 status point structures;

.4 accumulator point structures;

.5 flexible point structures;

.6 historical data structures;

.7 event data structures;

.8 user defined structures.

.2 Point database structures are to be comprised as a composite point with a number of associated parameters, which may be referenced relative to a single tag name. Specifically, each of these parameters are to be accessible by various sub-systems such as graphical operator interface, report generation system and application program interface in a simple POINT.PARAMETER format without the need to know any internal storage mechanism.

.3 System is to maintain portions of database requiring frequent high-speed access as memory resident information and other less frequently accessed data as disk resident data. Memory resident data is to be checkpoint to disk every minute to minimize loss of data in the event of loss of power or other system failure.

.4 Database backup is to be possible with system on-line, including backup of historical based data, via standard Microsoft Windows operating system utilities.

.5 Store point data in a composite point database structure that provides a wide range of configurable information including but not limited to:

.1 point name and description;

.2 multiple locations for data storage and device scanning addresses;

.3 scan period;

.4 multiple types and instances of alarms;

.5 multiple deadband or hysteresis settings (analog points);

.6 monitoring and control access restriction information;

.7 location of operator alarm handling instructions;

.8 location of ancillary information associated with the point;

.9 list of recent events pertaining to that point.

.6 Points are to display all recent events on their point detail displays, using a direct link to BAS event system.

.7 BAS system is to provide a means by which a number of alarm inputs, outputs and other related points can be grouped together for more convenient monitoring and control without need for custom graphics.

2.12 HISTORY MANAGEMENT

.1 Collection of historical point data is to be configurable as part of point definition. Once configured, historical data is to be collected automatically. Historical data collection is to be provided for both snapshots and averages with intervals ranging from 1 second to 24 hours.

.2 Once assigned to history, point data is to be available by POINT.PARAMETER access used in conjunction with a history offset to locate particular value of interest. Graphical operator interface, trend, report generation and application interfaces are to be able to access historical data.

.3 Modifications to history collection of a point is to be possible on-line without loss of previously collected data for point being changed or any other points in system currently being historized.

.4 History is to be easily configurable to be archived to an alternative file system or offline media. Different archive settings are to be available for different history types.

2.13 TRENDING

.1 System is to provide flexible trending allowing real-time, historical or archived data to be trended in a variety of formats. Include ability to combine trend data types to allow for comparisons between data e.g. current real-time data versus archived data. In addition, event database information is to be available for comparison and analysis purposes in same display and allow filtering of event data display based on time and location.

.1 Trend is to support annotations with system events within one display window, allowing operators to view historical plant information in a real time window with system events. Include support for filtering events by location and other standard filters available within event management system.

.2 Trend Types

.1 Present real-time, historical or archived data in a variety of formats, including single, dual and multiple value trends of up to 32 points.

.2 Allow operator to display trend data in multiple different views.

.3 Operators are to be able to zoom in on information displayed on trend sets for closer inspection by dragging out an area of interest with mouse or other pointing device.

.4 Scroll bars as well as time selectors for direct entry of beginning and ending times are to be available to move trend set backwards and forwards across historical records.

.5 It is to be possible to embed trend objects as part of custom displays in multiple formats.

2.14 EVENT MANAGEMENT

.1 As a standard function, BAS is to log events automatically into a relational database. Journal is to contain following event information:

.1 alarms;

.2 alarm acknowledgements;

.3 return to normal;

.4 operator control actions;

.5 operator login and security level changes;

.6 on-line database modifications;

.7 communications alarms;

.8 system restart messages;

.9 database changes.

.2 Event database entries are to contain following information as a minimum:

.1 time and date stamp;

.2 database partition code;

.3 source;

.4 operator;

.5 event type;

.6 condition;

.7 action;

.8 alarm priority;

.9 description;

.10 value;

.11 engineering units;

.12 comments.

.3 Events may be sorted by time and date, database partition or source of event. It is to be possible to apply filters to list of events to limit view of events to those which match filter. Filters may include multiple dimensions and wildcards and also able to be saved and restored for reuse.

.4 Event management system is to be fully integrated with standard reporting system. System is to automatically reference restored archive file if a report is requested containing a time search window covered by current archive file.

.5 Operator is to be able to restore previously archived files and review or print them from operator workstations.

.6 It is to be possible to directly generate an event report from event database filtered online without using reporting system.

2.15 ALARM MANAGEMENT

.1 BAS is to support several different types of alarms for analogue points, including:

.1 high alarm;

.2 high-high alarm;

.3 low alarms;

.4 low-low alarm;

.5 deviation high alarm;

.6 deviation low alarm;

.7 rate of change alarm;

.8 unreasonable value alarm.

.2 Any of these alarms are to be assignable to each analogue or accumulator point on an individual point basis as part of point configuration process.

.3 Status points are to allow each individual state to be alarmed.

.4 Alarm Priorities

.1 Each monitored point in system is to be able to be assigned one of 4 alarm priorities to individual states. Meaning of priorities are as follows:

.1 Journal - Changes of state are journalized to alarm/event log and optionally printed on alarm/event printer.

.2 Low - Change of state will generate a low priority alarm, which will appear on alarm summary. Optionally, alarm may be printed on alarm/event printer or generate an audible tone.

.3 High - Change of state will generate a high priority alarm, which will appear on alarm summary. Optionally, alarm may be printed on alarm/event printer or generate an audible tone.

.4 Urgent - This is highest priority. Change of state will generate an urgent priority alarm, which will appear on alarm summary. Optionally, alarm may be printed on alarm/event printer or generate an audible tone.

.5 Alarm Enunciation

.1 Alarms are to be enunciated by:

.1 most recent, highest priority alarm message appearing on dedicated alarm banner on operator interface;

.2 alarm message appearing on alarm summary display;

.3 available tone based on a "*.wav" or other sound file for each alarm priority;

.4 alarm message printed on alarm printer;

.5 alarm indicator flashing on operator interface.

.2 Indicate alarm conditions in a clear unambiguous manner, and indicate unacknowledged alarms differently to acknowledged alarms.

.3 Enunciate alarms at operator workstation even if there is no operator currently signed-on.

.4 Points are to be enunciated while in alarm. If a point is set to alarm inhibited, point is to no longer cause annunciation. If a point goes into an alarm state whilst inhibited and then is still in alarm state when point is set to alarm enabled, point is to immediately cause annunciation.

.6 Alarm Processing

.1 Assigning an alarm to point is to automatically cause system to perform following actions when an alarm occurs:

.1 alarm is to be time stamped to nearest second and logged in event database with point name (source), alarm type, alarm priority, point description, new value and engineering units;

.2 point value which is in alarm is to turn red (or other configurable colour) and flash on any standard or custom display which uses that point;

.3 unacknowledged alarm entry is to be made in system alarm summary for low, high and urgent alarms;

.4 audible alarm is to sound (if configured);

.5 alarm annunciation indicator is to flash synchronously on all displays.

.2 In addition, alarm banner of operator interface is to show most recent (or optionally oldest), highest priority, unacknowledged alarm in system.

.7 Alarm Summary

.1 Shows current or pending alarms on system including following requirements:

.1 standard summary display requiring no engineering to setup and commission;

.2 support filtering by time and date, database partition or source of alarm;

.3 capable of displaying a summary of current alarms by location as well as highest priority alarm within corresponding location, and ability to be filtered based on selected locations from location pane;

.4 recurring alarm counter:

.1 support a simple method to reconcile recurring alarms into a common alarm message preventing nuisance alarms from flooding alarm summary display;

.2 when same alarm from a plant device recurs, alarm display is to use a counter to represent how many times this alarm has occurred since last acknowledged;

.3 alarm consolidation is to minimize alarm messages for operator, but BAS will always track each new alarm into event subsystem thereby ensuring alarms are present regardless of how often they have recurred.

.8 Dedicated Alarm Banner and Alarm Indicator

.1 Dedicated alarm banner is to appear on all displays showing either most recent or oldest (configurable), highest priority, unacknowledged alarm in system. This banner is to be clear when there are no unacknowledged alarms for operator to process.

.2 Alarm indicator is to also appear on all displays. This indicator will flash red (or another configured colour) when there are any unacknowledged alarms pending in system. This indicator will remain solid red if there are alarms, which have not returned to normal but which have been acknowledged. Indicator will be clear if there are no points in an alarm condition.

.9 Alarm Logging

.1 As well as being logged on printer, alarms are to be logged to an event file for future retrieval in alarm reports or archived to removable media.

.10 Alarm Response Function Keys

.1 Following dedicated function keys are to be provided on keyboard for alarm action:

.1 Acknowledge - After moving cursor to point in alarm on screen and selecting point, operator is to be able to acknowledge an alarm by pressing this key. This action is to be logged in event file and on printer showing operator ID with alarm.

.2 Alarm Summary - By pressing a dedicated key at any time operator is to be able to view a display showing currently active alarms. Alarm messages are to be colour-coded showing priorities. Operator is to be able to view alarms according to priority or sorted based on other fields. It is to be possible to acknowledge alarms from this display and also go to associated display defined for point.

.3 Associated Display - After moving cursor to point in alarm on screen and selecting point, operator is to be able to bring up display applicable to that alarm by pressing this key. Just selecting associated display key directly will bring up associated display for point currently on alarm banner. This is generally a custom graphic showing location of alarm in facility.

.11 Alarm Acknowledgement

.1 On acknowledgement by operator, flashing indicator is to turn steady, and point value is to remain coloured with alarm priority colour, on any system or custom graphic. Acknowledgement is to also be logged in event database identifying operator or station that acknowledged alarm. If point goes out of alarm before being acknowledged by operator, alarm is to be shown by a different indication and remain in list until specifically acknowledged by operator. If a point is not acknowledged within a configurable period of time, then an additional alarm can be generated and reassigned to another location to allow other operators to take action.

.12 Alarm Filtering

.1 Alarm summary is to be able to filter alarms displayed to operator by limiting view of alarms to those that match filter. Include use of columns on alarm summary as part of a filter allowing sophisticated filters to be configured e.g. alarms from this particular point, with this value, during this period. Filters may include multiple dimensions and wildcards. Filters are to be able to be saved and restored so previously configured filters can be reused. It should also be obvious to operators when a filter has been applied to alarm summary.

.13 Alarm Link to Digital Video Recordings

.1 System is to allow linking and display of digital video recordings pertaining to alarms. If there is any video footage in digital format which is relevant to an alarm, then alarm summary is to indicate this by use of a special icon on alarm. By selecting icon, operator can then replay relevant digital video footage of alarm incident.

.14 Print Alarms as a Report

.1 Filtered alarm summary should be able to be printed directly as a report. From alarm summary page, it is to be possible to view current filtered list of alarms via a print preview button. This shows what alarms will look like when printed to configured report printer. From alarm summary, it is to be possible to print alarms directly using print button.

.15 Additional Alarm Information

.1 BAS system is to provide support for an additional message to be tagged to alarm. This message is to provide operator with additional information on alarm but is to not clutter alarm summary. It is to appear in a separate message summary at same time as alarm appears in alarm summary. Messages can be pre-configured and then simply attached to individual points by means of a message ID.

.16 Advanced Alarm Management

.1 BAS is to be capable of advanced alarm management, which includes set stages of alarm handling. Stages are to be:

.1 silence alarm condition;

.2 acknowledge and action alarm condition;

.3 respond to alarm condition by using pre-defined responses;

.4 optionally reset alarm.

.2 Record actions in event file for retrieval and auditing purposes.

.3 When an alarm is silenced, an instruction page for alarm will be displayed. Alarm may then be acknowledged from this page and alarm handling action completed.

.4 Once alarm is acknowledged and appropriate action has been taken, operator may move to response page to select from up to 100 user-defined responses to be logged in event file. Alternatively, operator is to be able to enter their own response, which will also be logged in event file. At same time, alarm is removed from alarm file. Optionally, point is to remain on alarm summary until a manual reset operation is performed.

.5 It is to be possible to enable/disable this feature on a point-by-point basis given appropriate system privilege level.

2.16 REPORTING

.1 Support a flexible reporting package to allow easy generation of report data. Reports provided are to include pre-configured standard reports for common requirements such as alarm event reports and custom report generation facilities configurable by user.

.2 Reports are to be activated in one or more of following ways:

.1 periodic activation at user specified intervals;

.2 operator demanded;

.3 event initiated e.g. change in point value;

.4 application initiated;

.5 printed directly from the alarm/event summary.

.3 Standard Reports

.1 Various pre-formatted reports are to be available on system.

.2 Configuration of these reports only require entry of schedule information, and other parameters such as point name or wildcard, filter information, time interval for search and destination printer to fully configure report. Specifically, no programming or scripting is required.

.4 Access Level Report

.1 Lists access levels matching a specified search criteria filtered by zones and allocated time periods.

.5 After Hours Report

.1 Produces a summary of alarms occurring during period specified by operator as "after hours".

.6 Alarm/Event Report

.1 Produces a summary of events of a specified type for nominated points occurring in a time period. Time period may be specified as an absolute start and end date and time, or as a period relative to current time. This report is to also be able to produce a summary of changes made by a specific operator.

.7 Alarm/Event SQL Reporting Services Report

.1 This sample report lists a summary of alarms and events by location and by date and time. It includes a graphic summary.

.8 All Points Report

.1 Produces a list of point information, including point name, description, point type, engineering units, and current values. Report configuration is to allow filtering based on a wide variety of criteria.

.9 Operator Trail Report

.1 Produces a summary of operator actions relating to a specific operator in a specified period.

.10 Point Trail Report

.1 Produces a summary of events of a specified type occurring in a period on nominated points.

.11 Point Attribute Report

.1 Report is to be provided to points selected by one of following attribute criteria:

.1 out-of-service;

.2 alarm suppressed;

.3 abnormal input levels;

.4 in manual mode.

.12 Point State Changes Report

.1 Lists information about time periods matching specified search criteria.

.13 Time Period Report

.1 Lists information about time periods matching specified search criteria.

2.17 CUSTOM REPORTS

.1 In addition to standard reports, configurable report generation facilities are provided allowing custom reports to be produced. They can be configured at any time with system online, and are able to access any database values. At least 3 methods of custom report generation are to be available.

.1 Microsoft Excel report;

.2 ODBC format for purpose of extracting data and creating custom reports. It is to be possible to access tables of data from BAS through an ODBC compliant tool such as Crystal Reports or SQL Server.

.3 SQL Reporting Services custom report.

2.18 USER DEFINABLE DATABASE

.1 In order to support other types of data such as user entered or calculated data from application programs, system is to provide a user definable database area that can be fully integrated into system. Data contained in this database is to be accessible by:

.1 custom graphics;

.2 custom reports;

.3 application programs;

.4 network applications using a Network API.

2.19 POINT INITIATED PROGRAMS (PIPS)

.1 In addition to standard point processing functions, system is to allow additional processing through use of standard PIPS that may be attached to any points.

.2 PIPs are to be either configurable standard algorithms, or preference is a VBscript can be written as a library function and attached to points within BAS.

2.20 HISTORICAL DATA ARCHIVING

.1 Support archiving of historical data allowing a continuous record of history to be built up over a period of time. Archived data may be stored on hard disk of system or a remote network drive or moved off-line to removable media such as DAT tape, or optical disk. Number of archives maintained on system before being transferred to off-line media is to only be limited by size of hard disk or remote network drive. Allow user to define specific intervals of history to be archived to avoid archiving of unnecessary data.

.2 Once archived, data is to be available for re-trending through system trend facilities in combination with current on-line history or other archives. Providing archived history is present on BAS server's hard disk or remote network drive, trend facilities are to be able to access it transparently for display, when a user scrolls beyond current on-line history limits.

.3 Support display of trend data from up to 10 years of age. Any required upgrades or updates to BAS system is to be capable of preserving historical information to enable review of data from any earlier release of system.

2.21 TIME SCHEDULES

.1 Include ability to specify time schedules for control of BAS points and control a range of a single point to a large number of points from a single schedule. Single time schedule is to define control to any combination of day and time.

.2 Scheduling management system is to be more flexible than providing weekly schedules with a provision for a finite number of special occasions/holidays, allowing schedules to be entered that recur on a non-weekly basis or only occur once on a given day in future.

.3 Time schedule is to provide ability to override normal schedule for holidays or special occasions, and user is able to create multiple different grouping of dates (Calendars) that can be assigned to individual points as applicable.

.4 Configuring time schedules is performed through a graphical user interface whereby operator selects appropriate time span from calendar. Systems where times and days are manually entered or managed by an external spreadsheet type form are not acceptable. User interface is to support capability of navigating to any future date to allow user to enter a time schedule. User interface is to provide graphical feedback to indicate various time schedule conditions.

.5 Allow user to view time schedules that have been configured in past, present, and future in a graphical calendar interface, and increase or decrease amount of time on a schedule which is currently active.

.6 Where control device supports an internal time schedule program, BAS is to upload, display, modify and download control device time schedules. Support for control device time schedules are to be in addition to BAS time schedules.

2.22 CONTROLLER SCHEDULING TOOL

.1 Ability to create, edit and maintain controller time schedules. Controller scheduling tool constructed in a way that allows compatibility with new controller types with minimal additional development.

.2 Allow downloading of schedules to several (supported) controllers in a single operation by provision of an integrated graphical interface.

.3 Include a clear, graphical indication of status of each downloadable schedule element, and automatically recover and complete any schedule download which, for any reason, has failed or been interrupted.

2.23 OPEN INTEGRATION

.1 Any of following Open Protocol Standards is to be used as necessary for integration of 3rd party devices or systems.

.2 Modbus

.1 Include an integrated interface to devices using Modbus RTU protocol, where BAS server is to be 'master' and external device or system is to be "slave".

.2 Support user definable data formats for Modbus devices to accommodate wide variety of formats in use in industry.

.3 BACnet (ANSI/ASHRAE 135)

.1 Capable of communicating to other building subsystems using ASHRAE standard BACnet, and capable of acting as both a BACnet operator workstation and a BACnet gateway and support various standard BACnet objects.

.4 BACnet Operator Workstation

.1 Integrated BACnet operator workstation allowing monitoring of BACnet devices via data acquisition and control.

.2 BACnet operator workstation is to support various BACnet Interoperability Building Blocks.

.5 BACnet Gateway

.1 Integrated BACnet gateway allowing 3rd party BACnet clients to access data.

.2 BACnet gateway is to support various BACnet Interoperability Building Blocks.

.6 OLE for Process Control (OPC)

.1 Include an integrated OPC Client, integrated OPC Data Access Server, and OPC Alarm and Event Server.

.7 Data Exchange

.1 Capability to interface to point database of other BAS systems (i.e. nodes) on a TCP/IP network enabling both acquiring of point data and issuing control outputs to and from connected BAS systems.

.8 Data Exchange with Microsoft Excel

.1 Capable of exporting bulk data to Microsoft Excel.

2.24 PAGING AND EXTERNAL ANNUNCIATION OF SYSTEM ALARMS

.1 Include a facility for sending alarm text from configured points to following external systems:

.1 alphanumeric pagers;

.2 mobile phones with text message (SMS) support;

.3 email;

.4 SNMP message.

.2 Each point's paging priority threshold is individually configurable, and individually enabled or disabled. Each external device configured in system is to have individually selectable times and days of operation, an alarm priority threshold, and an alternative device for use in escalation of unacknowledged alarms.

2.25 ACKNOWLEDGMENT OF REMOTE ALARMS RECEIVED FROM PAGING SYSTEM

.1 For alarms received on mobile phones via SMS message, include ability to allow acknowledgement of these alarms via same SMS solution allowing remote users to clear alarm status thereby indicating alarm status has been received and acknowledged.

2.26 DATABASE CONFIGURATION TOOL

.1 Database configuration tool, provided with BAS system, allowing configuration of point records, printers, controllers, and operator workstation connections. Utility is to be in the form of a relational database and operate in a true 64-bit graphical environment such as Windows Server of version recommended by manufacturer. Utility is to also have ability to export information to and import information from Microsoft applications such as Microsoft Excel.

.2 Users with sufficient security access are to be able to configure database while system is on-line.

.3 Ability to modify a range of communications and other parameters for each device.

.4 Include features that reduce configuration time of BAS system. These features are to include adding multiple points, controllers etc. at once.

.5 Support free format text fields, which user can use for additional information such as cabinet or wire numbers. These additional fields are to be simple extensions to existing items in database such as BAS points.

.6 Database management reports are to be provided by utility as standard. Utility is to also provide support for ad-hoc reporting facilities for engineering use.

2.27 SERVER SCRIPTING ENGINE

.1 Ability to extend its functionality easily by addition of small script code to certain server functions enabling additional customer specific functionality to be easily added to point, report and server processing. For example, a script is to enable a calculation to be performed and a number of points to be controlled based on another point going into alarm state. Scripts have ability to be attached to point processing, report generation, server start-up and shutdown, or executed on a periodic basis.

2.28 DIAGNOSTIC CAPABILITIES

.1 Ability to perform easy diagnostics to check health of system.

.2 Make diagnostic information viewable through an easy-to-use user interface and easily exported as a standalone collection of material for later analysis.

.3 Capabilities are to include: ability to run automated tests, record reproduction of a failure, as well as collection and organization of available diagnostic information (files, logs, and system settings).

2.29 WIRING MATERIALS

.1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in the appropriate Section(s) of the Electrical Work Division of the Specification.

2.30 ENCLOSURES

.1 NEMA rated appropriate for location of equipment, for BAS components including controllers, sensors and other devices except space sensors. Refer to Section entitled Automatic Control Systems for additional requirements regarding local control panels.

3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

.1 Provide a complete building automation system in accordance with requirements of this Section, Section entitled Automatic Control Systems, drawings, and input/output points list(s).

.2 Install BAS components and materials in accordance with manufacturer's instructions. Where drawings conflict with these instructions, submit a written request for clarification.

.3 Coordinate installation with other trades to avoid field condition conflicts.

.4 Electrical products and execution are to comply with requirements of applicable Electrical Division Sections.

.5 Provide operator workstation in lower level mechanical room.

.6 Provide necessary quantities of NC's to meet project requirements and connect NC's together using a BACnet/IP network. Provide sufficient number of NC's to support number of FEC's.

.7 Comply with system manufacturer's instructions with regards to maximum number of devices to be connected to a power or control circuit.

.8 Connect operator interface PC installed on project site to BAS via BACnet/IP.

.9 Provide and connect FEC's to NC's via BACnet MS/TP.

.1 To minimize number of mechanical systems that would be inoperative in event of FEC failure, a maximum of 1 major mechanical system is to be controlled by one FEC. Major mechanical systems are as follows:

.1 ;

.2 .

.2 FEC's for equipment (e.g., VAV boxes, VFD's, etc.) are to be connected to same NC used to control associated equipment/system (i.e., AHU, chiller plant, etc.).

.3 Failure of a single controller is not to result in system-wide failure.

.10 Surface wall mount NC and FEC control units in Mechanical Rooms ensuring they are not mounted on vibrating surfaces, and connect to 15A-1P circuit breakers dedicated for control system applications, in branch panel circuit boards in adjacent spaces. Power wiring from control units to circuit breakers is to be responsibility of controls contractor. Wiring is to be in conduit, and conduit and wiring are to be in accordance with standards and requirements of Electrical Division work Sections. Refer to electrical drawings for locations of branch circuit panelboards with dedicated circuits for controls system applications.

.11 Extend and connect wiring in conduit from terminal unit box actuators and connect to 15A-1P circuit breakers dedicated for terminal unit box applications, in branch circuit panelboards in adjacent spaces. Wiring is to be in conduit, and conduits and wiring are to be in accordance with standards and requirements of Electrical Division. Refer to electrical drawings for locations of branch circuit panelboards with dedicated circuits for controls system applications. No more than 15 terminal unit box circuits are to be connected to one dedicated circuit breaker.

.12 Provide 120 volt/24 volt transformers as required for control devices.

.13 Submit schedule(s) of input/output points to Consultant for review. Directly connect each NC and FEC to point devices in accordance with control diagrams and schedule of miscellaneous control points as shown on drawings. Sensor wires for each analogue input are to be No. 18 AWG twisted shielded cable. Other types of wire required are to be as recommended by system supplier.

.14 Supply and turn over to Consultant prior to application for a Certificate of Substantial Performance of the Work, reports to be used in assisting Owner in defining and debugging DDC programs. These reports are to consist, as a minimum, of following:

.1 process control language (PCL) logs;

.2 control loop logs;

.3 PCL master point.

.15 Submit Point Data Input forms to Consultant that Owner will fill out with DDC system supplier's assistance. Input this point data into system.

.16 Contacts will be supplied as part of mechanical work or electrical work for alarm and status points for systems and equipment other than building environmental systems and equipment. Connect to DDC system in accordance with point schedule.

.17 Indicate via number, systems controlled by NC and FEC. Indicate via a Lamacoid label mounted inside panel the identification number of electrical panel supplying power to NC and FEC.

.18 Meet with Owner and provide required number of hours of field work dedicated to following:

.1 developing custom dashboards/graphics;

.2 setting up time schedules and optimal start/stop programs;

.3 setting up alarms including method for monitoring, annunciating and handling of alarms;

.4 setting up trends including establishing and storing trend information for systems as required;

.5 ensuring all demand limiting and energy conservation strategies are set up according to Owner's energy plan (if applicable).

.19 Software provided including software to program operator interface and field level controllers to be licensed to Owner. Provide copy of all software used to Owner.

.20 Graphics and programs to be property of Owner. Provide backup copies of all programs and graphics. Provide any tool sets required to edit graphics.

3.02 SUPPLY OF ACTUATORS AND CONTROLLERS FOR TERMINAL UNITS

.1 Supply required 24 volt actuators and controllers for terminal units.

.2 Deliver actuators and controllers to successful terminal unit manufacturer's factory.

.3 Coordinate delivery of product with General Contractor and successful terminal unit manufacturer.

3.03 IMPLEMENTATION OF ENERGY MANAGEMENT PROGRAMS

.1 Implement energy management programs indicated for building equipment and systems.

.2 Ensure energy management program adjustable parameters are accessible to and adjustable by building operations personnel at operator's workstation.

.3 Configure energy management programs so they may be enabled/disabled on an individual basis for each system to which they apply.

3.04 REDUNDANCY

.1 Provide equipment to perform redundancy requirements as described in Part 2 of this Section.

3.05 CONTROL WIRING AND COMMUNICATIONS CABLING

.1 Perform required control wiring work for control systems except:

.1 power wiring connections to equipment and panels, except as noted below;

.2 control wiring associated with mechanical plant equipment and systems whose control is not part of the work specified in this Section;

.3 starter interlock wiring.

.2 Install control wiring in EMT in exposed or concealed, inaccessible locations. ULC plenum rated FT6 cable is acceptable for concealed, accessible locations, neatly harnessed, secured and identified. Unless otherwise specified, final 600 mm (2') connection to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.

.3 Field devices provided with pig-tail wiring without any integral means of flexible metal raceway attachment are to be enclosed with a suitable means to allow for flexible metal raceway attachment.

.4 Install parallel to building lines, supported from structural members. Raceway or plenum wiring supported from or anchored to piping, duct supports (raceway only), ceiling suspension system (raceway only), or other electrical conduits is not acceptable.

.5 Use flexible metal raceway, not in excess of 0.9 m (3') in length, for termination of raceway on vibrating equipment. Support flexible metal raceway at each end.

.6 Use shielded wiring where recommended by manufacturer and install in accordance with manufacturer's instructions.

.7 Install communications wiring as continuous lengths with no splices between termination points.

.8 Provide Ethernet/IP communications wiring and devices (hubs, repeaters, etc.) for dedicated use by BAS.

.9 Wiring work is to be in accordance with BAS manufacturer's certified wiring schematics and instructions, and wiring standards specified in Electrical Division Specification.

.10 Provide control wiring for water meters, gas meters, etc., as applicable, and connect to BAS for meter data integration.

3.06 INSTALLATION OF ENCLOSURES

.1 Provide NEMA rated enclosures, and coordinate enclosure locations with other trades and show in submittals.

3.07 IDENTIFICATION AND LABELLING

.1 Refer to Section entitled Basic Mechanical Materials and Methods.

.2 Identify BAS equipment as follows:

.1 enclosures and other devices mounted in field: engraved laminated nameplates with lettering such as "BAS Panel CP2", or "BAS Relays", or "BAS E/P Transformers", with all wording listed and reviewed with Consultant prior to manufacture of nameplates;

.2 panel points: weatherproof input/output layout sheet for each controller with name of each point connected to controller, and associated wire labelling information;

.3 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings;

.4 interface components: weatherproof layout sheet clearly illustrating/identifying purpose of each component within enclosure such that an operator or service technician can quickly identify exact use of each relay, transducer, contactor, etc., with each sheet fastened securely to back of enclosure door.

3.08 SOFTWARE SET-UP, CONFIGURATION AND PROGRAMMING

.1 Provide data base entry, software configuration, initialization of trends and alarms, and custom application programming to meet this specification.

.2 Set-points, PID tuning parameters, control deadbands, operating differentials, reset schedules, etc. are to be adjustable by an operator without need for accessing/modifying custom control programming code.

.3 Coordinate number of users, user passwords and user authority profiles with Owner.

.4 Provide following control software in addition to that described in sequence of operation (where applicable):

.1 PID Control: Each control loop is to be controlled by a PID (proportional-integral-derivative) algorithm. Loop is to be tuned using P and I gains as a minimum.

.2 Reset: Unless otherwise noted, any set-point required to be reset is to use a cascaded PID loop or an "every x minutes increment/decrement by y" algorithm. Contractor to tune these reset loops to provide stable control.

.3 Anti-Short Cycling: AO and DO points are to be protected from short cycling allowing minimum on-time and off-time to be selected. Unless otherwise noted, motors are to be limited to 4 starts per hour (1 per hour for a chiller, 6 for cooling tower fans).

.4 Optimum Start: Air handlers that do not operate continuously are to be optimally started at latest possible time to meet occupied conditions at time of occupancy. Utilize space temperature inputs associated with air handler, along with outside air temperature. Algorithm is to include tuning parameters for adjusting influence of space and outside air temperature on start time.

.1 Warm-up Mode -Optimally started AHU is to operate in warm-up mode until occupancy. Outside air damper(s) close and return air dampers open. If AHU supplies multiple zones (e.g., VAV boxes), supply air temperature is to be space temperature set-point (adjustable).

.2 Night Setback - When not in occupied or warm-up modes an AHU is to cycle on to maintain a night setback temperature of 15°C (60°F) (adjustable) if AHU supplies a single zone or if zones that cannot provide heating without operation of AHU (pinch-down VAV boxes with reheat coils).

.5 Alarm Communications: BAS' alarm/event communications features are to be set up to automatically initiate IP-based alarm/event communications (i.e., to pagers, mobile phones, email, alarm printers, etc.) for selected alarms/events. Consult with Owner to determine what communications method(s) is required, communications devices involved, and what alarm conditions/priority/time-of-day are to initiate these communications.

.5 Graphic Screens:

.1 Provide custom-developed graphic screens for controls included in this project (including points/data specified for digital communication with "3rd party" controls). Screens are to include schematic representations of controlled and/or monitored systems/equipment, points and relevant set-points/parameters (consult with Owner for format and content), and floor plans with space sensing points represented.

.2 Prior to creation of graphic screens, meet with Owner to develop, for their approval, a list of screens to be provided, and, for each screen, a conceptual layout of graphics, points/data included, and linkages to other screens. Submit to Consultant for review.

.3 Provide operator workstation with a fully programmed operator interface software package. Provide a web-based graphical operator interface. Graphics to be provided as follows:

.1 Provide an overall building layout to include overview information related to scheduling and energy consumption of building.

.2 Provide floor plans for each floor or area. Operator to be able to switch between various floor plan views as applicable to obtain different information. In all views, floor plans are to provide navigational links to individual control systems. Various floor plans to include:

.1 thermal graphics;

.2 equipment location;

.3 lighting (if applicable);

.4 energy consumption (if applicable).

.3 Provide summary plans to permit a quick overview of facility operations. Individual summary plans are to be provided for:

.1 thermal comfort;

.2 equipment operation;

.3 energy consumption.

.4 Summary plan for thermal comfort is to utilize a 3 light system (green, yellow, red) to provide indication of temperature/humidity control in all areas on one graphic.

.5 Summary plan for equipment operation (major systems only) to include an indicator of equipment status (on or off) as well as a 3 light system (green, yellow, red) for alarms and an indicator if any system point if overridden.

.6 Provide individual graphics for each system. Individual graphics to include all I/O points for system, various control carousels as applicable for operator control of system and dynamic animated graphics (moving fans, dampers, etc.). Graphics will also contain links to all associated system for quick access to heating/cooling plants, air handling units, VFD's and/or pumping systems. Individual graphics to also contain energy consumption data where available as well as links to as-built shop drawings, sequences of operation and O&M manuals. All major system graphics will be composed of at least 2 graphics per system. First graphic will provide general information (all I/O, system enable, main set-points and alarms). Second graphic will provide all operator adjustable parameters in table format.

.6 Point names, schedules, and space temperature set-points are to be chosen to meet approval of Owner (even if specified herein). Submit to Consultant for review.

.7 Set up logs (including trended points/data, frequency and number of samples) and alarmed points (including alarm limits, alarm messages, alarm message destination email, phone, printer, etc. addresses; and alarm message transmission formats to be used) to meet approval of Owner (consult with Owner and review with Consultant).

.1 As a minimum system is to trend all process variables, setpoints, output devices and equipment statuses for each system.

.2 Trend intervals (adjustable) are as follows:

.1 space temperature/humidity – 15 minutes;

.2 duct sensor – 1 minute;

.3 pressure sensor – 1 minute;

.4 outdoor sensor – 15 minutes;

.5 actuators – 1 minute;

.6 binary I/O – on COV;

.7 setpoints – on COV or with reading as above.

.8 Only one NC's BACnet BBMD (broadcast messaging management) capability is to be enabled per IP subnet and configured with list of peer BBMD's and its subnet's devices.

.9 Duct static pressure set points for VAV air handling units are to be selected based on coordination with TAB agency to provide design air flows.

.10 Coordinate duct differential pressure high/low limit setting values with TAB agency.

.11 Pipe static pressure set points for variable pumping systems are to be initially selected based on scheduled pressure drop(s) of coils at which static pressure sensor(s) is installed. Final selection is to be based on coordination with TAB agency to provide design water flows.

3.09 DATA CONTROL (D/C) AND GRAPHICS SUMMARY

.1 Provide hardware, custom software, application software, graphics, etc., necessary to accomplish control sequences and display graphics specified. Provide controllers, inputs, outputs, valves, dampers, actuators and flow meters required to provide control and graphic data described. Provide software set-points required for display in logical groups and graphics.

.2 Each digital output is to have a software-associated monitored input. Any time monitored input does not track its associated command output within a programmable time interval, a "command failed" alarm is to be reported.

.3 Where calculated points (such as CFM) are shown, they are to appear in their respective logical groups.

.4 Unless otherwise specified or approved prior to bidding, primary analogue input and analogue output of each DDC loop is to be resident in a single remote panel containing DDC algorithm, and are to function independent of any primary or UC communication links. Secondary (reset type) analogue inputs may be received from primary network, but approved default values and/or procedures are to be substituted in DDC algorithm for this secondary input if network communications fail or if secondary input becomes erroneous or invalid.

.5 In addition to unitary DDC controller data points specified to be presented on colour graphic displays, technical data for each zone mechanical apparatus is to be presented to operators on operator workstation in full English menu text displays including:

.1 apparatus name;

.2 heating and cooling PID loop P, I and D gains;

.3 primary CFM airflow (if measured);

.4 damper position (% open);

.5 reheat status/value;

.6 cooling set-point;

.7 heating dead-band;

.8 minimum and maximum CFM set-points;

.9 reheat CFM set-point;

.10 unoccupied temperature set-point;

.11 temperature sensor calibration offset;

.12 bypass push button time, in minutes;

.13 smoke purge mode damper position;

.14 smoke pressurization mode damper position;

.15 smoke depressurization mode damper position;

.16 morning warm-up mode damper position.

.6 Such points are to be presented in complete and direct read-write (command) format, unless they are provided in commandable colour graphic displays.

.7 Following additional graphics are to be provided:

.1 facility layout (showing buildings, streets, etc.);

.2 individual area layouts or isometrics;

.3 any other graphics necessary for logical penetration;

.4 individual HVAC systems graphics;

.5 facility/area layouts including alarm icon indicating which room has alarm;

.6 alarms displayed in alarm console linked to facility/area layout graphics to show where on layout alarm has occurred;

.7 sequences of operation;

.8 supervisor graphics;

.9 system configuration.

.8 Graphic templates of each system and graphics page to be reviewed by Consultant and approved by Owner, prior to installation and start-up.

3.10 APPLICATION REQUIREMENTS

.1 Software - Microprocessor-based control system is to rely on software for non-critical interlocks and time delays. Where required by specifications, these functions are to be provided by separate thermostats, relays, and delay timers.

.2 Interlocks - Safety and other interlocks may require relays depending on specific devices being used. Some devices may require a special power supply as shown in wiring details. Safeties are to be hardwired into control circuit and also monitored by BAS.

.3 Sensors - Select duct insertion sensors to suit application. For large ducts, use sensors with longer probe lengths. For heating and cooling coil freeze protection, use a long capillary type sensor. For mixed air and coil discharge temperature sensing, use averaging capillary type sensors.

.4 Valves - Ensure actuators meet job requirements (i.e., control signal, close off, action, etc.). Control valves are to be selected to suit both medium and specified configuration (i.e., straight-thru, 3-way, screwed, flanged, etc.).

.5 Damper Actuators - Total number of actuators may vary depending on damper size. Consult actuator's application literature to determine sizing requirements and use no less than 30% of minimum number of actuators recommended.

.6 Graphics - System graphics are to include operator control panels to facilitate working with AHUs such as:

.1 Warm-up Panel is to permit operator to monitor status of warm-up mode (on or off), and to change set-point of warm-up temperature.

.2 Unoccupied Cycle control panel is to permit operator to monitor status of mode (occupied or unoccupied), and to change unoccupied periods set-points.

.3 Mixed Air Dampers control panel is to permit operator to monitor economizer mode (on or off), monitor damper position, and to change minimum position set-point.

.4 Optimum Start/Stop control panel is to permit operator to monitor and change optimum start/stop program parameters.

.5 Reset Schedule control panel is to permit operator to monitor and change reset schedule program parameters. It is not acceptable to monitor and change these modes of control in a manner other than that specified. Having to edit, compile and reload application programs to achieve monitoring and control of these modes is not acceptable.

.6 Provide text of control sequence so it may be displayed on operator screen by clicking on sequence control button on system graphic. Sequence will incorporate parameter values and set-points, and will update them dynamically as they change or are changed.

3.11 SYSTEM PERFORMANCE REQUIREMENTS

.1 Installed system is to conform to following minimum performance standards:

.1 Graphic with 20 dynamic points is to display current data within 10 seconds.

.2 Graphic with 20 dynamic points is to refresh every 15 seconds.

.3 Screens for tuning are to refresh every 6 seconds.

.4 Commands from operator interface to device are to take no longer than 5 seconds.

.5 Alarms are to annunciate at workstation within 45 seconds.

.6 Field level controllers are to execute PID loops at a response time suitable for application with capability of executing once per second.

.7 Loop stability:

.1 Space temperature to be maintained within ±1°C of set-point.

.2 Return air humidity to be maintained within ±5% RH of set-point.

.3 Duct pressure to be maintained within ±50 Pa of set-point.

.4 Fluid differential pressure to be maintained within ±250 Pa of set-point.

.5 Air volume to be maintained within ±10% of set-point.

3.12 SEQUENCES OF OPERATION AND BAS POINTS

.1 Refer to mechanical drawings for control diagrams and sequences.

.2 Points – Points as shown on mechanical drawings are to be considered minimum. Provide points and point types required to meet sequence of operation.

.3 DDC Sequence for Manually Started Equipment – Unless noted otherwise, when an operator starts main component (e.g., fan, boiler, chiller, etc.) of an HVAC system (e.g., AHU, hot water plant, chiller plant, etc.) by a manual method outside of BAS (e.g., a motor starter H-O-A), BAS will execute described system (based on sensing motor operation via status input).

.4 Safeties – Safety sequences for high or low temperature reactions are not to be implemented by "software interlocks". Automatic resets of safeties will not be accepted.

3.13 SYSTEM TESTING AND ACCEPTANCE

.1 Perform BAS acceptance testing in presence of Owner or Owner-designated representative. System is to not be considered substantially complete until testing is complete and accepted. Perform calibration, start-up and testing procedures necessary to assure completion of system acceptance testing prior to commencement of system acceptance tests.

.2 Point Tests

.1 Perform following tests for each point:

.1 Analog Input - Compare sensor reading to that of a calibrated portable measurement device.

.2 Binary Input - Manually actuate monitored equipment and compare actual state with that read by system.

.3 Analog Output - Through software, set output to 3 or more values across full range of actuation and compare with position of controlled device (or output signal for controlled device positions that cannot be visually observed).

.4 Binary Output - Through software, actuate output and compare control command with actual operation of controlled device.

.5 Data (from digital communications with "3rd party controls") - Perform above tests, though comparison (except for data representing binary outputs) between that provided at 3rd party controller display and BAS. Perform above "Binary Output" test for data that represents digital outputs.

.3 System Tests

.1 Perform following tests for sequences of operation:

.1 Demonstrate DDC loop response. Contractor is to supply trend data output in a graphical form showing step response of each DDC loop. Test is to show loop's response to a change in set-point, which represents a change of actuator position of at least 25% of its full range. Sampling rate of trend is to be from 10 seconds to 3 minutes, depending on speed of loop. For each sample, trend data is to show set-point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control is to require further tuning by Contractor.

.2 Simulate loop (i.e. change set-points) to verify reset schedules and temperature lockouts.

.3 Manually initiate system start-ups to verify interlocks and sequencing.

.4 Simulate safety device and fire alarm system contact actuation to verify emergency, alarm, and life safety sequences.

.5 Simulate day/night changeover to observe occupied, unoccupied, optimum start, and warm-up modes.

.6 Simulate seasonal changeovers to observe proper operation of heating and cooling modes.

.4 In addition, arrange for control system manufacturer to supply at site, qualified control system technicians to make adjustments to control systems to suit air and water balancing and testing.

3.14 CERTIFICATION, START-UP AND TRAINING

.1 Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system manufacturer certification requirements.

.2 Refer to Section entitled Basic Mechanical Materials and Methods for equipment/system start-up requirements.

.3 Include for demonstration and training sessions for each of 2 groups of Owner's operating and maintenance personnel as follows:

.1 3 full, 8 hour, day orientation sessions at system manufacturer's office to educate personnel on BAS architecture, hardware, and software, with an overview of BAS operation and capabilities including but not limited to operational programmes, equipment functions (both individually and as part of a total integrated system), BAS commands, advisories, alarms, and appropriate operator intervention required in responding to BAS operation;

.2 2 full, 8 hour, day sessions at site using BAS for a "hands-on" demonstration of all BAS functions and features with instruction regarding chronological flow of information from field devices, contacts and sensors to the operator's workstation, an overview of communications network describing interplay between initiating devices, field hardware panels, systems communications, and their importance within operating BAS, and alarm indications and appropriate responses;

.3 2 full, 8 hour, day seasonal (summer-winter) site sessions to perform additional instruction regarding seasonal changes and how they affect BAS.

.4 Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full, 8 hour, day to provide additional system training and troubleshooting as required.

3.15 PROJECT CLOSEOUT WORK

.1 Include following in as-built record drawings at a minimum:

.1 schematic outline of BAS for quick reference of overall system scope;

.2 adequate record of Work as installed, including its exact location and wiring and route;

.3 adequate record of existing controls retained and/or interfaced, including its exact location and wiring, tubing, etc., route.

.2 Include following in O&M manual at a minimum:

.1 as-built versions of manufacturer's product data with list of equipment supplied, including its make, model number, name of local suppliers and quantity;

.2 complete network architecture indicating all network addresses, communication protocols, controllers, controller locations, and equipment controller by each controller;

.3 maintenance information for all devices;

.4 operator's manual including detailed instructions for operations of BAS;

.5 programmer's manual including information necessary to perform programming functions;

.6 system hardware specification manual, which provides a functional description of all hardware components;

.7 system operator's manual which provides concise instructions for operation of the system and an explanation and recovery route for all system alarms;

.8 system engineering manual which provides information for system set-up, definition and application;

.9 complete project-specific graphic screens, custom sequence programming, system databases, parameter listings, etc. for equipment controlled under this phase of work (backed up to operator interface or web server and onto CD/DVD's);

.10 copy of warranty;

.11 operating and maintenance cautions and instructions;

.12 log-in requirements, information, and/or instructions (including any hardware key(s) or software licensing documentation) to allow Owner access (for both viewing and modification) to system set-up databases, custom programming, service software, etc. at highest user level provided by manufacturer;

.13 recommended spare parts list;

.14 original issue documentation and software DVD's/CD's (if applicable) for 3rd party hardware and software;

.15 completed BAS test forms/checklists.

3.16 CONTROLS CONTRACTOR'S RESPONSIBILITIES

.1 Comply with applicable responsibilities specified in this Section and below:

.1 provide and pull power wire to controllers;

.2 provide start-up, test procedures and O&M manual;

.3 provide print out and electronic copy of all points connected to BAS;

.4 provide detailed consolidated wiring diagram showing interface of BAS controls with packaged controls;

.5 responsible for component and point to point testing;

.6 responsible for sensor calibration and actuator adjustment;

.7 provide calibration procedure for each analogue sensor;

.8 operate systems during testing;

.9 provide training and instruction;

.10 responsible for acceptance test for a 21 day period;

.11 set-up trend logs and group logs which are to be stored on hard disk;

.12 re-visit site during first year of operation to review BAS performance as detailed in this Section in article entitled Certification, Start-Up and Training;

.13 any other controls requirements specified in Contract Documents.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA Group.

.1 CSA-C22.1-21, Canadian Electrical Code, Part 1 (28th Edition), Safety Standard for Electrical Installations.

.2 CAN/CSA-C22.3 No. 1-06, Overhead Systems.

.3 CAN3-C235-83(R2006), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics (IEEE) National Electrical Safety Code Product Line (NESC).

.1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.3 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 The Ontario Electrical Safety Code 2021, and all bulletins (Ontario).

.6 Hydro requirements and local applicable codes and regulations.

1.2 ACTION AND INTERNATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.

.2 Product Data: submit WHMIS MSDS in accordance with Section 01 47 15 and Section 02 61 33.

.3 Submit for review single line electrical diagrams in glazed frames and locate in electrical rooms.

.1 Electrical distribution system in main electrical room.

.2 Colour Code single line electrical diagrams as follows:

.1 Normal Power – Black

.4 Shop Drawings:

.1 Submit PDF shop drawings to inspection authorities.

.2 If changes are required, notify Consultant of these changes before they are made.

.5 Certificates: in accordance with Section 01 45 00.

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract. Pay associated fees. Consultant will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.

.5 Submit, upon completion of Work, load balance report as described in PART 3 - Load Balance.

.6 Submit certificate of acceptance from Electrical Inspection Department authority having jurisdiction upon completion of Work to Consultant.

1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Consultant with schedule within 2 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

1.5 SYSTEM STARTUP

.1 Instruct Consultant and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates for control items in English.

2.2 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15.

2.3 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Section 01 61 00.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - Submittals.

.3 Factory assemble control panels and component assemblies.

2.4 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Control wiring and conduit: in accordance with Section 26 29 03 except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.5 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of inspection authorities and Departmental Representative.

.2 Decal signs, minimum size 175 x 250 mm.

.3 Paint in yellow “KEEP CLEAR AT ALL TIMES” around electrical working space. In locations where this is not practical, high visibility labels shall be affixed to the equipment.

2.6 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

.2 All power cable terminations shall be compression fitting type such as Thomas & Betts 54100 Series, Burndy Hylugs, or Burndy UNITAP Multiple Tap Connector (Clear/insulated).

2.7 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, white face, black core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.

.2 Lamicoid 3mm thick plastic engraving sheet red face, white core, mechanically attached with self-tapping screws for essential and emergency power.

.3 Lamicoid wording to include name, location, fed from location, voltage and phasing and to be approved by Queen’s PPS – Electrical Engineering

.4 Nameplates: lamicoid 3 mm thick plastic engraving sheet, white face, black core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.

.5 Lamicoid 3mm thick plastic engraving sheet red face, white core, mechanically attached with self-tapping screws for essential and emergency power.

.6 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Wording on nameplates to be approved by Consultant and Queens PPS prior to manufacture. Wording for switchboards, panelboards, transformers and ATS's to include equipment name, source panel name and source panels room location.

.3 Allow for minimum of twenty-five (25) letters per nameplate.

.4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.5 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.6 Terminal cabinets and pull boxes: indicate system and voltage.

.7 Transformers: indicate capacity, primary and secondary voltages. Location of feed and destination.

.8 Receptacles on emergency power shall be coloured red.

.9 A sticker indicating the source panel and circuit number shall be placed on all receptacles.

2.8 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA-C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.9 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code by pre-painting couplings, connectors and boxes.

.3 Colours:

Service	Colour
up to 250 V	yellow
up to 600 V	brown
Telephone/lan	green
Public address/Intercom	purple
Cable television (CATV)	blue
Closed Circuit television (CCTV)	orange
Fire Alarm	red
Door Control	black

2.10 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green".

.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA-C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.4 Connection to equipment subject to vibration/movement (such as motors) shall be flexible conduit.

.5 Provide a separate (minimum #12 AWG) green insulated ground wire in all conduits and raceways.

3.4 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise:

.1 Local switches: 1200 mm.

.2 Wall receptacles:

.1 General: 300 mm

.2 Above top of continuous baseboard heater: 1200 mm

.3 Above top of counters or counter splash backs: 175 mm

.4 In mechanical rooms: 1500 mm

.3 Panelboards: as required by Code or as indicated.

.4 Telephone and interphone outlets: 300 mm.

.5 Wall mounted telephone and interphone outlets: 1200 mm.

.6 Fire alarm stations: 1200 mm.

.7 Fire alarm bells/strobes: 2100 mm.

.8 Television outlets: 300 mm.

.9 Doorbell pushbuttons: 1200 mm.

.10 Manual starters: 1500 mm.

.11 Isolating switches: 1500 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

.1 Load Balance

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests in accordance with Section 01 45 00:

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system, communications.

.6 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Carry out tests in presence of Consultant.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

.3 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.

.4 Remove construction materials from wiring devices, coverplates, outlets, cabinets, enclosures, tubs, etc.

3.9 FIREPROOFING

.1 Where cables or conduits pass through floors and fire rated walls proper firestopping for the specific construction shall be used.

3.10 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into operation and maintenance manuals specified in Section 01780.

.2 Include in operation and maintenance data:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.

.3 Wiring and schematic diagrams and performance curves.

.4 Names and addresses of local suppliers for items included in maintenance manuals.

.5 Copy of reviewed shop drawings.

.6 As-built drawings

.7 Inspection certificates such as ESA, FA verification reports and any other test reports.

.3 Provide one manual which includes data listed above. Provide a simplified operation instruction sheet for each system. (i.e. fire alarm, door control, intercom, public address CCTV, CATV, Telephone/Lan, etc.). Provide 1 hard copy and 1 electronic copy in .pdf format of all documents.,

3.11 TRIAL USAGE

.1 Power supply, distribution system and equipment may be put into service for trial usage provided such use will not damage equipment or void guarantees.

.2 Consultant may use equipment and systems for test purposes prior to acceptance.

.3 Provide labour and equipment required for testing.

3.12 AS-BUILT RECORDS

.1 As work progresses, maintain accurate records to show deviations from contract drawings. The Consultant will provide a set of clean white prints for this purpose.

3.13 MAINTENANCE SCHEDULE

.1 Provide information for a computerized maintenance schedule indicating regular maintenance checks, procedures and results for insertion into a computerized maintenance program at the site by maintenance personnel.

Manufacturer:
Voltage:
Phase:
Model:
Serial No.:
Etc.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18.4-15, Hardware for the Support of Conduit, Tubing and Cable.

.2 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.3 CSA C22.2 No.65-13, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA).

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Divert unused wiring materials from landfill to metal recycling facility as approved by Consultant.

Part 2 Products

2.1 MATERIALS

.1 All fixtures and Branch Circuit wiring joints, in junction and outlet boxes shall be made with CSA Certified Pressure Type connectors rated at 600 volts maximum (1,000 volts when enclosed in fixture or sign). Connector body shall consist of a cone-shaped coil spring insert, insulated with a colour-coded, flame-retardant shell which shall be knurled for easy grip and capable for use with an Electrician's Pliers.

.2 Fixture type splicing connectors to: CSA C22.2 No. 65, with current carrying parts of copper or copper alloy sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to NEMA to consist of:

.1 Connector body and stud clamp for stranded and round copper conductors.

.2 Clamp for stranded or round copper conductors.

.3 Clamp for stranded ACSR conductors.

.4 Study clamp bolts.

.5 Bolts for copper conductors.

.6 Sized for conductors as needed.

.4 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, or flexible conduit. As required to: CAN/CSA-C22 No. 18.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by Manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2 NEMA.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

.1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

.1 CSA C22.2 No .0.3-09(R2014), Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131-14, Type TECK 90 Cable.

1.3 PRODUCT DATA

.1 Provide product data in accordance with Section 01 33 00.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: remove for reuse and return of pallets, crates, paddling and packaging materials in accordance with Section 01 74 20.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 12 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 or 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE or RWU90 XLPE, Non-Jacketed and minimum #12 AWG.

2.2 TECK 90 CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131 and Section 26 05 00.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation:

.1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 or 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: flat interlocking aluminum.

.6 Overall covering: thermoplastic material.

.7 To CSA C22.2 No. 0.3 Vertical Tray Fire Test.

.8 Fastenings:

.1 'P' clamps on 'U' channels.

.2 Channel type supports for two or more cables at 900 mm centers.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.9 Connectors:

.1 Watertight approved for TECK cable.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90.

.3 Armour: interlocking type fabricated from aluminum strip.

.4 Type: ACWU90 flame retardant jacket over thermoplastic armour and meeting requirements of vertical tray fire test of CSA C22.2 0.3 with maximum flame travel of 1.2 m.

.5 Connectors: anti short connectors.

.6 Armoured cable with aluminum strip/sheath to have 1000V insulation.

2.4 CONTROL CABLES

.1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:

.1 Insulation: thermoplastic.

.2 Sheath: thermoplastic jacket.

.2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:

.1 Insulation: TWH.

.2 Shielding: tape coated with paramagnetic material wire over each conductor.

.3 Overall covering: polyethylene jackets.

.3 Type: 600 V stranded annealed copper conductors, sizes as indicated:

.1 Insulation: RW90 (x-link).

.2 Shielding: non-magnetic tape over each conductor.

.3 Overall covering: thermosetting jackets

2.5 MINERAL-INSULATED CABLES

.1 Conductors: solid bare soft-annealed copper, size as indicated.

.2 Insulation: compressed powdered magnesium oxide or silicon dioxide to form compact homogeneous mass throughout entire length of cable.

.3 Outer covering: annealed seamless copper sheath, Type M1 rated 600 V, 250 degrees C and Type LWMI rated 300 V, 250 degrees C.

.4 Two hour fire rating.

.5 Connectors: watertight, field installed and approved for MI cable.

.6 Termination kits: field installed and approved for MI cable

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Install cable in trenches in accordance with Section 33 71 73.02.

.2 Lay cable in cable trays in accordance with Section 26 05 36.

.3 Terminate cables in accordance with Section 26 05 20.

.4 Cable Colour Coding: to Section 26 05 00.

.5 Conductor length for parallel feeders to be identical.

.6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.7 Wiring in plenums: Wire shall be installed in conduit drops to fixtures shall be AC90, maximum length 3 metres. Wiring AC90 shall not be used to loop feed from fixture to fixture.

.8 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.9 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.10 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34.

.2 In underground ducts in accordance with Section 33 and section 26 05 43.01.

3.4 INSTALLATION OF TECK 90 CABLE (0-1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable exposed, securely supported by straps.

3.5 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible on channels.

.2 Install AC90 armoured cable from junction boxes located in main EMT runs in all accessible T-Bar ceilings, mechanical and electrical rooms with no ceilings to lights. Maximum length 3.0 meters.

3.6 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit and cable troughs.

.2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International).

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required.

.2 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.

.3 Insulated grounding conductors: green, type RW90.

.4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Bonding jumpers, straps.

.5 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where PVC, EMT and flexible conduit is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.8 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.9 Bond gas main, incoming telephone cable TV service, LAN, main communications and sub closets with #6 bond wire.

3.2 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of secondary 120/208 V system.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators and distribution panels.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Engineer.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with epoxy anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with expandable inserts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.14 Provide channels for mounting of conduit, wiring and devices on walls of basements, mechanical rooms and attics.

.15 Provide spacers to prevent direct contact between 'U' channels and concrete.

.16 File rough edges of cut 'U' channels and paint with galvanized paint.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1-21, Canadian Electrical Code, Part 1, 28th Edition.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide Shop Drawings: in accordance with Section 01 33 00.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal.

.2 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

.1 Construction: welded steel enclosure.

.2 Covers Flush Mounted: 25 mm minimum extension all around.

.3 Covers Surface Mounted: screw-on flat covers.

.4 Cast junction and pull boxes in basements and attics.

2.2 CABINETS

.1 Construction: welded sheet steel hinged door, latch and catch.

.2 Type E Empty: flush overlapping sides mounting as indicated.

.3 Type T Terminal: flush overlapping sides mounting as indicated containing 19 mm G1S plywood backboard

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

.3 Install terminal block as required in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install additional pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.2 IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00.

.2 Identification Labels: size 2 indicating system name voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA-C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.

.2 CAN/CSA-C22.2 NO. 18.1-13, Metallic Outlet Boxes.

.3 CAN/CSA-C22.2 NO. 18.2-06(R2016), Non-metallic Outlet Boxes.

.4 CSA C22.2 No. 45-M1981 (R2003), Rigid Metal Conduit.

.5 CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.6 CSA C22.2 No. 83-07(R2017), Electrical Metallic Tubing.

.7 CSA C22.2 No. 211.2-06(R2016), Rigid PVC (Un-plasticized) Conduit

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.

.3 Quality assurance submittals:

.1 Instructions: submit manufacturer's installation instructions.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children Products.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.

.2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with expanded ends.

.3 Rigid PVC conduit: to CSA C22.2 No. 211.2.

.4 Flexible metal conduit: to CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

.1 One-hole steel straps to secure surface conduits NPS 2 50 mm and smaller.

.1 Two-hole steel straps for conduits larger than NPS 2 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.2 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for NPS 1 27 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.

.1 Set-screws are not acceptable.

.4 Steel coupling for life safety systems. Eg. Fire alarm, exit and emergency lighting.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fitting with internal bonding assembly suitable for linear expansion as per Ontario Electrical Safety Code 2018, 27th Edition, Section 12.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in basements, mechanical and electrical service rooms and in unfinished areas such as attics.

.3 Use electrical metallic tubing (EMT) conduit for surface mounting except where specified elsewhere.

.4 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m, under slab and in inaccessible ceilings.

.5 Use rigid PVC conduit underground.

.6 Use flexible metal conduit for connection to motors in dry areas, transformers, connection to surface or recessed fixtures.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.8 Minimum conduit size for lighting and power circuits: 21 mm.

.9 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.10 Mechanically bend steel conduit over 21 mm diameter.

.11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.12 Install fish cord in empty conduits.

.13 Run three 27 mm spare conduits up to accessible ceiling space and two 25 mm spare conduits down to accessible ceiling space from each flush panel.

.1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.

.14 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.15 Dry conduits out before installing wire.

.16 Use electrical non-metallic tubing (ENT) conduit embedded in concrete.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel.

.1 Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.

.1 Use cold mastic between sleeve and conduit.

.5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 27 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Run conduits 27 mm and larger below slab and encase in 75 mm concrete envelope.

.1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.8 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

.1 CSA Group (CSA)
  .1 CSA C22.2 No.26-(R2009), Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

1.02 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for wireways and include product characteristics, performance criteria, physical size, finish and limitations.

1.03 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for wireways for incorporation into manual.

1.04 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
  .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store and protect wireways from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 WIREWAYS

.1 Wireways and fittings: to CSA C22.2 No.26.

.2 60063 T6 Aluminum Alloy with clip-on cover to give uninterrupted access.

.3 Finish: baked grey enamel in accordance with Section 26 05 00 - Common Work Results for Electrical.

.4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

3 EXECUTION

3.01 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wireways and auxiliary gutters installation in accordance with manufacturer's written instructions.
   .1 Visually inspect substrate in presence of Consultant.
   .2 Consultant of unacceptable conditions immediately upon discovery.
   .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.02 INSTALLATION

.1 Install wireways in accordance with manufacturer's written recommendations.

.2 Keep number of elbows, offsets, connections to minimum.

.3 Install supports, elbows, tees, connectors, fittings.

.4 Install dividing barrier in all wireways.

.5 Install gutter to full length of equipment.

.6 Ground metallic wireways and gutters as required.

3.03 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
   .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

.1 Section 06 10 00.01 - Rough Carpentry - Short Form: Plywood Backboard.

.2 Section 26 05 00 - Common Work Results - Electrical.

.3 Section 26 28 21 - Moulded Case Circuit Breakers.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 29-2015, Panelboards and Enclosed Panelboards.

1.4 SHOP DRAWINGS

.1 Submit Shop Drawings in accordance with Section 01 33 00.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 250 or 600 V panelboards: bus and breakers rated for 10000 A (symmetrical) interrupting capacity or as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Two keys for each panelboard and key panelboards alike.

.6 Copper bus with neutral of same ampere rating as mains.

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

.9 Trim tub and door finish: baked grey enamel.

.10 Arc flash labels for new panels LP-1G and LP-1P.

.11 Acceptable manufacturers: Schneider (Square D), Siemens, Eaton (Cutler-Hammer).

2.2 CUSTOM BUILT PANELBOARD ASSEMBLIES

.1 Feed through lugs as indicated.

2.3 BREAKERS

.1 Breakers: to Section 26 28 21.

.2 Bolt-on Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for receptacles, fire alarm, emergency, door supervisory, intercom, stairway, exit and night light circuits.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit and breaker size.

Part 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

.6 Co-ordinate the thickness of partition walls in which panelboards are to be located prior to rough-in. Failure to do this work shall require this Contractor to assume any costs for modifying walls, revising panels or electrical components.

.7 Thoroughly vacuum all panelboards to remove construction debris and dust, prior to installation of panel covers.

.8 Multi-section double wide panelboard tubs shall be spaced 40 mm apart and secured together using manufacturer's spacers and mounting hardware. A minimum of two close nipples complete with locknuts shall be installed between the tubs.

.9 Install 3 - 27mm spare conduits up to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes located in the accessible ceiling space

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42-10(R2015), General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CAN/CSA-C22.2 No.42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-National standard, with UL 514D).

.3 CSA-C22.2 No.55-15, Special Use Switches.

.4 CSA-C22.2 No.111-10(R2015), General-Use Snap Switches (Bi-national standard, with UL 20.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit Shop Drawings in accordance with Section 01 33 00.

.2 Acceptable manufacturers are Hubbell, Bryant, Arrow Hart, Pass & Seymour and Leviton.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Consultant.

Part 2 Products

2.1 SWITCHES

.1 20 A, 120 V, single pole, three-way, four-way switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

.2 Manually-operated general purpose AC switches with following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver alloy contacts.

.3 Urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 White toggle.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 White urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contact power pressure contacts and with fingers in contact when receptacle no in use and riveted grounding contacts.

.6 Heavy duty, one-piece, chromate plated steel mounting strap secured to body of receptacle at both ends.

.2 Safety type duplex receptacles shall be CSA type 5-20R, 125V, U-ground to CSA-C22.2 No. 42 with the following features:

.1 Duplex receptacle T-slot.

.2 Heavy duty, one-piece, chromate plated steel mounting strap secured to body of receptacle at both ends.

.3 Heavy-duty White urea molded housing.

.4 Break off links for use as split receptacle.

.5 Triple wipe constant power pressure contacts with fingers in contact when receptacle is not in use and riveted grounding contacts.

.6 Suitable for No. 10 AWG for back and side wiring.

.3 Surge suppression receptacles:

.1 Duplex receptacle, CSA 5-15R 125V, 15Amp, 'U' ground with following features:

.1 Blue urea molded housing for normal power

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Damage alter-alarm with muting screw.

.4 Power-on indicator.

.5 CSA certified to C22.2 No.42m.

.6 120V-60Hz.

.7 Response time 5NS.

.8 Peak energy 210 joules.

.9 Peal current 13000 amps.

.10 EMI/RFI attenuation at 50 OHMS-500KHZ-100MHZ.

.11 Metal oxide varistor to absorb and dissipate transient surges.

.4 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following feature:

.1 White urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Four back wired entrances, 2 side wiring screws.

.4 Triple wipe contact power pressure contacts and with fingers in contact when receptacle no in use and riveted grounding contacts.

.5 Heavy duty, one-piece, chromate plated steel mounting strap secured to body of receptacle at both ends.

.5 Other receptacles with ampacity and voltage as indicated.

.6 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

.1 Cover plates for wiring devices to: CAN/CSA-C22.2 No.42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.5 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Weatherproof in use coverplate, complete with gaskets for duplex receptacles on roof ort exterior.

Part 3 Execution

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00.

.4 Locate light switches on latch side of door.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 as indicated.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Device Identification: 1 Identify all receptacles with self-adhesive marker describing circuit number (i.e. "A-32"). Marker shall be fastened around mounting ears of receptacle.

.1 Identify all receptacle coverplates with clear self-adhesive Mylar tape with black lettering.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.

.3 Waste Management: separate waste materials for recycling reuse in accordance with Section 01 74 21 - - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 28 23 – Disconnect Switches – Fused and Non-Fused.

1.2 REFERENCE STANDARDS

.1

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide fuse performance data characteristics for each fuse type and size above

.3 Shop Drawings:

.1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Store fuses in original containers in storage cabinet.

.4 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.5 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Three spare fuses of each type and size installed above 600 A.

.3 Six spare fuses of each type and size installed up to and including 600 A.

Part 2 Products

2.1 FUSES - GENERAL

.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

.1 Class L fuses.

.1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type L2, fast acting.

.2 Class J fuses.

.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Type J2, fast acting.

.3 Class R -R fuses.

.1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.

.2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.

.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

.4 Class C fuses.

2.3 FUSE STORAGE CABINET

.1 Fuse storage cabinet, manufactured from 2.0 mm thick 750 aluminum mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00 - Common Work Results for Electrical.

Part 3 Execution

3.1 INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.

.1 Install rejection clips for Class R fuses.

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Where UL Class RK1 fuses are specified, install warning label. Use only UL Class RK1 fuses for replacement on equipment.

.5 Install spare fuses in fuse storage cabinet.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers, and ground-fault circuit-interrupters.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 5-16, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2016).

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00.

.2 Include time-current characteristic curves for breakers with ampacity of 600 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

.3 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 1 copy of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.

.1 Production certificate of origin must be submitted to Consultant for approval.

.2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.

.3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate or origin by Consultant. Unless complying with this requirement, Consultant reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

.4 Production certificate of origin must contain:

.1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.

.2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.

.3 Contractor's name and address and person responsible for project.

.4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.

.5 Name and address of building where circuit breakers will be installed:

.1 Project title.

.2 End user's reference number.

.3 List of circuit breakers.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.3 Separate for reuse and recycling and place in designated containers Steel, Metal and Plastic waste in accordance with Waste Management Plan.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, and Ground-fault circuit-interrupters: to CSA C22.2 No. 5.

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers to have minimum 10,000 A symmetrical rms interrupting capacity rating.

.6 New breakers on existing panels to match the type, Manufacturer and short circuit ratings to ensure the integrity of the panel's series rating.

2.2 THERMAL MAGNETIC BREAKERS DESIGN

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.

.3 Waste Management: separate waste materials for recycling reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Equipment and installation for ground fault circuit interrupters (GFCI).

1.2 PAYMENT

.1 Payment for field testing of ground fault equipment performed by Contractor in accordance with Section 01 29 83 - Payment Procedures: Testing Laboratory Services.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.144-M91 (R2015), Ground Fault Circuit Interrupters.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA PG 2.2-2014, Application Guide for Ground Fault Protection Devices for Equipment.

1.4 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00.

.2 Submit product data and Shop Drawings.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 MATERIALS

.1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA-C22.2 No.144 NEMA PG 2.2.

.2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

.1 Single pole ground fault circuit interrupter for 15 A or 20A, 120 V, 1 phase circuit c/w test and reset facilities.

2.3 GROUND FAULT PROTECTOR UNIT

.1 Self-contained with 15 A or 20A, 120 V circuit interrupter and duplex receptacle complete with:

.1 Solid state ground sensing device.

.2 Facility for testing and reset.

.3 CSA Enclosure 1, flush mounted with stainless steel face plate.

Part 3 Execution

3.1 INSTALLATION

.1 Do not ground neutral on load side of ground fault relay.

.2 Pass phase conductors including neutral through zero sequence transformers.

.3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Arrange for field testing of ground fault equipment by Contractor before commissioning service.

.3 Demonstrate simulated ground fault tests.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20

1.3 REFERENCE STANDARDS

.1 CSA Group.

.1 CSA C22.2 No.39-13, Fuse Holder Assemblies.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible or Non-fusible, horsepower rated disconnect switch in CSA Enclosure 3R or 12, size as indicated.

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated (if applicable).

.5 Fuse Holders: to CSA C22.2 No.69 suitable without adaptors, for type and size of fuse indicated (if applicable).

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Acceptable manufacturers: Schneider (Square D), Siemens and Eaton (Cutler-Hammer).

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

.2 Mount securely at 1800 mm above finished floor to top of switch. Provide a minimum of 1000 mm clear floor space in front of the switch.

3.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section Identification 26 05 00.

.2 Nameplate for each disconnect switch Size 5 engraved in accordance with Section 26 05 00. Indicate disconnect load, amperage, voltage, and phase (i.e., rooftop unit, 60 amp, 120/208V, 3 phase).

.3 Identify circuit number on disconnect switch (i.e. "B-36").

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 IEEE C62.41.2-2002, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

.2 ASTM International Inc.

.1 ASTM F1137 (2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.3 Canadian Standards Association (CSA International)

.4 ICES-005-07, Radio Frequency Lighting Devices.

.5 Underwriters' Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.

.3 Photometric data to include:

.1 Total input watts.

.2 Candela.

.3 Distribution zonal lumen summary.

.4 Luminaire efficiency.

.5 Coefficient of utilization.

.6 Lamp type.

.3 Quality assurance submittals: provide following in accordance with Section 01 45 00.

.1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

.4 Submit a luminaire, ballast/driver and lamp shop drawing for each luminaire type.

.5 Submit lighting control shop drawings.

.6 For all fixtures, ensure that each of the specified driver/ballast features is specifically shown on shop drawings.

1.3 QUALITY ASSURANCE

.1 Provide mock-ups in accordance with Section 01 45 00.

.2 Provide one type B fixture with two LED lamps, 0-10V dimming control and install on-site for review and approval by consultant and owner prior to proceeding with full light fixture order.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates paddling and packaging materials in accordance with Section 01 74 20.

.4 Divert unused metal materials from landfill to metal recycling facility.

.5 Disposal and recycling of fluorescent lamps as per local regulations.

1.5 SPARE LED LAMPS AND BALLASTS

.1 Provide spare LED Lamps as follows:

.1 5% of each LED Lamp type.

.2 Provide spare ballasts as follows:

.1 Five (5) spare 0-10V Dimming Ballasts.

.2 Five (5) spare Non-Dimming Ballasts.

1.6 GUARANTEE

.1 Replace:

.1 LED Lamps failing within 3 months of Substantial Performance of Work.

.2 Ballasts failing out within 6 months of takeover.

.3 Ballasts that fail or exceed their original noise level rating within 12 months of Substantial Performance of Work.

.4 Fixtures that fall within 12 months of Substantial Performance of the work.

Part 2 Products

2.1 LEDS

.1 Integrated LED sources to be high power, minimum rated 50,000 hour, white, 3500°k, minimum 80CRI. Exterior LED sources to be high power, minimum rated 50,000 hour, white, 3500°K.

.2 LED Lamps to be Type C InstantFit, G13 cap-base, minimum rated 50,000 hour, white, 3500°k, minimum 80CRI, minimum output to be 140lumens/watt, 120-277V, 347V, dimmable.

.1 Acceptable manufacturers/products

.1 Philips

.1 14T8/48-3500 IF 10/1 DIM TAA/NAFTA

2.2 BALLASTS

.1 Physical Characteristics

.1 Driver shall be physical interchangeable with standard electro magnetic or standard electronic ballasts, where applicable.

.2 Driver shall be provided with integral leads color coded per ANSI C82.11.

.2 Performance Requirements

.1 Driver shall energize compatible LED lamps within 1 second after mains power is applied.

.2 Driver shall provide independent lamp operation (ILO) allowing remaining lamps to maintain full light output when one or more lamps fail.

.3 Driver shall contain auto restart circuitry in order to restart lamps without resetting power.

.4 Driver shall operate from a 50Hz or 60Hz AC input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency).

.5 Driver shall be high frequency electronic type and operate lamps at frequencies above 42kHz to avoid interference with infrared devices and eliminate visible flicker.

.6 Driver shall have a power factor of 0.94 or above when operating the maximum rated number of compatible lamps, and .88 or above when operating the minimum rated number of compatible lamps.

.7 Driver input current shall Total Harmonic Distortion (THD) of 10% or less when operating the maximum rated number of compatible lamps and 15% or less when operating the minimum rated number of compatible lamps.

.8 Driver shall have a Class A sound rating.

.9 Driver shall have a minimum starting temperature of -13F/-25C.

.10 Driver shall tolerate sustained open circuit and short circuit output conditions.

.11 Driver shall control lamp light output from 100% - %5 relative light output for T8 TLED.

.12 Driver shall be suitable of operation in up to a 45C ambient temperature.

.3 Regulatory requirements

.1 Driver shall not contain any Polychlorinated Biphenyl (PCB).

.2 Driver shall be Underwriters Laboratories (UL) Recognized, Class P, and suitable for Damp and Dry conditions; and CSA Certified where applicable.

.3 Driver shall comply with ANSI C62.41 Category A transient protection.

.4 Driver shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47, CFR part 15, Non-Consumer (class A) for EMI/RFI (conducted and radiated).

.5 Driver shall comply with NEMA 410 for in-rush current limits.

.4 Other

.1 Driver shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

.2 Driver shall carry a five year warranty from date of manufacture against defects in material and workmanship when operating in a 45C ambient environment or less.

.5 Acceptable manufacturers/products

.1 Philips

.1 IZT-2P16-TLED-SC or approved alternate.

2.3 FINISHES

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 LUMINARE SCHEDULE

.1 Refer to lighting schedule on drawings E501.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and install luminaires as indicated.

.2 Provide adequate support to suit ceiling system.

.3 Provide plaster frame and trim as required and turn over to trade providing ceiling installation.

.4 Support luminaires directly from building structure.

.5 Provide low temperature rated drivers for exterior installations.

.6 Install luminaires so that they can be completely removed from below the finished ceiling.

.7 Recessed lighting luminaires in inaccessible ceilings shall be secured to blocking attached to building structure.

.8 Where no finished ceiling exists, luminaires shall be suspended on rigid conduit hangers complete with ball aligner, and outlet box canopy. All suspension components shall be degreased and painted white, unless otherwise noted.

.9 Replace Ballast, which in the opinion of the Consultant, are found to exhibit excessive noise.

.10 Coordinate installation of luminaires with Divisions 22, 23 and 24 to avoid conflicts between luminaires, and mechanical system components.

.11 A maximum of four fluorescent luminaires recessed in T-bar shall be energized from one junction box mounted on the underside of the structural ceiling. A separate armoured cable drop shall be provided for each luminaire. Length of drop shall be adequate to allow relocation of luminaire one tile in all directions from its specified location.

.12 Fixtures used for emergency lighting shall be marked with a visible label indicating that it is an emergency lighting fixture.

3.2 WIRING

.1 Connect luminaries to lighting circuits:

.1 Install flexible or rigid conduit for luminaries as required.

3.3 LUMINAIRE SUPPORTS

.1 For suspended ceiling installations support luminaires independently of ceiling using jack chains and ‘S’ hooks.

3.4 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

1 GENERAL

1.01 GENERAL REQUIREMENTS

.1 These instructions apply to and form part of all Communications Sections and drawing(s).

.2 These Specification documents have been prepared by WSP specifically for use on this project and may not be reproduced in whole or in part without the express written consent of WSP. These documents may not be used for any other purpose and/or for any other project and are considered confidential for the use of preparing a tender response.

.3 This Specification divided into Sections which are not intended to identify contractual limits between Sub-Contractors nor between the Contractor and his Sub-Contractors. The requirements of anyone Section applies to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.

.4 These Specification documents shall remain the property WSP.

.5 The Communications Contractor shall report any discrepancies between drawings and all applicable specifications to WSP.

.6 All drawings and details have been prepared to illustrate the existing and new conditions of the project and shall be considered diagrammatic. The Communications Contractor shall ensure all components required to complete the fully operational system installed at no additional cost to Queen’s or WSP.

.7 Provide all labor, materials, tools, and equipment required for the complete installation of work called for in all Sections of the Contract Documents.

.8 The Communications Contractor shall verify exact locations of all items shown and verify with Project Manager / General Contractor all-new locations before installation. It shall be the responsibility of the Communications Contractor to provide Project Manager / General Contractor detailed layouts of all rooms and locations of installation before installation for approval. All costs, including other trades as applicable, associated with changes resulting from the non-approved installation will be the responsibility of the Communications Contractor.

.9 Minor changes in locations may be required by the Owner to coordinate site conditions with other divisions, and Project Manager / General Contractor reserves the right to make these changes at no additional cost to the Owner.

1.02 SCOPE

.1 The project consists of the supply and installation of the communication cabling system for the Stauffer Library project.

.2 The Communications Contractor(s) shall be responsible for the complete installation of the following system(s):

.1 Structured cabling solution

.1 Supply and install CAT 6 copper horizontal cabling as per drawings.

.2 Test all cabling to current standards using certified test equipment.

.2 Wi-Fi System (Access Points)

.1 Install client supplied wireless access points, Category 6 cabling and mounting hardware to provide coverage at specified performance levels throughout the building.

.3 Communications cable tray shall be installed in the Telecommunications rooms as identified in on the drawings and these specifications.

.4 The work for these systems shall include; installation of cabling on Communications Contractor installed pathways (some pathways may be shown to be installed by Division 26, refer to drawings and details), termination jacks, patch panels, workstation outlets, cross-connects, grounding and bonding, fire stopping, and project documentation.

.5 Site:

.1 The specific structured cabling system scope of this project includes but is not limited to:

.1 Supply of electronic copies of shop drawings for all products before placing a material order to acquire written approval from WSP.

.2 Supply and installation of 4-pair Category 6 UTP horizontal copper cabling and related accessories to support end-user data, voice, and others as applicable.

.3 Supply and installation of two (2) 4-pair Category 6 UTP horizontal copper cabling and related accessories per access point to support end-user Wi-Fi.

.4 Supply and installation of new equipment and accessories as indicated on drawings.

.5 Fire-stop all slab penetrations used for communications cabling.

.6 Complete testing of each cable in a timely fashion and in coordination with other trades and services to ensure a completely tested system before activation by the Owner.

.7 Supply temporary and final record drawings as specified.

.8 Complete all final documentation requirements including documentation and site reviews to provide manufacturer’s certification/warranty. No third party certification allowed.

1.03 SCHEDULE

.1 The Communications Contractor shall be responsible for meeting the project schedule as provided by the Project Manager and the Owner.

.2 Work is generally to be performed during regular work hours unless noted otherwise in this document. The Communications Contractor shall include for all necessary overtime labor to complete the project. The Communications Contractor shall be responsible for providing labor to complete the work within the schedule with no additional cost to the Owner.

.3 The Communications Contractor shall supply a written project plan detailing schedule of installation in coordination with the overall project schedule. The project plan shall be prepared in MS Project or equivalent.

.4 At and near the completion of the project the Communications Contractor will be responsible for providing project documentation for Queen’s further use. Documentation will include:

.1 Temporary As-Built

.2 Contact Info for Technician

.3 As-Built Test Results

.4 As-Built Drawings

.5 As-Built Plan Holder(s)

1.04 SHOP DRAWINGS

.1 Shop drawings shall be stamped and signed “For Review” complete with date submitted.

.2 Manufacturers shop drawings showing various model or styles labeled with identification arrows showing which items are being proposed. Arrows shall be reproducible through standard photocopying.

.3 WSP shall approve shop drawings before starting the installation, and the Communications Contractor will be responsible for the cost of replacing of all installed product not approved.

.4 Approved shop drawings shall be included in the Project Manual for this project.

1.05 LABOUR

.1 The Communications Contractor shall provide only skilled, trained tradespeople experienced in the installation of a certified installation. Each installer shall be an approved and certified technician by the manufacturer providing the warranty for this project.

.2 Sub-Contractors shall not be allowed to perform all or any portion of the project unless approved in writing by General Contractor or Project Manager and the Owner. Subcontractors shall be identified at the time of tender to be considered for approval.

.3 The Communications Contractor shall be in compliance at all times with local, provincial and federal employee standards; safety acts, fire codes and other applicable legislation, codes, and acts affecting the delivery of the project. The Communications Contractor is responsible for the training and notifying their employees of any details associated with all codes, standards, acts, and legislation applicable to this project.

.4 The Communications Contractor shall provide WSIB (Workplace Safety Insurance Board) clearance certificate indicating a good standing before acceptance of any contract.

1.06 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

.1 It is the responsibility of the Communications Contractor to read these specifications and drawing(s) carefully and report any discrepancies immediately to General Contractor or Project Manager.

.2 At the time of tendering the Communications Contractor shall notify General Contractor or Project Manager in writing of any equipment, wiring feature, software or device necessary for full operation of any of the systems not included in the Specification documents or drawings. Failure to supply notification shall not relieve the Communications Contractor of the responsibility for providing a fully functioning system at the bid price.

.3 While every attempt has been made to ensure that all information (including specified products and part numbers) is correct, it is the responsibility of the Communications Contractor to verify availability of products and verify all part numbers.

.4 Specifications and drawings are schematic and represent the intent of the project.

.5 Dimensions and measurements shown in these documents shall be verified by the Communications Contractor on site before final installation.

.6 Quantities and lengths identified are approximate and shall not be used to gage or limit work.

.7 These Specifications are an integral part of the accompanying drawing(s). Any item or subject omitted from one or the other, but which is either mentioned or implied shall be considered as properly and sufficiently specified.

.8 Certain details indicated in the drawings are general and not specifically identified for every occurrence of use; however, such details shall apply to every occurrence on the drawings.

.9 The location and size of existing services and equipment shown in the drawings are based on the best available information. The Communications Contractor shall verify the exact location, type, size and any other pertinent information before commencing work.

1.07 INSTALLATION

.1 Leave areas clear where space designated as reserved for future equipment and equipment for other trades.

.2 Adequate space and provisions for removal of components and servicing of equipment, with minimum inconvenience to the operation of systems.

.3 Where equipment is shown to be ‘roughed in only’ obtain information from General Contractor or Project Manager before proceeding with the work.

1.08 COORDINATION

.1 The Communications Contractor shall provide installation and make all changes associated with coordination with other trades and to accommodate unforeseen site conditions at no additional cost to the Owner.

.2 The Communications Contractor shall be responsible for attending coordination meetings as requested by the General Contractor or Project Manager for the coordination of locations and services. The project manager selected shall be assigned for the duration of the project and may only change with the written consent of General Contractor or Project Manager.

.3 The Communications Contractor in addition to coordination meetings shall attend weekly site meetings and be prepared to provide current project progress status, the anticipated completion of future tasks and information on outstanding delivery items.

.4 Access to the site shall comply with all rules, regulations, safety standards and security procedures established for the project or building. Fees for after-hours access shall be considered included in the tender amount. No additional cost will be accepted by the Owner for these requirements.

1.09 COOPERATION WITH OTHER DIVISIONS

.1 Communications Cabling shall not touch or be supported from piping, ductwork, conduits; ceiling supports or any other service/equipment.

.2 Communications Cabling shall be in basket tray and conduit. Use of approved j-hooks shall be limited as an exception and shall be subject to review and approval with the Owner.

.3 Supply all items to built in ample time for rapid progression of the work. Schedule and provide workforce and materials to proceed with work as required to satisfy the construction schedule.

.4 It is the Division 27 contractor's responsibility to coordinate all power, rough-in, and grounding with the Division 26 contractor prior to installation

1.10 EXISTING SERVICES AND EQUIPMENT

.1 All changes and connections to existing services shall be made only in a manner and at a time approved by General Contractor or Project Manager and/or Queen's to avoid any interruption of such services during normal working hours.

.2 If necessary, changes and connections to existing services shall be made outside of normal business hours at no extra cost to Queen's.

1.11 CODES AND STANDARDS

.1 The Communications Contractor shall adhere to all applicable codes, standards, and regulations.

.2 All equipment, products, and installation methods shall adhere to all Codes and Standards having jurisdiction and as listed in this document.

.3 The latest version, including technical bulletins and addenda, will apply to all codes and standards.

.4 If a conflict between codes, standards, and this specification occur, the most stringent will be applicable.

.5 All national & local codes and standards not listed for Products, Buildings, Fire, Health & Safety and Electrical, will also apply.

TIA-568-C.0-E	Generic Telecommunications Cabling for Customer Premises
TIA 568-C.1-E	Commercial Building Telecommunications Infrastructure
TIA-568-C.2-D	Balanced Twisted-Pair Telecommunications Cabling and Components
TIA-568-C.4-D	Broadband Coaxial Cabling and Components
TIA-569-D	Telecommunications Pathways and Spaces
TIA 606-C	Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
TIA 607-C	Commercial Building Grounding and Bonding Requirements for Telecommunications
BICSI STANDARDS	All current Bicsi design standards and Best Practices
CSA C22.1-98	Canadian Electric Code Part I: Safety Standards for Electrical Installations
CSA C22.2 No. 181.4	Plugs, Receptacles, and Connectors for Communication Systems

CSA C22.2 No. 214	Communications Cables
CSA C22.2 No. 0	Canadian Electric Code Part II: General Requirements (Communications Cables)
CSA T527	Grounding and Bonding for Telecommunications in Commercial Buildings
CSA T528	Design Guidelines for Administration of Telecommunications Infrastructure in Commercial Buildings
CSA T529	Design Guidelines for Telecommunications Wiring Systems in Commercial Buildings
CSA T530	Building Facilities, Design Guidelines for Telecommunications
CAN/ULC S101	Standard Method of Fire Endurance Tests of Building Construction and Materials
CAN/ULC S102	Standard Method of Testing for Surface Burning Characteristics of Building Materials and Assemblies
J-STD-607	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
CEC, Part 1	The Canadian Electrical Code, Part 1
NEMA WC 63	Performance Standard for Field Testing of Unshielded Twisted-Pair Cabling System

2 PRODUCTS

2.01 GENERAL

.1 All equipment and products supplied shall be new and free of all manufacturer defects and delivery or installation damage.

.2 All equipment and products supplied shall meet all manufacturer listed characteristics as identified in the latest manufacturer catalog.

.3 All products shall meet all applicable codes and standards and bare the UL/ULC label, be CSA approved and meet FCC/CRTC Regulations.

.4 All products shall comply with local, provincial and national fire ratings for the installation of this project.

.5 The only acceptable Manufacturers of an end to end solution for this project and as further specified in this document will be the following:

.1 BELDEN, for the cabling system

2.02 CERTIFICATION

.1 Queen's requires a complete "Permanent Link" tested and certified to category 6 standards.

.2 The Communications Contractor shall currently be an authorized installer of the manufacturer.

.1 BELDEN

.3 The Communications Contractor shall provide a written one year warranty inclusive of all parts and labor for the end to end solution. The Communications Contractor shall also state and agree in writing to respond to any warranty request within 24 hours during this warranty period.

2.03 MATERIAL HANDLING

.1 The Communications Contractor is responsible for the delivery of all materials to site and transportation to the workplace in compliance with all safety regulations and procedures.

.2 Make arrangements and schedule all hoisting with the General Contractor.

.3 Provide and be responsible for lockable storage for all tools and material required to complete the installation through the duration of the project. Once the project is complete remove all tools and excess materials within two business days.

.4 The Owner and its representatives shall in no way be held liable for any missing material, equipment or tools required to complete the installation.

3 EXECUTION

3.01 GENERAL

.1 The Communications Contractor shall supply all materials, labor, tools, and equipment to provide a complete warranted installation as outlined in the contract documents and suitable to the approval of the Owner, General Contractor or Project Manager Limited and inspection bodies having jurisdiction.

.2 The Communications Contractor shall be responsible for installing and providing pulling strings, ropes, and fishing walls wherever conduit is not installed, or conduit is installed without these provisions.

.3 Provide continuity of all existing services while completing the specified installation. Losses due to interruption of services will be the responsibility of the Communications Contractor.

.4 Should services be interrupted accidentally, the Communications Contractor shall provide material and labor to re-establish services immediately and shall continue without stoppage until all services have been re-established. All material and labor costs including overtime shall be borne solely by the Communications Contractor. Any material and/or labor costs including overtime associated with other trades and/or the General Contractor to assist in any way the Communications Contractor in re-establishing services shall be borne solely by the Communications Contractor.

3.02 SITE CONDITIONS

.1 The Communications Contractor is responsible for maintaining a clean work environment and is responsible for the removal of all debris on a daily basis. Debris and removed materials shall be disposed of in conformance with all local by laws and regulations. Failing to comply and after a reasonable time and written notice the General Contractor reserves the right to hire cleaners to complete the cleaning and back charge the Communications Contractor.

.2 The Communications Contractor shall be responsible for the removal and reinstallation of all floor or ceiling tiles, hatchways or access panels. All items shall be removed and replaced on a daily basis and left in the original condition. Special caution shall be taken not to break, chip or discolor with dirt or fingerprints any such items. The Communications Contractor will be fully responsible for repair or replacement of all damaged pieces at the discretion of the Project Manager or the Owner.

.3 The Communications Contractor is fully responsible for storage of all temporarily removed items for the project.

.4 All materials and installation throughout the project will remain the responsibility of the Communications Contractor until completion of the project is accepted by the Owner. Damages to any item installed shall be replaced or repaired by the Communications Contractor to provide a complete final installation at no additional cost to the Owner.

.5 At the completion of the project or as and when the Owner requires, restore the original condition of all materials, equipment, and surfaces within the work area affected by this installation.

.6 All vehicular traffic entering the site shall be coordinated with the General Contractor.

3.03 CUTTING, PATCHING, AND REPAIRING

.1 It is the responsibility of the Communications Contractor to perform all cutting, patching, and repair related to the Communications Cabling work including any penetrations through walls or floors.

3.04 HOISTING FACILITIES

.1 This Division shall provide its hoisting facilities regardless of height required to perform work.

.2 Hoisting facilities may be provided by the General Contractor, although the General Contractor may at its discretion not allow the Communications Contractor to make use of such.

3.05 SAFETY

.1 The Communications Contractor shall adhere to all safety laws, rules and regulations issued by the authorities having jurisdiction, General Contractor, Project Manager and the Owner.

.2 The Communications Contractor shall attend all Safety Program meetings requested by the General Contractor.

3.06 SITE ADJUSTMENTS

.1 Locations of all equipment, outlets or devices before installation may be revised to within (3) metres without any additional cost or change request.

.2 Portions of the project may be at any time identified in writing to be “On Hold.” Work in these areas shall not be started, continued or completed until further direction is received. No additional cost shall be accepted by the Owner for areas put on hold.

3.07 PROJECT DOCUMENTATION

.1 The Communications Contractor shall provide hand marked record drawings showing all cable numbers on floor plans, rack elevations, backboard layouts and cable routing at the completion of the project. Drawings shall include all architectural and project changes.

.2 Prepare a complete test report for each cable identifying a successful test on each cable, complete with the technician's signature and date. Test reports shall be full test reports in the testing software format and with one page per cable.

.3 At the completion of the project be prepared to submit a project manual. This project manual shall include:

.1 Contractor's Name, contact information, and lead installer/foreman's contact info

.2 Final bill of materials

.3 Approved shop drawings

.4 WHIMS data sheets on all applicable materials including fire stopping

.5 Maintenance and/or operation manuals for all equipment

.6 Connectivity database

.7 Test results

.8 Record drawings

.9 Letter of 1-year installation warranty

.4 Provide (1) hard copy and (1) soft copy for Queen's use before the move-in date.

.5 Final documentation not provided within 30 days of project completion and with reasonable notification may result in the commissioning of another agent to prepare such documents. Costs for this work will be deducted from all Holdback amounts available to the Communications Contractor.

END OF SECTION

1 GENERAL

1.01 WORK INCLUDED

.1 Comply with Section 27 00 00 – General Specifications and Scope.

1.02 GENERAL

.1 The Communications Contractor shall be responsible for measuring and confirming cable pathways before installation of any cable to ensure no cabling will exceed the specified distance limitations. Where the distance limitations exceed the maximum distance required to comply with the current standards and manufacturer's guidelines, the Communications Contractor shall inform General Contractor or Project Manager before installation of cabling. No compensation for removal of over length cabling will be accepted or approved.

1.03 INDOOR CABLE DISTRIBUTION

.1 Ensure ANSI/TIA-568-C installation practices apply to all indoor cable distribution.

.2 The Communications Contractor shall install and distribute cabling using riser sleeves, conduit, communications cable tray, floor ducts systems and/or surface raceways as indicated on drawings and as supplied and installed by Division 26.

.3 All cable extending from the cable tray shall be in conduit to the point of termination. J-hooks and slings shall be used as an exception where conduit run may be impractical as reviewed with the Owner, and as otherwise noted in these specifications. Where use of J-hooks and slings is permitted, secure cable bundles with Velcro straps.

2 PRODUCTS

2.01 METALLIC CONDUIT (EMT)

.1 Unless noted elsewhere in these specifications, horizontal distribution cables shall be routed in EMT conduit from the basket tray to service/drop location.

.2 Refer to Division 26 for general EMT conduit specifications. Unless otherwise noted in Division 27 specifications, minimum conduit size for use with communications cabling shall be 19mm (3/4”).

2.02 J-HOOKS

.1 J-hooks shall be made of metal and/or plastic and shall be Plenum rated.

.2 J-hooks shall be supplied and installed with all necessary fastening suitable for the building structure being used to support the cabling and as per the manufacturer’s installation requirements or guidelines.

.3 J-hooks shall be manufactured by Erico or Panduit and sized to suit.

Specified Product:

Erico	CAT12
Erico	CAT21
Erico	CAT32

Erico	CAT64
Panduit	JP75
Panduit	JP131
Panduit	JP2
Panduit	JP4

Notes: Product Codes shown above indicate only Series numbers and are not application specific.

2.03 CABLE SLINGS

.1 Cable slings shall be supplied and installed as indicated on drawings and as required to support larger bundles of cabling.

.2 Cable slings shall be supplied with all necessary fastening suitable for the building structure being used to support the cabling and as per the manufacturer's installation requirements or guidelines.

.3 Cable slings manufactured by Erico and sized to suit installation or as noted in drawings.

Specified Product: (Or approved Equivalent)

Erico CAT425

Notes: Product Code shown above indicates only Series number and is not application specific.

2.04 VELCRO WRAPS

.1 Velcro wraps shall be supplied and installed to support and neatly bundle all cabling.

.2 No nylon or plastic wraps will be permitted on this project and will be removed and replaced by Velcro wraps at the expense of the Communications Contractor.

.3 Velcro wraps shall be black.

Specified Product: (Or approved Equivalent)

Manufacturer	Part Number	Width	Tensile Strength
Panduit	HLM-15R0	0.330"	18
Panduit	HLS-15R0	0.750"	50
Panduit	HLS-75R0	0.750"	50
Panduit	TTS-20R0	0.750"	40
Panduit	TTS-35R3-0	0.750"	40

2.05 SPLIT WRAP

.1 Split wrap shall be supplied to dress cabling from wall feed to furniture feed locations.

.2 Split wrap shall be sized to suit each location.

.3 Split wrap shall be colored to match the power whip supplied with the furniture.

Specified Product: (Or approved Equivalent)

Manufacturer	Part Number	Tool Required
Panduit	PW50F-T20	PWT50
Panduit	PW75F-C20	PWT75
Panduit	PW100F-C20	PWT100
Panduit	PW150F-L20	PWT150

2.06 OVERHEAD WIRE BASKET TRAY (BY DIVISION 26)

.1 Provide wire basket of types and sizes indicated with all required splicing and mounting hardware.

.2 Wire basket crosswire to be constructed with shaped wire to provide a flat surface for cable support, avoiding pressure points or cable strain. Round wire construction shall not be allowed.

.3 Wire basket shall be made of high strength steel wires and formed into a standard 2 inch by 4-inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along the entire length of the straight section.

.4 Wire diameter shall be 0.195” (5mm) minimum on all mesh sections up to 16 linear inches. Wire diameter line wire shall be 0.234” (6mm) minimum on all mesh sections more than 16 linear inches.

.5 All straight section longitudinal wires shall be constructed with a continuous top wire safety edge.

.6 All Tray sections and splicing assemblies shall be UL/C-UL Classified as an Equipment Ground Conductor (EGC).

.7 The cable tray shall be installed complete with splice bars, “uni-strut” trapeze supports, threaded rod, Waterfall at all cable exit points, ceiling anchors and all manufacturer recommended installation components following manufacturer’s installation guidelines and recommendations.

.8 All cable intersections including but not limited to “T”, 45 and 90 degree corners, etc shall be factory made and shall not be fabricated on site.

3 EXECUTION

3.01 GENERAL

.1 All pathways shall be installed to run parallel to building lines at all times.

.2 Pathways shall be installed in coordination with other trades to minimize interferences and obstructions. The Communications Contractor shall be responsible for relocating installed pathways at no cost to the Owner.

.3 All cable supports shall take into account all required seismic requirements as per applicable codes and standards.

.4 All cable supports shall be installed to the permanent structure of the building and be limited to areas that will not damage the structural stability such as tensioned beams and slabs. It is the responsibility of the Communications Contractor to submit information to the structural engineer for review and approval before installation.

.5 Anchors for Cable Slings shall not be drilled into post-tensioned beams under any circumstances. All anchors shall be drilled into the slab.

.6 Pneumatic hammers shall not be used unless the Communications Contractor has written authorization from the building owner/landlord.

.7 The Communications Contractor shall minimize the removal/disturbance of fire spray insulation while installing cable supports and/or accessories.

3.2 DATA INDOOR CABLE DISTRIBUTION

.1 All data communication cables shall be separated from sources of electromagnetic radiation in compliance with TIA Standard Proposal SP-2072 and the following:

Item	Minimum Separation Distances (<2kVA)	(2-5kVA)	(>5kVA)
Unshielded power lines or electrical equipment in proximity to open or non-metallic pathway.	127 mm (5”(in))	305 mm (12”(in))	610 mm (24”(in))
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway.	64 mm (2.5”(in))	152 mm (6”(in))	305 mm (12”(in))
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway.	---	76 mm (3”(in))	152 mm (6”(in))
Motors		1.2 m (4’-0”)	
Transformers		1.2 m (4’-0”)	
Conduit and cables used for electrical distribution less than 1kV		0.3 m (1’-0”)	
Conduit and cables used for electrical distribution greater than 1kV		1.0 m (3’-0”)	
Fluorescent Luminaires		300 mm (12”)	
Pipes (gas, oil, water, etc.)		120 mm (5”)	
HVAC (equipment, ducts, etc.)		150 mm (6”)	

.2 All pathways and cabling installation shall maintain clearances from all electrical and heat sources as outlined below:

Fluorescent Fixtures	300 mm
Electrical distribution cabling and conduits less than 1KVA	1.0 m
Electrical distribution cabling and conduits greater than 1KVA	3.0 m
Transformers and Motors	1.2 m
HVAC system including ducts	150 mm
Mechanical piping	150 mm

.3 Prepare all conduits and pathways before installation of cabling. This shall include a bushing or ream all conduit openings, pulling of wire brush and mandrel to clean out ducts and identifying any potential cause of damage to cabling during installation. Report all items to General Contractor or Project Manager immediately.

.4 When installing cables in stacked duct banks install cabling in lower ducts leaving upper ducts for future installations.

3.3 METALLIC CONDUIT (EMT)

.1 Conduit runs shall follow building lines.

.2 Install plastic bushing/collars on any conduit end/opening.

3.3 J-HOOKS AND CABLE SLINGS

.1 Cable slings shall be installed as noted on drawings and when cabling exceeds the capacity of J-hooks.

.2 shall be installed every 915 mm to 1.2 m to support cabling (ensure that the distance between cable slings is not consistent; do not place cable slings the same distance apart repeatedly).

.3 All cabling shall be installed to have no more than 76 mm sag between cable slings.

.4 shall be sized not to exceed 80% of the manufacturers published capacities.

3.4 VELCRO WRAPS

.1 Velcro wraps shall be installed at every J-hook, between every pair of J-hooks or within 50 mm of a J-hook to bundle cabling neatly.

.2 Velcro wraps shall be installed every 915 mm to bundle cabling installed in cable tray neatly.

.3 Velcro wraps shall be installed every 152 mm to neatly bundle cabling at all locations on racks, cabinets, patch panels and IDC mounts.

3.5 SPLIT WRAP

.1 Split wrap shall be installed to neat bundle cabling from outlet location to system furniture connection point.

.2 Split wrap installation should be in a manner to minimize the amount of exposed spiral wrap.

3.6 FIRE STOPPING

.1 All communications pathways shall be fire stopped with approved fire-stopping assembly as required by all applicable codes and standards.

3.7 GROUNDING AND BONDING

.1 All communications pathways shall be grounded as required by all applicable codes and standards. Grounding and Bonding shall comply with TIA 607 current standard and product manufacturer installation guidelines.

END OF SECTION

1 GENERAL

1.01 WORK INCLUDED

.1 Comply with Section 27 00 00 – General Specifications and Scope.

1.02 GENERAL

.1 Horizontal cabling shall be installed in pathways indicated on drawings and as per Section 27 05 28 of this specification.

.2 All cables shall be neatly bundled and installed as per the manufacturer's guidelines or the standards in these specifications; whichever is more stringent.

.3 Ensure that all cables are sufficiently long to allow for slack, vertical runs, wastage, connectorization and future moves.

2 PRODUCTS

2.01 CAT6 HORIZONTAL UNSHIELDED TWISTED PAIR (UTP) COPPER CABLING

.1 All general-use horizontal cabling shall be CAT 6 UTP, 4 pair, minimum 22 AWG, solid copper conductor, compliant with EIA/TIA cable category as identified below.

.2 The cable shall be CSA certified and stamped with CMP rating accordingly.

.3 Plenum cables are to be used in all cable implementations for both fiber and copper.

.4 All UTP cables shall meet requirements identified below.

.5 Specified Product:

	CAT	Rating	Colour	System	Termination
BELDEN 2413	6	FT6	White	Data/Voice	GigaBIX

3 EXECUTION

3.01 HORIZONTAL CABLING

.1 Cabling shall be terminated as per manufacturer's guidelines and remove only enough cable jacket to perform a termination.

.2 Untwist pairs a maximum of 13 mm (1/2") for all categories of cables.

.3 Provide a minimum of 3.0 m (10'-0") of slack at both ends of each cable. Neatly coil slack and attach to ladder tray or provide independent support in the ceiling. Slack for workstation outlets shall be located above the outlet in ceiling space.

.4 Cabling shall be neatly bundled using Velcro straps. Bundle cables separately for identification purposes when applicable.

.5 Comply with manufacturer's recommended bundling practices for installation. Ensure that excess pressure is not placed on the cable at any point that may result in the compression or deformation of the cable jacket and internal pair/conductor geometry.

.6 Cables shall not be scrapped, dented or otherwise damaged before, during or after installation. All damaged cabling shall be replaced at no extra cost to the Owner.

.7 Ensure that all cables are of sufficient length to allow for slack, vertical runs, wastage, connectorization and future moves.

3.02 CABLE ROUTING

.1 Make all necessary adjustments to cable route(s) / pathway(s) to accommodate architectural, structural, mechanical and/or electrical conditions.

.2 All pathways shall be parallel to building lines. If it is necessary to route cables otherwise to accommodate cable length written permission shall be obtained from WSP before installation.

3.03 BEND RADIUS

.1 Coordinate closely with Electrical trade to ensure conduit runs for horizontal cable adhere to bend radius limits and to remain within pull limits to prevent damage and stress on the cable.

.2 Do not kink or exceed the cable minimum bend radius for all cabling. For all copper, cabling maintains a minimum of (4) times cable diameter as bend radii if the manufacturer specifies no bend radius.

.3 Where there is the potential for excess stress on a cable(s) when pulling through conduit systems, apply a non-corrosive quick drying lubricant to the cable to facilitate pulling. Water-based lubricants not allowed.

.4 Completely remove all cable lubricant from cable jacket as cable exits the conduit system before termination and labeling.

END OF SECTION

1 GENERAL

1.01 WORK INCLUDED

.1 Comply with Section 27 00 00 – General Specifications and Scope.

1.02 OUTLET LOCATIONS

.1 Horizontal cable outlets may be relocated before installation from the location shown on the drawings to a maximum distance of 3.05m (10’-0”) without adjustment to the contract price.

.2 Communications contractor shall provide Keystone connectors as needed to ensure proper mounting within faceplates.

1.03 ACCEPTABLE MANUFACTURERS

.1 All Communications faceplates, adaptors and connectors shall be supplied as part of a single end to end solutions

.2 Acceptable manufacturers are:

.1 Belden

.2 Or approved equivalent

2 PRODUCTS

2.01 UTP TERMINATION MODULES

.1 All Cat6 UTP termination modules shall be rated for 200 MHz usable bandwidth

.2 The contact material of the jack in a modular jack connector shall be phosphor bronze with 50 micro-inches of gold over nickel.

.3 UTP termination modules shall be Belden PS6+ mdvo. Exception made for Keyconnect where necessary (eg. Floor boxes).

.4 UTP cables shall be terminated with modules as listed below:

Specified Product:

Cat.	Colour	System
6	Almond	Voice/data

2.02 KEYSTONE STYLE UTP TERMINATION MODULES (OUTLET)

.1 All Cat6 UTP termination modules shall be rated for 200 MHz minimum bandwidth

.2 The contact material of the termination module shall be phosphor bronze with 50 micro-inches of gold over nickel.

.3 Keystone style UTP termination modules shall be of the same category as the UTP cabling to ensure that manufacturer end to end warranties can be attained.

.4 UTP cables shall be terminated with keystone style modules as listed below:

Specified Product:

Cat.	Colour	System
6	Almond	Voice/Data
6	Almond	Wifi

2.03 WORKSTATION FACEPLATES AND ADAPTERS

.1 Workstation outlets shall be supplied and installed for all terminations at the workstation end and as further specified below to suit the application.

.2 The Communications Contractor shall confirm the color of outlets before placing an order.

.3 Workstation outlets shall be manufactured by the end to end solution manufacturer when available.

.4 Modular Furniture Faceplates

.1 Modular furniture faceplates shall be installed in all furniture outlets that have a modular furniture knockout shall consist of a minimum of (3) ports.

.2 Each outlet shall be installed with the specified termination modules or a blank insert. No openings shall remain exposed.

.3 Communications Contractor shall verify furniture manufacturer and modular faceplate requirement before placing an order.

.4 Shall be black in colour.

.5 Decora Adapters

.1 Decora style adapters and faceplates shall be installed for all wall outlets, floor or raceway outlets and shall consist of a minimum of (2) ports.

.2 Each outlet shall be installed with the specified termination modules or a blank insert. No openings shall remain exposed.

.3 Shall be Almond in colour.

.6 Wall Faceplates

.1 Where electrical outlets are not ganged with communications outlets, wall faceplates shall be used and shall consist of a minimum of (4) port mdvo.

.2 Shall be Almond in colour.

.7 Surface Mount Boxes

.1 Surface mount boxes shall be installed for all furniture outlets that do not have a modular furniture knockout, exposed ceiling outlets or any location not provided with an electrical back box.

.2 The surface mounted box shall consist of a minimum of (2) ports.

.3 Each outlet shall be installed with the specified termination modules or a blank insert. No openings are to remain exposed.

.4 Shall be white in colour.

.8 Wall Mount Phone Plate

.1 Shall be single gang stainless steel.

.2 Shall contain one keystone port.

.9 Blank inserts and faceplates shall be installed in all unused ports for all communications outlets. Blank insert plates shall be manufactured by the end to end solution manufacturer and be of the same colour as the workstation outlet.

3 EXECUTION

3.01 TERMINATION REQUIREMENTS

.1 All cabling shall be terminated using pinout T568A configuration.

3.02 WORKSTATION OUTLETS

.1 Install all workstation outlets level and flush to the wall surface.

.2 All faceplates and adaptors shall be properly sized for the number of available cables.

.3 Provide a final installation that is clean of all fingerprints and dirt complete with identification labeling as per these specifications.

END OF SECTION 27.15.43

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 Underwriter's Laboratories of Canada (ULC)

- .1 CAN/ULC-S524-2014, Installation of Fire Alarm Systems.
- .2 ULC-S525-16, Audible Signal Appliances for Fire Alarm.
- .3 CAN/ULC-S526-16, Visual Signal Appliances, Fire Alarm.
- .4 CAN/ULC-S527-2014, Control Units.
- .5 CAN/ULC-S528-2014, Manual Pull Stations.
- .6 CAN/ULC-S529-2016, Smoke Detectors.
- .7 CAN/ULC-S531-M14, Smoke Alarms.
- .8 CAN/ULC-S536-13, Inspection and Testing of Fire Alarm Systems.
- .9 CAN/ULC-S537-13, Verification of Fire Alarm Systems.

1.3 SCOPE OF WORK

.1 Provide Fire Alarm devices as detailed on drawings. Coordinate with Siemens to supply fire alarm components, perform programming and verification.

1.4 SYSTEM DESCRIPTION

.1 Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.

.2 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signaling to monitoring agency.

.3 Zoned, non-coded single stage.

.4 Modular in design to allow for future expansion.

.5 Operation of system shall not require personnel with special computer skills.

.6 System to include:

- .1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.
- .2 Power supplies.
- .3 Initiating/input circuits.
- .4 Output circuits.
- .5 Auxiliary circuits.
- .6 Wiring.
- .7 Manual and automatic initiating devices.

.8 Audible and visual signaling devices.

.9 End-of-line resistors.

.10 Local and Remote displays.

.11 Printer Event log memory chip.

.12 Historic event recorder.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

.1 System components: listed by ULC and comply with applicable provisions of National Building Code, Local/Provincial Building Code, and meet requirements of local authority having jurisdiction.

1.6 SHOP DRAWINGS

.1 Include:

.1 Detail assembly and internal wiring diagrams for control units and Auxiliary cabinets.

.2 Overall system riser wiring diagram identifying control equipment initiating zones signaling circuits; identifying terminations, terminal numbers, conductors and raceways.

.3 Details for devices.

.4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.

.5 Step-by-step operating sequence, cross referenced to logic flow diagram.

1.7 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for fire alarm system.

.2 Include:

.1 Instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.

.4 List of recommended spare parts for system.

.5 Fire alarm Verification Report.

Part 2 Products

2.1 MATERIALS

.1 Equipment and devices: ULC listed and labelled and supplied by Siemens Canada Ltd.

.2 Power supply: to CAN/ULC-S524.

.3 Audible signal devices: to ULC-S525.

.4 Visual signal devices: to CAN/ULC-S526.

.5 Control unit: to CAN/ULC-S527.

.6 Manual pull stations: to CAN/ULC-S528.

.7 Thermal detectors: to CAN/ULC-S530.

.8 Smoke detectors: to CAN/ULC-S529.

.9 Smoke alarms: to CAN/ULC-S531.

2.2 SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY

.1 Actuation of any alarm initiating device to:

.1 Cause electronic latch to lock-in alarm state at central control unit.

.2 Indicate zone of alarm at central control unit and remote display.

.3 Cause audible signaling devices to sound continuously temporal throughout building and at central control unit.

.4 Transmit signal to fire department via central station.

.5 Cause air conditioning and ventilation fans to shut down.

.6 Cause elevators to return to floor of egress, or to alternate floor, as required.

.2 Acknowledging alarm: indicated at central control unit.

.3 Possible to silence signals by "alarm silence" switch at control unit, after 60s period of operation.

.4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.

.5 Actuation of supervisory devices to:

.1 Cause electronic latch to lock-in supervisory state at central control unit.

.2 Indicate respective supervisory zone at central control unit and at remote display.

.3 Cause audible signal at central control unit to sound.

.4 Activate common supervisory sequence.

.6 Resetting alarm or supervisory device not to return system indications/functions back to normal until control unit has been reset.

.7 Trouble on system to:

.1 Indicate circuit in trouble at central control unit.

.2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.

.8 Trouble on system: suppressed during course of alarm.

.9 Trouble condition on any circuit in system not to initiate alarm conditions.

2.3 CONTROL PANEL

.1 Central control unit (CCU).

.1 Suitable for DCLA communication style: to CAN/ULC-S524.

.2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.

.3 Minimum capacity of 500 addressable monitoring and 500 addressable control/signal points. Points may be divided between 2 communication channels in distributed system, each channel operating independently of other. Faults on one communication channel not to affect operation of another channel.

.4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.

.5 Integral power supply, battery charger and standby batteries.

.6 Basic life safety software: retained in non-volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (e.g. zone labels, priorities) and changing of system operation software.

.7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.

.8 Should communications fail between CCU and remote units, audible and visual trouble to be indicated at CCU. Data communication to be binary DC, baseband, time-division multiplex, half-duplex. Each data channel: capable of communicating up to distance of 3,000 m.

.9 Equipped with software routines to provide Event-Initiated-Programs (EIP); change in status of one or more monitor points, may be programmed to operate any or all of system's control points.

.10 Software and hardware to maintain time of day, day of week, day of month, month and year.

.11 Software to operate variable sensitivity addressable smoke detectors and annunciate their status and sensitivity settings at control panel.

2.4 POWER SUPPLIES

.1 120 V, 60 Hz as primary source of power for system.

.2 Voltage regulated, current limited distributed system power.

.3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.

.4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.

.5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.

.6 Standby batteries: sealed, maintenance free.

.7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.5 INITIATING/ INPUT CIRCUITS

.1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors and water flow switches, wired in DCLA configuration to central control unit.

.2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.

.3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".

.4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit.

.5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

2.6 ALARM OUTPUT CIRCUITS

.1 Alarm output circuit: connected to signals, wired in class A configuration to suites and wired in Class B configuration in common areas from central control unit.

.1 Signal circuits' operation to follow system programming; capable of sounding horns continuously temporal. Each signal circuit: rated at 2 A, 24 VDC; fuse-protected from overloading/overcurrent.

.2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

.3 Visual signal control for strobes to be synchronized.

2.7 AUXILIARY CIRCUITS

.1 Auxiliary contacts for control functions.

.2 Alarm and or supervisory trouble on system to cause operation of programmed auxiliary output circuits.

.3 Two sets of separate contacts for elevator capture (to main floor of egress and to alternate floor of egress).

.4 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.

.5 Relay output for alarm, trouble, supervisory signals for monitoring by ERC CAP’s panel.

2.8 WIRING

.1 Twisted copper conductors: rated 300 V.

.2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

.3 To signal circuits: 12 AWG minimum, and in accordance with manufacturer's requirements.

.4 To control circuits: 12 AWG minimum, and in accordance with manufacturer's requirements.

.5 Refer to Section 26 05 21 - Wires and Cables (0-1000V).

2.9 MANUAL ALARM STATIONS

.1 Manual alarm stations: pull lever, glass rod, wall mounted semi-flush type, or surface with backbox non-coded single pole normally open contact for single stage English signage.

.2 Addressable manual pull station.

.1 Pull lever, break glass rod, semi-flush or surface wall mounted type, single action, single stage, electronics to communicate station's status to addressable module over 2 wires and to supply power to station. Station address to be set on station in field.

.3 Plastic lift up cover.

2.10 AUTOMATIC ALARM INITIATING DEVICES

.1 Addressable smoke detectors.

.1 Photo-electric plug-in type.

.2 Electronics to communicate detector's status to addressable module.

.3 Ability to annunciate detector contamination automatically with trouble condition at control panel.

.4 Complete with manufacturer's base and ceiling trim units.

2.11 AUDIBLE SIGNAL DEVICES

.1 Horns/Strobes: semi-flush mounting, 24 V dc, integral with strobe lights.

2.12 VISUAL ALARM SIGNAL DEVICES

.1 Strobe type: flashing, red, 24 V dc, integral with horn or stand alone 60 Candella.

.2 Designed for surface mounting walls as part of horn assembly.

2.13 LINE ISOLATOR MODULE

.1 Installed on addressable circuits to isolate a section affected by a short circuit. Input devices located on wiring sections not directly affected by the short shall continue to function normally.

.2 The system shall indicate short circuit trouble on the loop and identify the devices no longer connected.

.3 Provide line isolators at fire separations per CAN/ULC-S524-2014.

2.14 END-OF-LINE DEVICES

.1 End-of-line devices to control supervisory current in alarm circuits and signaling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.15 REMOTE ANNUNCIATORS

.1 Liquid crystal display.

.2 80 characters.

.3 Standard flush mount.

.4 Indicate all alarm activities.

2.16 GRAPHIC DISPLAY

.1 Passive type.

.2 Locate graphic at main panel and remote annunciator.

.3 Indicate building Zones, "You Are Here" and Exits.

.4 Colour: indicate zones with solid color. Each zone color to be visibly distinct exits and “You Are Here” to be coloured red. Provide shop drawing for approval prior to manufacturer.

.5 Correctly oriented for mounting location.

.6 Polished aluminum frame, polycarbonate cover sheet white film.

2.17 ANCILLARY DEVICES

.1 Remote relay unit to initiate fan shutdown.

2.18 ELECTRO-MAGNETIC DOOR HOLDER-RELEASES

.1 Provide as indicated.

.2 Mount armature portion on door. Armature complete with adjusting screw for setting angle of contact plate.

.3 Mount electro-magnetic release on wall or in wall recess behind door.

.4 Activation of fire alarm system, smoke detector or smoke detector designated for door release service to release doors on circuit to close.

.5 Total projection of door holder-release not to exceed 100mm.

.6 Door holders: must close upon power loss and do not require battery backup power.

2.19 DUCT SMOKE DETECTORS

.1 Provide detectors installed in ducts of ionization photoelectric type and listed by ULC duct installation.

.2 Provide integral control and power modules required for operation with main control panel.

.3 Ensure detectors and associated modules are compatible with main control panel and suitable for use in supervised circuit.

.4 Detector circuits: 4-wire type where detector operating power is transmitted over conductors separate from initiating circuit. Malfunction of electrical circuits to detector or its control or power modules to cause operation of system trouble signals.

.5 Provide a separate, fused power circuit for each smoke detection initiating circuit.

.6 Failure of power circuit: indicated as a trouble condition on corresponding initiating circuit.

.7 Provide duct detectors in accordance with NBC.

.8 Provide duct detectors with approved duct housing, mounted exterior to duct, with perforated sampling tubes extending across width of duct.

.9 Activation of duct detectors to cause shutdown of associated air handling unit, annunciation at control panel, and tripping of transmitter and sounding of building evacuation alarms.

.10 Provide detectors with visible indicator lamp that flashes when detector is in normal standby mode and glows continuously when detector is activated.

.11 Provide remote indicator lamp for each detector.

.12 Permanently label remote indicator with description or number of associated air handling unit(s).

.13 Provide each detector with remote test switch. Mount switch not more than 1.8 m above finished floor.

.14 Permanently label test switch with description or number of associated air handling unit(s).

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install systems in accordance with CAN/ULC-S524.

.2 Install central control unit and connect to ac power supply, dc standby power.

.3 Install manual alarm stations and connect to alarm circuit wiring.

.4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

.5 Connect alarm circuits to main control panel.

.6 Install signal, horns and visual signal devices and connect to signaling circuits.

.7 Connect signaling circuits to main control panel.

.8 Install end-of-line devices at end of signaling circuits.

.9 Install remote annunciator panels and connect to annunciator circuit wiring.

.10 Install remote relay units to control fan shut down.

.11 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

.12 Splices are not permitted.

.13 Provide necessary raceways, cable and wiring to make interconnections to annunciator equipment, as required by equipment manufacturer.

.14 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.

.15 Identify circuits and other related wiring at central control unit and annunciators.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and CAN/ULC-S537.

.2 Fire alarm system:

.1 Test such device and alarm circuit to ensure manual stations and smoke detectors and sprinkler system transmit alarm to control panel and actuate first stage alarm and ancillary devices.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of systems.

.4 Addressable circuits system style DCLA:

.1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

.2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

END OF SECTION